FINAL REPORT

Highways Department

Agreement No. CE 46/97 Environmental Impact Assessment Study for Footbridge and Improvements to Ap Lei Chau Bridge Road & Ap Lei Chau Drive : *Environmental Impact Assessment Report*

5 January 1999

Reference C1765/103282

CONTENTS:

1 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Highways Department (HyD) proposes to improve the traffic condition at Ap Lei Chau Bridge Road and Ap Lei Chau Drive, which includes junction improvement at Ap Lei Chau Bridge Road/Ap Lei Chau Drive, Ap Lei Chau Drive/Lei Tung Estate Road and Ap Lei Chau Drive/Ap Lei Chau Coastal Road, widening of Ap Lei Chau Drive and construction of a footbridge at western approach of Ap Lei Chau Bridge Road to replace the existing at-grade pedestrian crossing. These works are included in the Public Works Programme (PWP) Item No. B130TB - "Footbridge and Improvements to Ap Lei Chau Bridge Road and Ap Lei Chau Drive" (hereinafter called "the Project").

Following the completion of a Preliminary Environmental Review (PER) in July 1996, it was concluded that traffic noise impact arising from the Project would affect the adjacent sensitive receivers. An Environmental Impact Assessment (EIA) Study for the Project is therefore required to further investigate the noise and associated issues. ERM-Hong Kong Ltd, in association with Maunsell Consultants Asia Ltd, have been commissioned by the Highways Department to undertake the EIA to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project.

1.2 OBJECTIVES OF THE ENVIRONMENTAL IMPACT ASSESSMENT

The Study Brief sets out the objectives of the Study to be:

i) to describe the Project and associated works together with the requirements for carrying out the Project;

ii) to identify and describe the elements of the existing and planned uses likely to be affected by the Project, and/or likely to cause adverse impacts on the Project;

iii) to identity and quantify environmental polluting sources and determine the severity of impacts on sensitive receivers and potential affected uses;

iv) to propose the provision of infrastructure or mitigation measures to minimize potential pollution, environmental disturbance and nuisance arising from the Project during construction and operational phases;

v) to identify, predict and evaluate the residual (ie. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction and operational phases of the Project in relation to sensitive receivers and potential affected uses;

vi) to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the Project which are necessary to mitigate these impacts and reduce them to established levels;

vii) to design and specify the environmental monitoring and audit requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted;

viii) to investigate the extent of side-effects of proposed mitigation measures, particularly construction impacts of mitigation measures, that may lead to other forms of impacts;

ix) to identify constraints associated with the mitigation measures recommended in the EIA Study; and

x) to identify any additional studies necessary to fulfill the objectives to the requirements of the EIA Study.

1.3 REQUIREMENTS OF STUDY BRIEF

The assessment of impacts during construction and operational phases of the Project will be undertaken according to the requirements stated in the Study Brief, SB-025/BC of the Register established under the *Environmental Impact Assessment Ordinance* (EIAO).

Road traffic noise impact on the nearby sensitive uses has been identified to be a key environmental issue after the PER. The assessment of noise at identified sensitive receivers is detailed in *Section 5*. In case adverse noise impacts are identified at the sensitive uses, the opportunity to provide direct technical remedies to reduce these impacts should be explored.

For any proposed noise mitigation measures, the air quality implications should also be addressed as a requirement under the Study Brief.

1.4 STRUCTURE OF THE EIA REPORT

After this introductory section, the remainder of this EIA Report is arranged as followed:

- *Section 2* - presents the scope and phasing of the Project;
- *Section 3* - details the criteria stipulated in government legislations and environmental standards relevant to the Study, which will be used for the evaluation of predicted environmental impacts;
- *Section 4* - describes the existing environment and identifies sensitive receivers likely to be affected by the Project;
- *Section 5* - examines the potential noise impacts arising through the construction and subsequent operational phase of the Project and if appropriate, recommends any practical mitigation measures;
- *Section 6* - evaluates potential air quality impacts associated with the construction phase of the Project, and investigates any air quality implications arising from the proposed noise mitigation measures;

- *Section 7 -* sets out the Environmental Monitoring & Audit (EM&A) requirements for the Project;

- *Section 8 -* outlines the schedule for the implementation of recommended mitigation measures during the construction and operational phases; and

- *Section 9 -* reviews the findings and presents the overall conclusions of the EIA Study.

2 PROJECT DESCRIPTION

2.1 PROJECT JUSTIFICATION

In mid-1994, the Task Force on Land Supply and Property Prices identified three potential public housing sites in Southern District. Housing Department subsequently undertook a traffic impact assessment with a view to developing each site for PSPS purposes. The assessment concluded that both the proposed and committed developments in the locality would overload the junction of Ap Lei Chau Bridge Road and Ap Lei Chau Drive in year 2001, and the junction would suffer negative reserve capacity during the peak hour periods. The traffic impact assessment considered that the scope for major junction improvements were limited. The alternative of a pedestrian subway had been considered and was found less favourable than the proposed footbridge in terms of the traffic interruption during construction; user attractiveness and cost of construction and operation. The proposed junction widening works and footbridge construction would relieve the pressure from traffic at this junction. The situation could be further improved through traffic management scheme by banning the right-turning traffic movement from Ap Lei Chau Bridge Road eastbound to Ap Lei Chau Drive upon the completion of the Ap Lei Chau North Coastal Road.

Without the improvement works, it is envisaged that over-saturation at junction of Ap Lei Chau Bridge Road and Ap Lei Chau Drive in the design year of 2001 would result in intolerable congestion to and from Ap Lei Chau where a design population of 71,400 is expected by 2001.

The Traffic and Transport Committee of the Southern Provisional District Board have been consulted of the project in September and November 1998. Members supported the scheme and urged for early commencement of the works.

2.2 SCOPE OF PROJECT

The Project includes the following works:

(i) widening of the section of Ap Lei Chau Drive between Ap Lei Chau Bridge Road and Lei Tung Estate Road from 3 lanes to 4 lanes and that section between Lei Tung Estate Road and Ap Lei Chau Praya Road from 2 lanes to 3 lanes plus a GMB/taxi lay-by of about 75m on the northern side;

(ii) widening of the approaches on Ap Lei Chau Bridge Road at its junction with Ap Lei Chau Drive;

(iii) widening of the approach on Lei Tung Estate Road at its junction with Ap Lei Chau Drive;

(iv) construction of a mini-roundabout at the junction of Ap Lei Chau Drive/Ap Lei Chau Praya Road;

(v) construction of a footbridge with clear width of 2.5m on the western approach of Ap Lei Chau Bridge Road;

(vi) signalization of the junction of Ap Lei Chau Drive/Lei Tung Estate Road;

and

(vii) associated geotechnical works and modifications to footpath, central reserves and pedestrian refuge islands.

Figure 2.2a shows the extent and the limit of the proposed road works. The Project will be constructed, operated and maintained by HyD.

Although the scope of the Project has been reasonably defined, there are a few factors affecting the scope. Subject to the findings of this EIA Study, direct technical remedies to reduce impacts from road traffic noise may be required. In case the provision of direct technical remedies could not thoroughly eliminate the impacts at noise sensitive receivers, indirect technical remedies in accordance with the prevailing government policy may have to be incorporated.

Under the current policy, normally ramps for disabled have to be provided for footbridges. If policy support to replace the ramps by lifts to facilitate the use of footbridge by the disabled, the layout of the footbridge could be revised to minimise the encroachment onto the existing caisson wall on the southern side of Ap Lei Chau Bridge Road. This option shall be further explored in the detailed design stage.

2.3 PHASING OF THE PROJECT

The construction of the Project is anticipated to be undertaken in 20 months, starting from March 2001 until the end of October 2002. The traffic on Ap Lei Chau Bridge Road, Ap Lei Chau Drive and Lei Tung Estate Road will be maintained during this period by means of appropriate temporary traffic arrangement. The preliminary construction programme of the Project is given in *Figure 2.3a* and the following key construction activities have been identified:

- retaining wall construction (from March 2001 to mid-January 2002);
- footbridge construction (from September 2001 to August 2002);
- road construction and drainage works
  - Ap Lei Chau Bridge Road East and Ap Lei Chau Drive (from February 2002 to April 2002);
  - Lei Tung Estate Road (from April 2002 to June 2002);
  - Ap Lei Chau Bridge Road (other locations) (from June 2002 to August 2002); and
  - Ap Lei Chau Bridge Road (around footbridge) (from August 2002 to October 2002).

It is anticipated that the scheme will be opened immediately after the completion of the works.

Another road project identified in the immediate vicinity of the scheme is Ap Lei Chau North Coastal Road. It will run along the northern coast line of Ap Lei Chau, starting from the junction of Ap Lei Chau Drive/Ap Lei Chau Praya Road extending and linking up with the existing Lee Chi Road. This road is scheduled to be constructed during the period from January 2002 and December 2003. The environmental impacts associated with this new road will be covered in a separate Environmental Study.

For the purpose of this EIA Study, predictions of future road traffic noise should

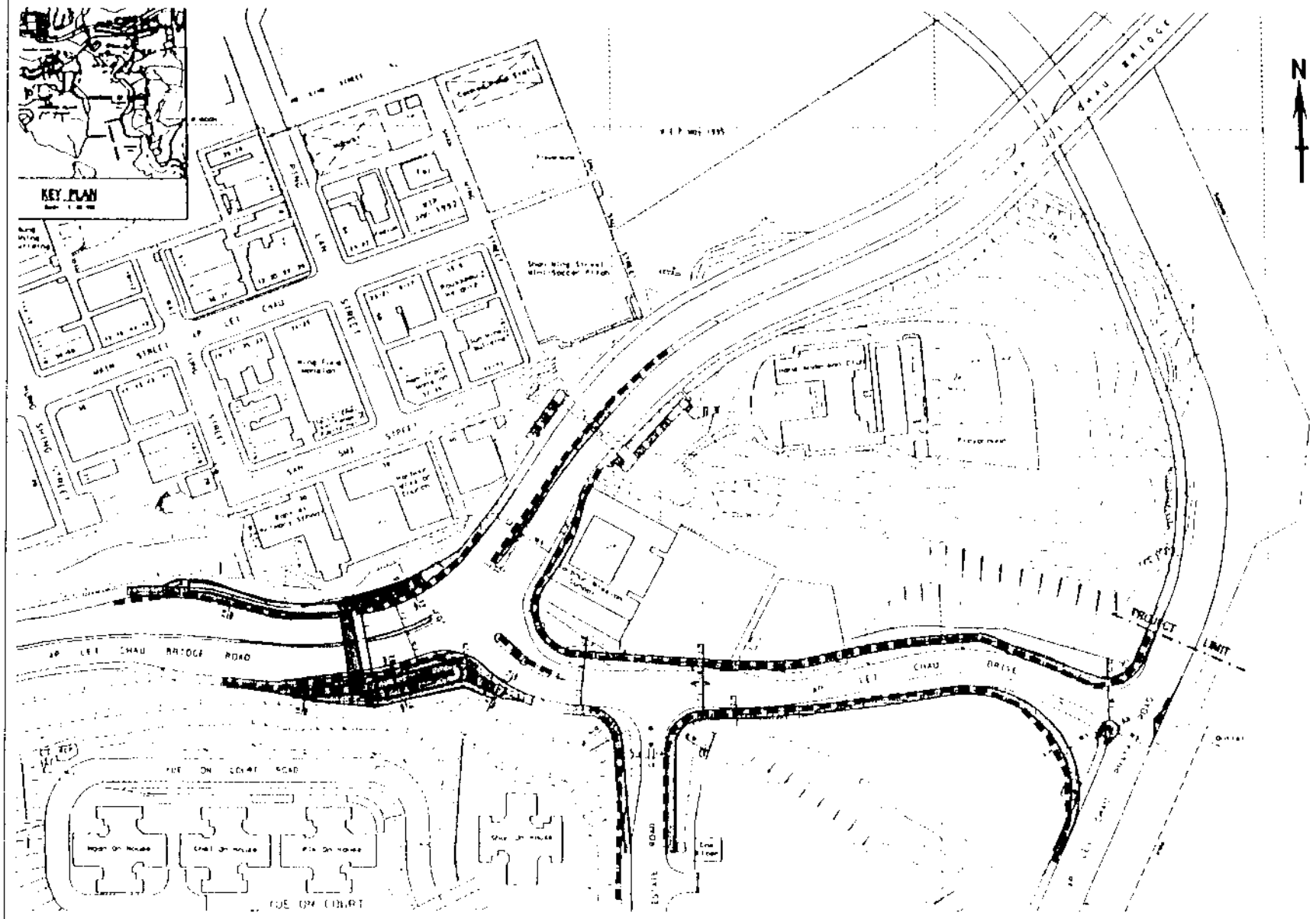


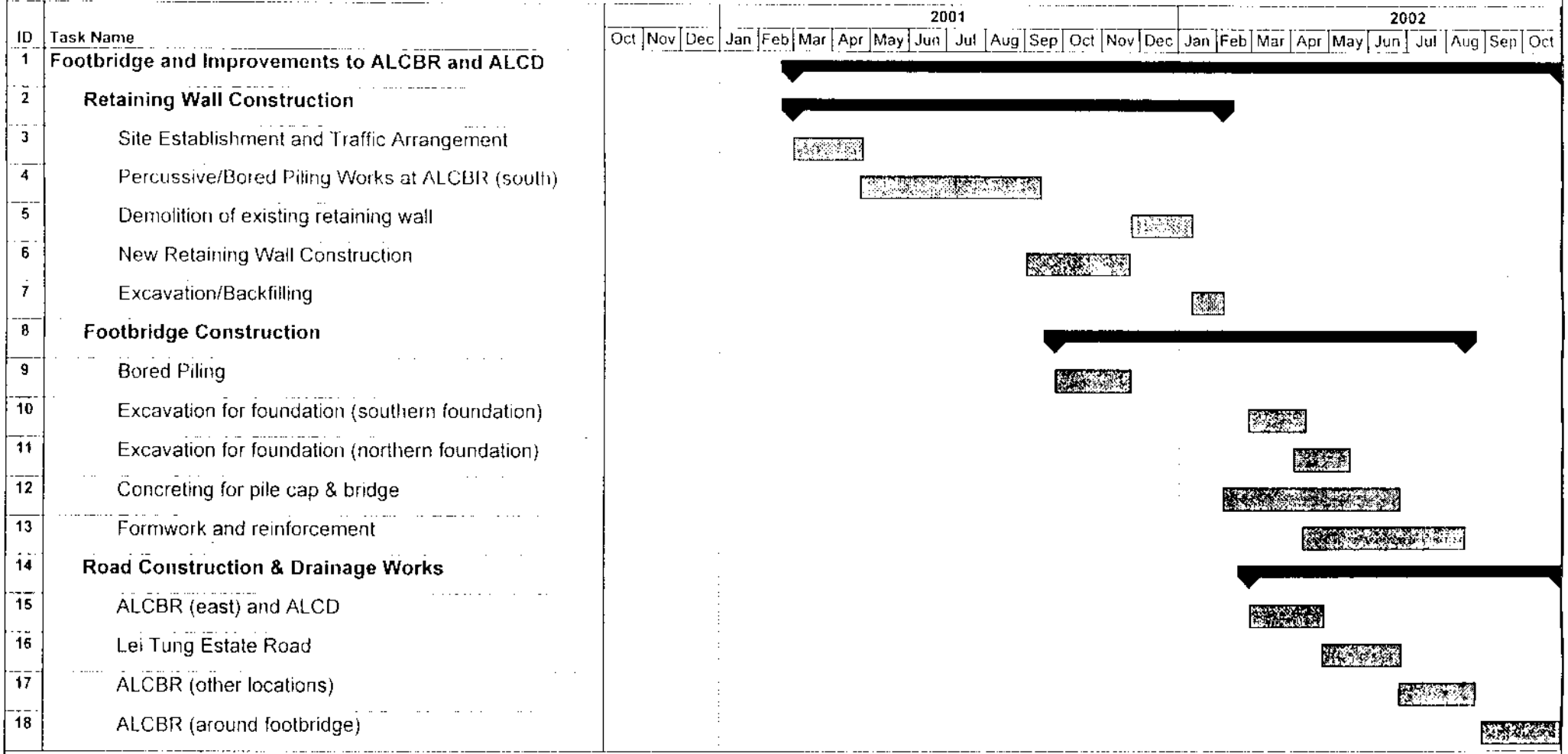
FIGURE 2.2a

PROPOSED ROAD WORKS AT AP LEI CHAU BRIDGE ROAD AND AP LEI CHAU DRIVE

Environmental Resources Management

ERM

Proposed Construction Programme for Footbridge and Improvements to Ap Lei Chau Bridge Road and Ap Lei Chau Drive



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Task

Summary

Figure 2.3a

be based on traffic forecasts for the worst scenario within a 15-year period upon commencement of operation of the Project. It is expected that the maximum traffic projection for the peak hour traffic flow is in year 2017, taking account of the traffic on future Ap Lei Chau North Coastal Road and the traffic growth within the local area. Traffic forecasts used in this Environmental Study are described in *Section* 5.3 of this EIA Report.

2.4 *RESIDUES AND EMISSIONS*

Air and noise impacts would affect the environment during both construction and operation periods. This report will assess these issues in detail. However, as the Project is similar to many other road improvement projects both in nature and scope, it is expected that both construction and operation phase would not generate adverse impacts on water quality and waste, on the understanding that good site management and control measures are implemented as a usual practice.

3.1 NOISE

3.1.1 Construction Noise Standards

General

The principal legislation on the control of construction noise is the *Noise Control Ordinance* (NCO) (Cap 400) and the EIAO (Cap 499). Various Technical Memoranda (TMs), which stipulate control approaches and criteria, have been issued under the NCO and EIAO. The following TMs are applicable to the control of noise from construction activities:

- *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 Areas* (DA-TM); and
- *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM).

Percussive Piling

Percussive piling is prohibited at any time on Sundays and public holidays and during the weekday evening and nighttime hours (1900-0700 hours, Monday through Saturday). A Construction Noise Permit (CNP) is required for such works during the weekday daytime hours (0700-1900 hours, Monday through Saturday).

When assessing a CNP application for the carrying out of percussive piling, the Environmental Protection Department (EPD) is guided by the PP-TM. The EPD will look at the difference between the Acceptable Noise Levels (ANLs), as promulgated in the PP-TM, and the Corrected Noise Levels (CNLs) that are associated with the proposed piling activities. Depending on the level of noise impact on nearby Noise Sensitive Receivers (NSRs), the EPD would allow 3, 5 or 12 hours of daily piling time (see *Table 3.1a* below).

Table 3.1a ***Permitted Hours of Operation for Percussive Piling (not involving the use of diesel, pneumatic and/or steam hammers)***

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a holiday
more than 10 dB(A)	0800 to 0900 and 1230 to 1330 and 1700 to 1800
between 0 dB(A) and 10 dB(A)	0800 to 0930 and 1200 to 1400 and 1630 to 1800
no exceedance	0700 to 1900

For any educational institutions identified for this EIA Study, the ANLs should be adjusted by a -10 dB(A) correction factor in the subsequent noise assessment, taking account of the relative noise sensitivity of these uses.

The Government is committed to phase out the use of diesel, pneumatic and

steam hammer pile drivers, which are particularly noisy. Such pile drivers cannot be used after 1 October 1999. In preparation for the incoming legislative control, the Government has already (since July 1997) administratively banned the use of diesel hammers in Government projects.

General Construction Works

Noise arises from general construction works during normal working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday) at the openable windows of buildings is governed by the EIAO-TM. The recommended noise standards are presented in *Table 3.1b* below.

Table 3.1b ***EIAO-TM Daytime Construction Noise Limit ($L_{eq,\ 30\ min}$ dB(A))***

Uses	Noise Standards
Domestic Premises	75
Educational Institutions (normal periods)	70
Educational Institutions (during examination periods)	65

The NCO provides statutory controls on general construction works during the restricted hours (ie 1900-0700 hours Monday to Saturday and at any time on Sundays and public holidays). The use of powered mechanical equipment (PME) for the carrying out of construction works during the restricted hours would require a CNP. The EPD is guided by the GW-TM when assessing such an application.

When assessing an application for the use of PME, the EPD will compare the ANLs, as promulgated in the GW-TM, and the CNLs (after accounting for factors such as barrier effects and reflections) associated with the proposed PME operations. A CNP will be issued if the CNL is equal to or less than the ANL. The ANLs are related to the noise sensitivity of the area in question and different Area Sensitivity Ratings have been drawn up to reflect the background characteristics of different areas. The relevant ANLs are shown in *Table 3.1c* below.

Table 3.1c ***Acceptable Noise Levels (ANL, $L_{eq,\ 5\ min}$ dB(A))***

Time Period	Area Sensitivity Rating		
	A	B	C
All days during the evening (1900-2300 hours) and general holidays (including Sundays) during the day and evening (0700-2300 hours)	60	65	70
All days during the night-time (2300-0700 hours)	45	50	55

In addition to the general controls on the use of PME during the restricted hours, the EPD has implemented a more stringent scheme via the DA-TM. The DA-TM regulates the use of five types of Specified Powered Mechanical Equipment (SPME) and three types of Prescribed Construction Work (PCW), which are non-PME activities, in primarily densely populated neighbourhoods called Designated Areas (DAs). The SPME and PCW are:

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

In the interest of offering additional protection to the population, the carrying out of PCW is generally banned inside a DA. As for the use of SPME, it would be necessary to comply with DA-TM noise level requirements that are 15 dB(A) more stringent than those listed in the GW-TM before a CNP would be issued.

3.1.2 *Road Traffic Noise Standards*

Road traffic noise levels are predicted at 1 m from the sensitive façades and any sensitive buildings which rely upon openable windows for ventilation are within the scope of EIAO-TM. The relevant criteria are shown in *Table 3.1d*.

Table 3.1d EIAO-TM Road Traffic Noise Criteria

Sensitive Uses	Road Traffic Noise $L_{10\ (1\ hr)}$ dB(A)
Domestic Premises	70
Offices	70
Educational institutions	65

Any predicted road traffic noise levels which exceed these criteria are considered to be causing adverse environmental impacts on the nearby NSRs. Practicable direct mitigation measures would be recommended, where appropriate, to ensure that the noise levels are reduced to within the noise standards.

3.2 *Air Quality*

The principal legislation for the management of air quality is the *Air Pollution Control Ordinance* (APCO) (Cap 311). The whole of the Hong Kong Special Administrative Region (SAR) is covered by the *Hong Kong Air Quality Objectives* (AQOs) which stipulate the statutory limits of some typical air pollutants and the maximum allowable numbers of exceedance over specific periods. The AQOs are shown in *Table 3.2a*.

In addition, the EIAO-TM stipulates an hourly TSP limit of 500 $\mu g\ m^{-3}$ measured at 298K (25°C) and 101.325 kPa (1 atm) for construction dust impact assessment. Mitigation measures required to reduce the impact of dust from construction sites have also been specified in the *Air Pollution Control (Construction Dust) Regulation*.

Table 3.2a *Hong Kong Air Quality Objectives ($\mu g\ m^{-3}$)[1]*

Pollutant	Averaging Time			
	1 Hour [2]	8 Hours [3]	24 Hours [3]	1 Year [4]
Total Suspended Particulates (TSP)	-	-	260	80
Respirable Suspended Particulates [5] (RSP)	-	-	180	55
Nitrogen Dioxide (NO_2)	300	-	150	80
Sulphur Dioxide (SO_2)	800	-	350	80
Carbon Monoxide (CO)	30,000	10,000	-	-

Note:
(1) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).
(2) Not to be exceeded more than three times per year.
(3) Not to be exceeded more than once per year.
(4) Arithmetic means.
(5) Respirable suspended particulates are defined as particles suspended in the air with a nominal aerodynamic diameter of 10 μm and smaller.

4.1 BASELINE CONDITIONS

The existing environment is mainly affected by the traffic on Ap Lei Chau Bridge Road, Ap Lei Chau Drive, Ap Lei Chau Praya Road and other roads in the vicinity of the Project. No industrial uses are identified within the Study Area and thus traffic on this road network is considered to be the dominant source of noise and air pollutants.

As there are no air quality monitoring stations located in the Study Area, monitoring results obtained from the nearest monitoring station operated by the EPD positioned at Central/Western District (Upper Level Police Station, No. 1 High Street, Sai Ying Pun) are used to reflect the background air quality. A summary of the monitoring results for year 1996 is given in *Table 4.1a* below.

Table 4.1a ***Annual Average of Air Pollutants Monitored at Central/Western District in 1996 ($\mu g\ m^{-3}$)***

Pollutant	Concentration
TSP	87
RSP	52
NO_2	47
CO	1100 [1]

Note: [1] CO was not monitored at Central/Western District, the data obtained was from Mongkok Station monitored at ground level.

It is anticipated that the future environment will still be affected and dominated by the traffic. With the operation of future Ap Lei Chau North Coastal Road and the increased traffic volume on Ap Lei Chau Bridge Road and Ap Lei Chau Drive, the level of noise and air pollutants within the local area will be moderately affected.

4.2 SENSITIVE RECEIVERS

In accordance with the Outline Zoning Plan of Aberdeen and Ap Lei Chau (Plan no. S/H15/9, 1998), sensitive land uses in the vicinity of the Project mainly consist of government/institution/community (G/IC) uses, high-rise residential sites including Yue On Court, Lei Tung Estate and the planned residential development along Ap Lei Chau Drive; and commercial/residential uses along Main Street, Ap Lei Chau.

Representative sensitive receivers, including both existing sensitive uses and future developments, have been identified within a spatial scope of 300m from the project limit and are detailed in *Table 4.2a*. *Figure 4.2a* shows the location of the identified sensitive receivers. These sensitive receivers are selected according to *Hong Kong Planning Standards and Guidelines* (HKPSG), *Annex 12* and *Annex 13* of EIAO-TM (Guidelines for Air Quality and Noise Assessment). The assessment of environmental impacts during both construction and operational phases will

be undertaken with respect to these sensitive receivers, which are considered to be the worst affected in conjunction with the Project.

Table 4.2a *Representative Sensitive Receivers*

Reference No.	Description
1	Coble Court
2	Manley House
3	Yen Ching Building
4	Sunny Court
5	Fortune Mansion
6	Hoi Lee Building
7	Residential Buildings (No. 14, 16 & 18, Wai Fung Street)
8	Shun King Court
9	Residential Buildings (No. 13, 15, 17 & 19, Wai Fung Street)
10	Ap Lei Chau Baptist Kindergarten
11	Ning Fung Mansion
12	Harbour Mission Church and Yan Oi Kindergarten
13	Nam Tack Mansion
14	Rousseau Heights
15	Sun Ming Building
16	Proposed Residential Development (R(A) zone)
17	Hong Kong True Light College
18	Tung Ping House
19	Wu On House
20	Shan On House
21	Pik On House
22	Choi On House
23	Ngan On House
24	The Former Harbour Mission School Site
25	Residential use at lot ApIL 130
26	Toho Court
27	Hung Fook Court
28	Radiant Towers

Other sensitive uses having a direct line of sight to the Project but further away from the scheme have also been identified. These include Toho Court, Hung Fook Court, Lee Fat Building and the new Sandwich Class Housing development, Radiant Towers. These sensitive receivers will be considered in evaluating the degree of impact and the effectiveness of recommended mitigation measures.

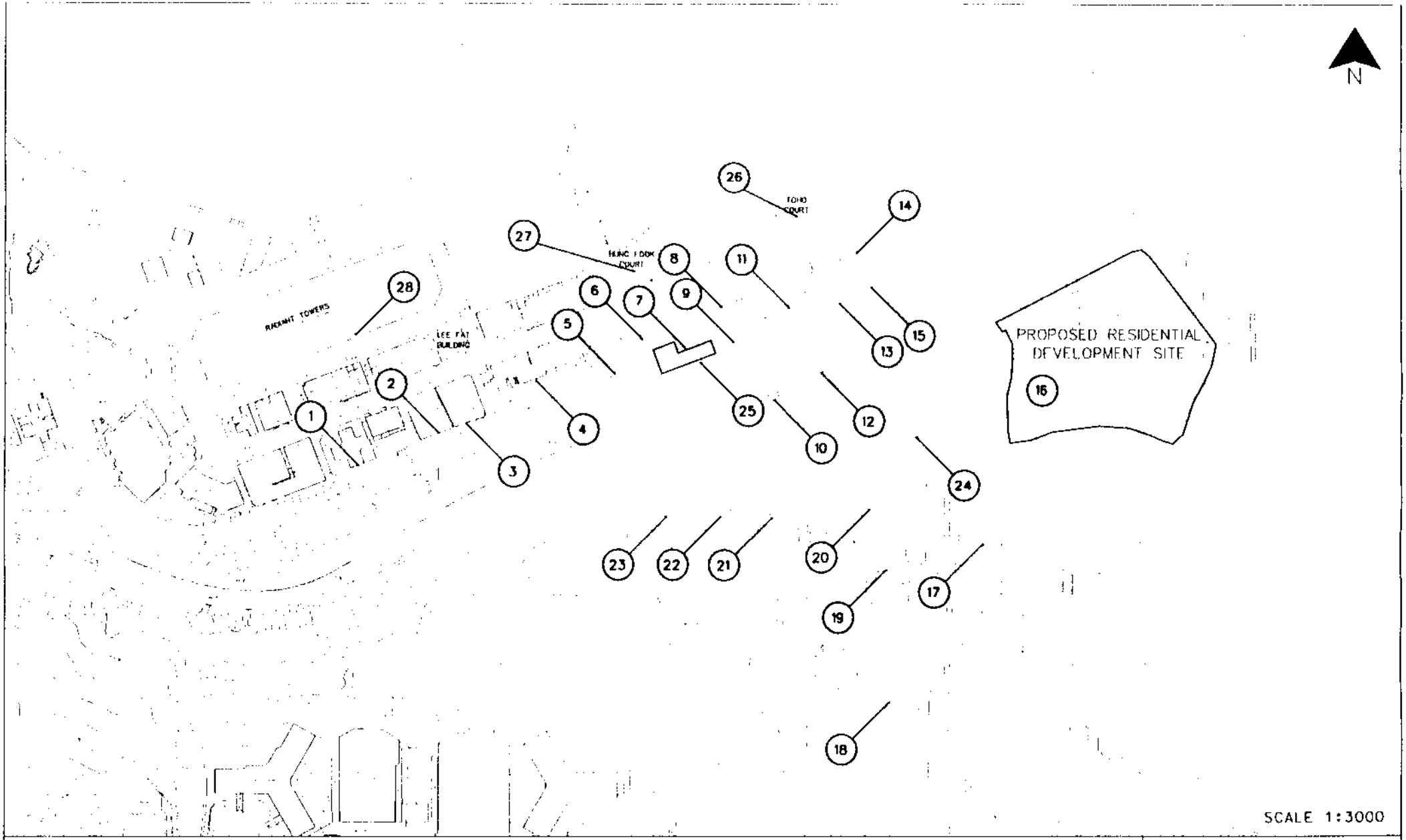

FIGURE 4.2a

LOCATION OF SENSITIVE RECEIVERS

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Environmental Resources Management

ERM

The proposed residential development along Ap Lei Chau Drive and the planned sensitive use at the former Harbour Mission School site are excluded in construction phase impact assessment as it is envisaged that the sites would not be occupied during the construction stage of the Project.

5 NOISE IMPACT ASSESSMENT

5.1 INTRODUCTION

This section presents the assessment of potential noise impacts associated with the construction and operational phases of the Project. Practical mitigation measures are recommended, where appropriate, to reduce the noise impacts at identified NSRs in order to satisfy relevant noise standards.

5.2 CONSTRUCTION PHASE

5.2.1 *Potential Source of Impacts*

The source of noise during each construction stage of the Project is mainly from the use of PME on site. The works will require a number of noisy activities including the use of heavy plant for excavation, filling, concreting and piling operations. The whole project will involve four construction stages and the key activities are outlined below:

- *Retaining Wall Construction*
  - i) excavation works;
  - ii) demolition of existing retaining wall
  - ii) bored piling and percussive piling;
  - iii) formwork and reinforcement; and
  - iv) concreting and backfilling.

- *Footbridge Construction*
  - i) excavation for foundation;
  - ii) bored piling;
  - iii) formwork and reinforcement; and
  - iv) concreting for pile cap and bridge.

- *Road Construction*
  - i) excavation;
  - ii) placement of road base;
  - iii) levelling of new road; and
  - iv) kerbing and road paving.

- *Drainage Works*
  - i) excavation;
  - ii) preparation of formation;
  - iii) laying of pipes;
  - iv) construction of manholes; and
  - v) backfilling.

The overall construction period for the Project will be about 20 months.

5.2.2 *Assessment Methodology*

The assessment of noise impact from the works associated with the Project will be undertaken based on the procedure outlined in the GW-TM. In general, the

methodology is as follows:

- locate representative NSRs that may be affected by the works;
- determine plant teams for corresponding construction activities; based on available information or agreed plant inventories;
- assign sound power levels (SWLs) to the PME proposed based on the GW-TM or other sources;
- calculate the correction factors based on the distance between the NSRs and the notional noise source position of the work sites;
- apply corrections such as potential screening effect and acoustic reflection, if any, in the calculations; and
- predict construction noise levels at NSRs in the absence of any mitigation measures.

The total SWL associated with each activity has been established based on the assumed plant inventory, and the details are enclosed in *Annex A*. The notional point of each work site is established in accordance with the procedure stated in the GW-TM. Noise impacts at NSRs will be quantified by comparing the predicted noise levels with the EIAO-TM daytime construction noise limits ($L_{eq,\ 30\ min}$ dB(A)), as given in *Section 3.1.1*. As night-time works are not expected, noise criteria stipulated for the restricted hours period are not applicable in this Study.

Mitigation measures will be considered when noise impacts at the NSRs are identified. A re-evaluation of the total SWL for each construction activity will be made by assuming the use of practical mitigation measures such as quiet plant and reducing the number of noisy plant working simultaneously.

For noise from percussive piling, the noise will be assessed based on the methodology and procedure outlined in the PP-TM. The CNL at the NSRs will be calculated and the permitted hours of operation are determined by the amount by which the CNL exceeds the ANL as defined in the PP-TM. As most of the sensitive receivers have openable windows to maintain natural ventilation, ANL of 85 dB(A) is adopted for residential uses and 75 dB(A) is used for educational uses.

5.2.3 *Prediction and Evaluation of Impacts*

The unmitigated predicted noise levels at the worst case representative NSRs for each construction stage have been predicted and the results are given in *Tables 5.2a* and *5.2b*. Detailed construction noise calculations are presented in *Annex B*. The predictions were conducted taking into account of distance attenuation, potential screening effects and façade reflection. Noise predictions have been undertaken at the worst receiver levels of representative NSRs.

Percussive Piling

Percussive piling may be employed on site for retaining wall construction of the Project. Prediction results in *Table 5.2a* indicated that the use of single-acting hydraulic hammer would result in a maximum noise exceedance of 10 dB(A) at Ap Lei Chau Baptist Kindergarten. A noise exceedance of 13 dB(A) was also predicted at this NSR if drop hammer is used in percussive piling operation.

The permitted hours of operation for percussive piling would be specified by the Noise Control Authority having considered the requirements of the local

community and degree of impact on NSRs. The PP-TM has provided the following as a guide but the actual hours of operation would be specified by the Authority:

- using hydraulic hammer (single-acting) - 0800 to 0930, 1200 to 1400 and 1630 to 1800, on any day not being a holiday; and
- using drop hammer - 0800 to 0900, 1230 to 1330 and 1700 to 1800, on any day not being a holiday.

Table 5.2a ***Predicted Construction Noise Level (dB(A)) - Percussive Piling***

Ref No.	Description	Hydraulic Hammer (single acting)	Drop Hammer
1	Coble Court	73	76
2	Manley House	75	78
3	Yen Ching Building	76	79
4	Sunny Court	78	81
5	Fortune Mansion	80	83
6	Hoi Lee Building	80	83
7	Residential Buildings (No. 14, 16 & 18, Wai Fung Street)	78	81
8	Shun King Court	81	84
9	Residential Buildings (No. 13, 15, 17 & 19, Wai Fung Street)	78	81
10	Ap Lei Chau Baptist Kindergarten (classrooms are located at lower and middle floors only)	85	88
11	Ning Fung Mansion	83	86
12	Harbour Mission Church and Yan Oi Kindergarten (classrooms are located at lower floor only)	83	86
13	Nam Tack Mansion	83	86
14	Rousseau Heights	80	83
15	Sun Ming Building	82	85
17	Hong Kong True Light College	75	78
18	Tung Ping House	72	75
19	Wu On House	82	85
20	Shan On House	88	91
21	Pik On House	88	91
22	Choi On House	85	88
23	Ngan On House	83	86
25	Residential use at lot ApIL 130	82	85
26	Toho Court	78	81
27	Hung Fook Court	78	81

Ref No.	Description	Hydraulic Hammer (single acting)	Drop Hammer
28	Radiant Towers	73	76
	Max. Predicted Noise Exceedance	10	13

Table 5.2b Predicted Construction Noise Level (dB(A)) - General Construction Works

Ref No.	Description	Average Assessment height above source (m)	Max. PNL - Drainage Works (dB(A))	Max. PNL - Footbridge Construction (dB(A))	Max. PNL - Retaining Wall Construction (dB(A))	Max. PNL - Road Construction (dB(A))	Worst Predicted Cumulative Noise Level (dB(A))	Critical Construction Stage/Activity causing noise exceedance
1	Coble Court	4.5/58.5[2]	66/66[2]	68/68	69/69	68/68	72/71	-
2	Manley House	4.5/28.5	70/70	72/72	71/71	72/72	75/75	-
3	Yen Ching Building	4.5/7.5	71/71	73/73	72/72	73/73	76/76	excavation activity for footbridge construction and road construction
4	Sunny Court	4.5/52.5	73/72	75/74	74/74	75/74	78/77	excavation activity for footbridge construction and road construction
5	Fortune Mansion	4.5/52.5	75/73	77/75	76/75	77/75	80/78	excavation activity for footbridge, retaining wall construction and construction and road construction
6	Hoi Lee Building	4.5/55.5	76/74	78/76	76/75	78/76	81/79	excavation activity for footbridge, retaining wall construction and construction and road construction
7	Residential Buildings (No. 14, 16 & 18, Wai Fung Street)	4.5	75	77	74	77	80	excavation activity for footbridge construction and road construction
8	Shun King Court	4.5/61.5	76/73	79/76	77/76	78/75	81/79	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction
9	Residential Buildings (No. 13, 15, 17 & 19, Wai Fung Street)	4.5	74	78	74	76	80	excavation activity for footbridge construction and road construction
10	Ap Lei Chau Baptist Kindergarten (classrooms are located at lower and middle floors only)	-7.0/-1.0	78/78	86/86	81/81	80/80	87/88	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction
11	Ning Fung Mansion	4.5/49.5	79/76	81/78	79/78	81/78	84/81	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction
12	Harbour Mission Church and Yan Oi Kindergarten (classrooms are located at lower floor only)	12.0/-3.0	82/84	78/78	79/79	84/86	86/88	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction
13	Nam Tack Mansion	4.5	80	78	79	82	84	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction

Ref No.	Description	Average Assessment height above source (m)	Max. PNL - Drainage Works (dB(A))	Max. PNL - Footbridge Construction (dB(A))	Max. PNL - Retaining Wall Construction (dB(A))	Max. PNL - Road Construction (dB(A))	Worst Predicted Cumulative Noise Level (dB(A))	Critical Construction Stage/Activity causing noise exceedance
14	Rousseau Heights	4.5/19.5	77/77	75/75	76/76	79/79	82/81	excavation activity for drainage works, retaining wall construction and road construction
15	Sun Ming Building	4.5/7.5	81/81	76/76	78/78	83/83	85/85	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction
17	Hong Kong True Light College	9.0/30.0	83/80	66/66	71/70	85/82	87/85	excavation activity for drainage works and road construction
18	Tung Ping House	18.5/117.5	72/69	64/63	68/66	74/71	76/73	excavation activity for drainage works and road construction
19	Wu On House	16.4/114.5	81/71	73/70	78/74	83/73	85/77	excavation activity for drainage works, retaining wall construction and road construction
20	Shan On House	16.4/114.5	86/72	76/72	84/75	88/74	90/77	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction
21	Pik On House	29.0/127.5	75/70	79/72	84/75	77/72	85/76	excavation activity for footbridge construction, retaining wall construction and road construction
22	Choi On House	29.0/127.5	74/69	79/72	81/74	76/71	83/76	excavation activity for footbridge construction, retaining wall construction and road construction
23	Ngan On House	29.0/127.5	72/69	77/72	79/74	74/71	81/76	excavation activity for footbridge construction and retaining wall construction
25	Residential use at lot ApIL 130	4.5/54.9	79/76	76/74	78/76	81/78	83/80	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction
26	Toho Court	5.2/53.2	72/71	75/74	74/74	74/73	77/77	excavation activity for footbridge construction and road construction
27	Hung Fook Court	5.2/53.2	73/71	73/72	74/73	75/73	77/76	excavation activity for road construction
28	Radiant Towers	44.4/104.4	66/66	67/66	69/68	68/68	72/71	-

Note: (1) Worst predicted receiver level on lower floor/top floor.
(2) Predicted noise level at the worst affected receiver level at lower floor/top floor.

General Construction Works

Prediction results in *Table 5.2b* indicated that the majority of the NSRs would be impacted by the works during daytime period in the absence of any noise abatement measures. During the drainage works and road construction stage of the Project, noise levels at the identified NSRs exceeding the daytime noise criteria (ie. 75 dB(A) for residential use and 70 dB(A) for educational use) in the range of 1-15 dB(A) were predicted. Owing to the proximity of the construction activities, NSRs such as Harbour Mission Church and Yan Oi Kindergarten (Ref. no. 12), Hong Kong True Light College (Ref. no. 17) and Ap Lei Chau Baptist Kindergarten (Ref. no. 10) would be the worst affected by these construction activities. A higher degree of impact at the schools would be likely during the examination period.

According to the prediction results, a maximum noise exceedance of 16 dB(A) was predicted at Ap Lei Chau Baptist Kindergarten during footbridge construction in normal school hours. Ap Lei Chau Baptists Kindergarten was also predicted to be impacted by retaining wall construction by a maximum of 11 dB(A) above the daytime noise criterion. Other NSRs in the vicinity of the works were predicted to be impacted by these construction activities, the degree of impact was comparatively lower.

Construction activities found to be the most noise polluting include excavation works during various stages of construction, placement of road base and road paving activities in road construction.

The cumulative noise impacts on the NSRs, when there are works on two or more work sites within the project limit, would be severe. A maximum cumulative noise exceedance of 17 dB(A) at Ap Lei Chau Baptist Kindergarten and Hong Kong True Light College was predicted. The total number of residential dwellings affected by the works was estimated to be 1180 without any mitigation measures. The estimated population likely to be affected by the Project during construction phase was approximately 4,700 (assuming that each flat will have 4 occupants). The number of classrooms likely to be impacted during construction stage of the Project was about 47 and there would be approximately 1,800 students affected by the works.

Judging from the small buffer distance between the sites and NSRs and the identified noise impacts, effective mitigation measures and proper environmental control practises should be considered during the construction phase of the Project.

5.2.4 *Mitigation Measures*

Noise emissions from construction sites can be minimised through good site practice, selecting quiet plant, adopting quieter working methods and restriction on the use of noisy equipment on site. The recommended mitigation measures detailed in this section should be incorporated into the Contract Specification in order to ensure the environmental performance of construction works.

The Contractor may develop a different package of environmental control measures to meet the required noise standards, but the following illustrates a feasible approach to mitigate the predicted noise impacts during the construction phase.

Good Site Practice

Good site practice and noise management can considerably reduce the noise impact from construction site activities on nearby NSRs. The following package of 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 works;
- machines and plant 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, should, where possible, be orientated to direct noise away from nearby NSRs;
- silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction works;
- mobile plant should be sited as far away from NSRs as possible; and
- material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

Although it is difficult to quantify the noise reduction achieved, the environmental performance of the works would be improved through these control practices.

Selecting Quieter Plant and Working Methods

The use of quiet plant is identified to be a feasible solution to tackle the adverse impacts associated with the construction works. The Contractor may be able to obtain particular models of plant that are quieter than standard types given in GW-TM. The benefits achievable in this way will depend on the details of the Contractors' chosen methods of working, and it is considered too restrictive to specify that a Contractor has to use specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total SWL of all plant on the site so that the Contractor is allowed some flexibility to select plant to suit his needs.

Quiet plant is defined as PME whose actual SWL is less than the value specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME taken from a British Standard, namely *Noise Control on Construction and Open Sites, BS5228 : Part 1 : 1997*, which are known to be used are given in *Table 5.2c*.

It should be noted that various types of silenced equipment can be found in Hong Kong. However, the EPD, when processing a CNP application, will apply the noise levels contained in the GW-TM, unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration.

Table 5.2c *Sound Power Levels for specific silenced PME*

PME	BS5228 Table no.	Ref no.	SWL dB(A) max	Relative size or power rating (where applicable)
Bulldozer	7	65	111	46 kW
Mobile Crane	10	110	106	56 kW
Air Compressor	10	25	98	7 m^3/min
Concrete Pump	9	36	106	100 kW
Dump Truck	12	29	109	35 t
Excavator				
- for trenching	77	97	105	52 kW
- for ground excavation		35	106	45 kW
Generator	10	62	100	-
Lorry	12	27	105	35 t
Loader	7	97	105	52 kW
Concrete Lorry Mixer	9	35	100	5 m^3
Vibratory Roller	7	115	102	9 kW
Grader	7	76	111	-
Breaker	6	10	110	35 kg
Road Roller	11	27	104	10 t
Poker Vibrator	9	32	100	-

The mitigated noise levels at identified NSRs are shown in *Table 5.2d*. With the use of quiet plant on site, the overall maximum noise reduction to the worst predicted noise levels from footbridge construction, retaining wall construction and road construction was up to 6 dB(A). The associated reduction in noise emission from drainage works was 8 dB(A).

Prediction results indicated that residual impacts would still be likely at the identified schools (Harbour Mission Church and Yan Oi Kindergarten (Ref. no. 12), Hong Kong True Light College (Ref. no. 17) and Ap Lei Chau Baptist Kindergarten (Ref. no. 10)), Ning Fung Mansion (Ref. no. 11), Nam Tack Mansion (Ref. no. 13), Sun Ming Building (Ref. no. 15), Wu On House (Ref. no. 19), Shan On House (Ref. no. 20), Pik On House (Ref. no. 21), Choi On House (Ref. no. 22) and the residential use at lot ApIL 130 (Ref. no. 25) with the recommended mitigation measure.

Residual impacts of up to 10 dB(A) were predicted at the schools in normal school hours and 7 dB(A) at Shan On House. The worst predicted cumulative noise levels at these NSRs also reflected the possible noise impacts from the works during the construction phase of the Project when construction activities would be undertaken at the same time. The total number of affected residential dwellings with the use of quiet plant would be reduced to about 250, with an estimated affected population of approximately 1,000. The estimated number of affected classrooms remains to be 47 given the level of noise exceedance and the sensitivity of classrooms to construction noise.

Table 5.2d Mitigated Construction Noise Level (dB(A)) - General Construction Works (Use of Quiet Plant)

Ref No.	Description	Assessment height above source (m)	Max. PNL - Drainage Works (dB(A))	Max. PNL - Footbridge Construction (dB(A))	Max. PNL - Retaining Wall Construction (dB(A))	Max. PNL - Road Construction (dB(A))	Worst Predicted Cumulative Noise Level (dB(A))	Critical Construction Stage/Activity causing noise exceedance
1	Coble Court	4.5/58.5[0]	58/58[0]	62/62	61/61	62/62	65/65	-
2	Manley House	4.5/28.5	62/62	66/66	63/63	66/66	69/69	-
3	Yen Ching Building	4.5/7.5	63/63	67/67	64/64	67/67	70/70	-
4	Sunny Court	4.5/52.5	65/64	69/68	66/66	69/68	72/71	-
5	Fortune Mansion	4.5/52.5	67/65	71/69	68/67	71/69	74/72	-
6	Hoi Lee Building	4.5/55.5	68/66	72/70	68/67	72/70	75/73	-
7	Residential Buildings (No. 14, 16 & 18, Wai Fung Street)	4.5	67	71	66	71	74	-
8	Shun King Court	4.5/61.5	68/65	73/70	69/68	72/69	75/73	-
9	Residential Buildings (No. 13, 15, 17 & 19, Wai Fung Street)	4.5	66	72	66	70	74	-
10	Ap Lei Chau Baptist Kindergarten (classrooms are located at lower and middle floors only)	-7.0/-1.0	70/70	80/80	73/73	74/74	81/81	excavation activity for footbridge construction, retaining wall construction and road construction; road paving in road construction
11	Ning Fung Mansion	4.5/49.5	71/68	75/72	71/70	75/72	78/75	excavation activity for footbridge construction and road construction; road paving in road construction
12	Harbour Mission Church and Yan Oi Kindergarten (classrooms are located at lower floor only)	-12.0/-3.0	74/76	72/72	71/71	78/80	80/82	excavation activity for drainage works, footbridge construction, retaining wall construction and road construction; road paving in road construction
13	Nam Tack Mansion	4.5	72	72	71	76	77	excavation activity and road paving in road construction
14	Rousseau Heights	4.5/19.5	69/69	69/69	68/68	73/73	75/74	-
15	Sun Ming Building	4.5/7.5	73/73	70/70	70/70	77/77	79/79	excavation activity and road paving in road construction
17	Hong Kong True Light College	9.0/30.0	75/72	60/60	63/62	79/76	81/78	excavation activity for drainage works and road construction; road paving in road construction

Ref No.	Description	Assessment height above source (m)	Max. PNL - Drainage Works (dB(A))	Max. PNL - Footbridge Construction (dB(A))	Max. PNL - Retaining Wall Construction (dB(A))	Max. PNL - Road Construction (dB(A))	Worst Predicted Cumulative Noise Level (dB(A))	Critical Construction Stage/Activity causing noise exceedance
18	Tung Ping House	18.5/117.5	64/61	58/57	60/58	68/65	69/66	-
19	Wu On House	16.4/114.5	73/63	67/64	70/66	77/67	78/70	excavation activity and road paving in road construction
20	Shan On House	16.4/114.5	78/64	70/66	76/67	82/68	84/70	excavation activity for drainage works, retaining wall construction and road construction; road paving in road construction
21	Pik On House	29.0/127.5	67/62	73/66	76/67	71/66	77/69	excavation activity for retaining wall construction
22	Choi On House	29.0/127.5	66/61	73/66	73/66	70/65	76/69	excavation activity for footbridge construction and retaining wall construction
23	Ngan On House	29.0/127.5	64/61	71/66	71/66	68/65	74/69	-
25	Residential use at lot ApIL 130	4.5/54.9	71/68	70/68	70/68	75/72	76/73	excavation activity and road paving in road construction
26	Toho Court	5.2/53.2	64/63	69/68	66/66	68/67	71/70	-
27	Hung Fook Court	5.2/53.2	63/63	67/66	66/65	69/67	71/70	-
28	Radiant Towers	44.4/104.4	58/58	61/60	61/60	62/62	65/64	-

Note: (1) Worst predicted receiver level on lower floor/top floor.
(2) Predicted noise level at the worst affected receiver level at lower floor/top floor.

5.2.5 *Residual Impacts*

Mitigation measures have been recommended in the preceding section and noise exceedances of EIAO-TM daytime noise criteria during the construction phase of the project were still predicted.

Predicted residual impacts at the schools as well as the residential uses were mainly contributed by the noise from dump truck and excavator for excavation works, the use of dump truck and asphalt paver during road paving and the use of winch and breaker in other construction activities. *Table 5.2e* summarises the identified residual construction noise impact and the source of the impact in the worst case scenario.

These residual impacts could be further reduced by limiting the number of noisy PME operating close to these NSRs, and also by restricting the usage of PME on-site during various noisy construction stages.

In general, the number of plant items operating on-site should be left to the choice of the Contractor. However, in some occasions it may be appropriate to restrict the number of particularly noisy equipment operating within certain parts of the site, such as the junction areas and the sites close to schools. The percentage of time that the noisy equipment is in operation may also need to be controlled so as to reduce the noise emissions during critical construction stages. For instance, by limiting the operation of noisy construction plant to 50% or 75% could reduce noise emission by 3 to 6 dB during critical construction period.

As construction noise impact may exist at a few of identified NSRs with the use of quiet plant and limiting the usage of construction equipment on-site, additional mitigation measures are still required. These include avoidance of the use of PMEs, avoidance of simultaneous noisy activities near junctions and close to schools, as indicated in *Table 5.2e*. These measures could minimize the impact from the works and eliminate the cumulative noise impacts at the worst affected NSRs. Since it is difficult to provide quantitative assessment for these measures and to identify the occurrence of worst case construction period, regular monitoring at the NSRs will be required during different construction phases. This will also enable the Contractor to beware of and provide necessary action if the assessment criteria are approached and to reduce noise emissions at specific areas. The effectiveness of on-site control measures could also be evaluated through the monitoring exercise. The monitoring requirement will be addressed in *Section 7* of this document and the details are reported in a separate EM&A Manual.

With the adoption of appropriate measures as stated above and the implementation of an effective monitoring exercise which would draw the contractor's attention to any excessive impact and to trigger appropriate corrective actions, it is expected that the residual impacts can be reduced to acceptable levels in accordance with the EIAO-TM requirements. It should be noted that works in relation to the Project are similar in scope and nature of many roadworks in Hong Kong and the associated impacts would be not much different from such projects.

Table 5.2e ***Summary of Residual Construction Noise Impact***

Affected NSR	Details of Residual Noise Impact	Source of Impact	Mitigation Measure Considered
10 - Ap Lei Chau Baptist Kindergarten (classrooms are located at lower and middle floors only)	Max. impact of 10 dB(A) during footbridge construction; 3 dB(A) during retaining wall construction and 4 dB(A) during road construction. Cumulative noise impact of 11 dB(A).	Use of winch, dump truck, asphalt paver, grader, breaker and excavator.	Quiet Plant used for dump truck, grader, breaker and excavator.
11 - Ning Fung Mansion	Max. cumulative noise impact of 3 dB(A).	Use of winch, breaker, dump truck and asphalt paver.	Quiet Plant used for breaker and dump truck
12 - Harbour Mission Church and Yan Oi Kindergarten (classrooms are located at lower floor only)	Max. impact of 4 dB(A) during drainage works; 2 dB(A) during footbridge construction; 1 dB(A) during retaining wall construction and 8 dB(A) during road construction. Cumulative noise impact of 10 dB(A).	Use of excavator, breaker, dump truck, grader and asphalt paver.	Quiet Plant used for excavator, breaker, dump truck and grader.
13 - Nam Tack Mansion	Max. impact of 1 dB(A) during road construction. Cumulative noise impact of 2 dB(A).	Use of dump truck, asphalt paver, grader, breaker and excavator.	Quiet Plant used for dump truck, grader, breaker and excavator.
15 - Sun Ming Building	Max. impact of 2 dB(A) during road construction. Cumulative noise impact of 4 dB(A).	Use of dump truck, asphalt paver, grader, breaker and excavator.	Quiet Plant used for dump truck, grader, breaker and excavator.
17 - Hong Kong True Light College	Max. impact of 5 dB(A) during drainage works and 9 dB(A) during road construction. Cumulative noise impact of 11 dB(A).	Use of excavator, breaker, dump truck and asphalt paver.	Quiet Plant used for excavators, breaker and dump truck.
19 - Wu On House	Max. impact of 2 dB(A) during road construction. Cumulative noise impact of 3 dB(A).	Use of dump truck and asphalt paver.	Quiet Plant used for dump truck.

Affected NSR	Details of Residual Noise Impact	Source of Impact	Mitigation Measure Considered
20 - Shan On House	Max. impact of 3 dB(A) during drainage works; 1 dB(A) during retaining wall construction and 7 dB(A) during road construction. Cumulative noise impact of 9 dB(A).	Use of excavator, breaker, dump truck and asphalt paver.	Quiet Plant used for excavator, breaker and dump truck.
21 - Pik On House	Max. impact of 1 dB(A) during retaining wall construction. Cumulative noise impact of 2 dB(A).	Use of excavator, breaker and dump truck.	Quiet Plant used for excavator, breaker and dump truck
22 - Choi On House	Max. cumulative noise impact of 1 dB(A).	Use of excavator, breaker and dump truck.	Quiet Plant used for excavator, breaker and dump truck.
25 - Residential use at lot ApIL 130	Max. cumulative noise impact of 1 dB(A).	Use of excavator, breaker, dump truck and asphalt paver.	Quiet Plant used for excavator, breaker and dump truck.

5.3 OPERATIONAL PHASE

5.3.1 *Potential Source of Impacts*

The dominant noise source affecting the NSRs in the vicinity of Ap Lei Chau Bridge Road and Ap Lei Chau Drive, as previously mentioned in *Section 4.1*, is road traffic noise. In view of the traffic volume and the small buffer distances, the nearby sensitive uses would be inevitably affected by road noise.

A traffic study has been undertaken in June 1998 to generate traffic data for the EIA Study. *Annex C* details the traffic forecasts conducted and presents the projection results. Traffic forecasts given in *Figures 5.3a* and *5.3b* reflect the traffic condition for the model years of 2000 and 2017 during the morning peak hour. The noise impacts in conjunction with the future widened roads and the associated changes in traffic condition are addressed in the following sections.

5.3.2 *Assessment Methodology*

The assessment of road traffic noise has been divided into two distinct parts: the calculations of prevailing noise levels and the predictions of future noise levels. The details are described below.

Presentation of Prevailing Noise Level

The calculation of road traffic noise was based on the methodology and procedure set out in *Calculation of Road Traffic Noise* (CRTN), published by the UK Department of Transport in 1988. *HFANoise*, a traffic noise model developed by Halcrow Fox was used to build the noise model. It is a road traffic noise assessment package which follows all the requirements in CRTN.

The modelling scheme for the presentation of prevailing noise level included a noise model of existing unaltered roads and other roads in the vicinity of the Study Area. The road scheme was divided into 70 segments, each of which was assigned one of 16 road layouts. A road layout defines the key elements of a road link which include road width, surface type, traffic conditions as well as the road configuration. The segmentation process was carried out in accordance with CRTN. Hard ground was assumed throughout the Study Area. Road surfaces were assumed to be standard wearing course. All other features that could add noise screening or reflection to the modelling process have been included.

Peak hour traffic flow of model year 2000, the year just before the commencement of improvements works was adopted, as given in *Figure 5.3a*. A vehicular speed of 50 kph was used in the modelling scheme for all the roadways. The prevailing noise levels were presented in $L_{10,\,peak\,hour}$ at all identified NSRs at the worst affected floor heights.

For planned uses, noise was predicted at a position 10m inside the boundary of the development zone and predicted at representative receiver heights according to the type of planning zone considered. Standard school layout was assumed for the planned school site. Regarding the planned residential site, information on development layout is not available at the moment, the assessment of road traffic noise was based on the layout of proposed PSPS development previously developed (ie. proposed 38-storey residential towers on top of a podium, roof level of podium was +25 mPD).

Prediction of Future Noise Level

Prediction of traffic noise levels in the future was undertaken following the similar modelling procedure mentioned in the preceding section. The scope of the proposed project was analysed to identify appropriate new or existing "unaltered" road sections.

According to the Study Brief, if a road section undergoes major modification which will result in 25% increase in lanes or substantial alterations in alignment or traffic characters, it should be regarded as a new road for the purpose of traffic noise impact assessment. The widened sections of Ap Lei Chau Bridge Road and Ap Lei Chau Drive described in *Section 2.1* are classified as new roads in this Study. *Figure 5.3c* shows the new road segments considered in this assessment. Roads classified as "unaltered" roads include those will remain either completely unchanged or which will undergo only very minor alterations.

The assessment scheme was divided into 78 segments and with a total of 22 road layouts. All the segmentation procedure was conducted according to the requirements stated in CRTN. Calculations for future road traffic noise again were based on the peak hour traffic flow in respect of the maximum traffic projection for year 2017. The information is detailed in *Figure 5.3b*. The traffic noise levels at identified NSRs were calculated in respect of each road segment and overall noise levels from both new and existing road sections. A sample *HFANoise* model output is shown in *Annex D*.

This assessment focused on the sensitive façades which were facing the proposed scheme directly. Reviewing the traffic on the future Ap Lei Chau North Coastal Road and the screening effect offered by the intervening buildings, noise contributed by this roadway to the overall predicted noise level would be low. Nonetheless, the associated changes of traffic on other roads within the Project with respect to this new coastal road have been considered.

Traffic noise impacts were then assessed against the EIAO-TM road traffic noise limits of $L_{10, peak hour}$ 70 dB(A) for residential uses and $L_{10, peak hour}$ 65 dB(A) for educational institutions. Any predicted levels exceeding the EIAO-TM road traffic noise limits are considered to constitute significant impacts and practicable direct mitigation measures will be recommended.

Development of Noise Mitigation Measures

Direct mitigation measures, where practicable, would be recommended when adverse noise impacts were predicted at NSRs. The civil and traffic engineering constraints of the roads would also be considered in the development of mitigation measures.

In cases where practical direct mitigation measures could not be incorporated into the design, residual impacts for NSR would be assessed against a second criterion to consider if, as a last resort, the affected NSR would qualify for noise insulation. This criterion would have to be exceeded (when rounded to the nearest 0.1 dB(A)) for the NSR to qualify for insulation. This "noise insulation criterion" embodies the conditions specified in the ExCo directive, *Equitable Redress for Persons Exposed to Increased Noise Resulting From The Use of New Roads*, such that the assessment criterion would be exceeded if all three of the following conditions are met:

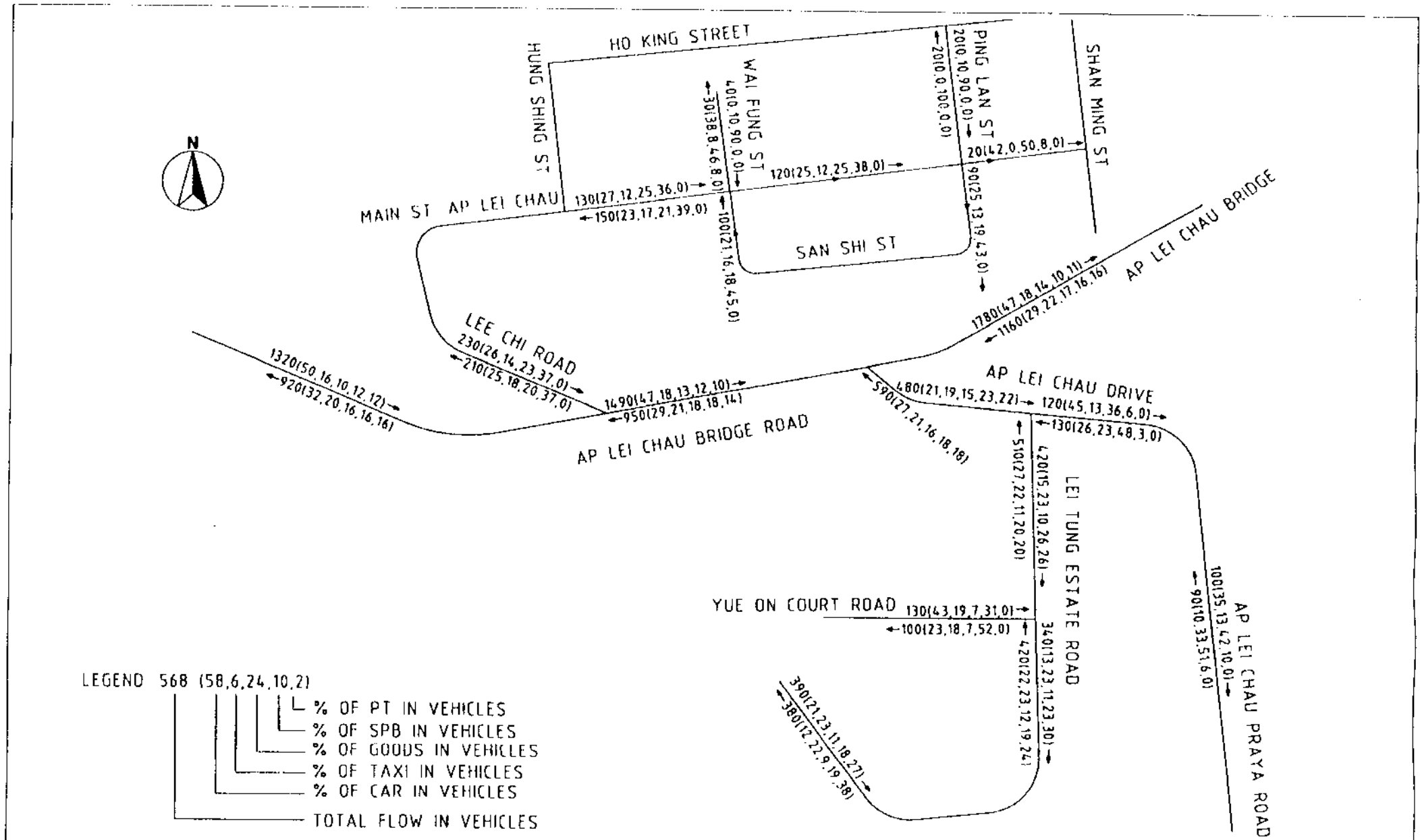

FIGURE 5.3a

PROJECTED 2000 AM TRAFFIC FLOWS

FILE: C1765/C1765D
DATE: 17/06/98

Environmental Resources Management

ERM

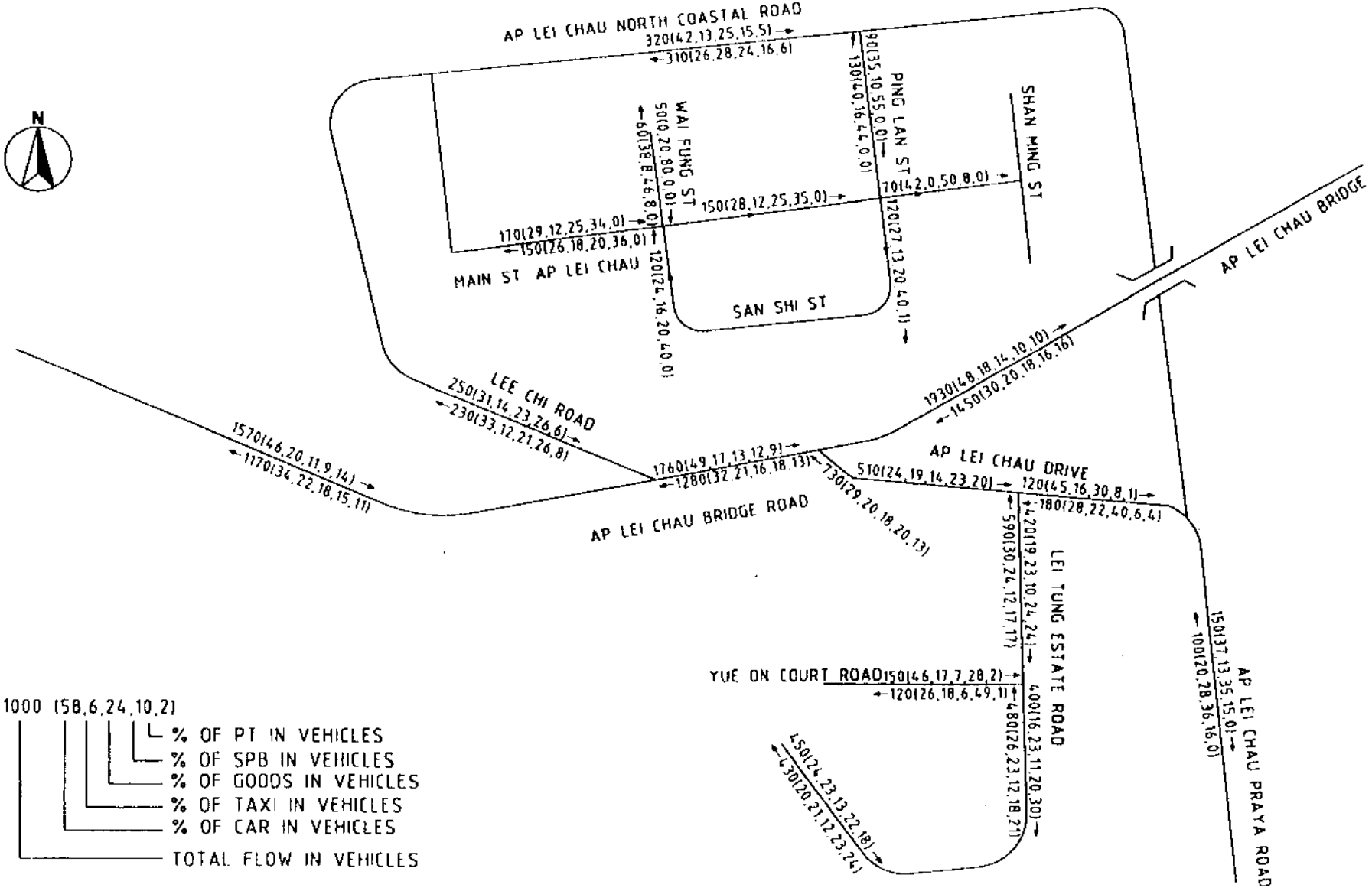

FIGURE 5.3b

PROJECTED 2017 AM TRAFFIC FLOWS - WITH AP LEI CHAU NORTH COASTAL ROAD

FILE: C1765/C1765D4
DATE: 17/06/98

Environmental Resources Management

ERM

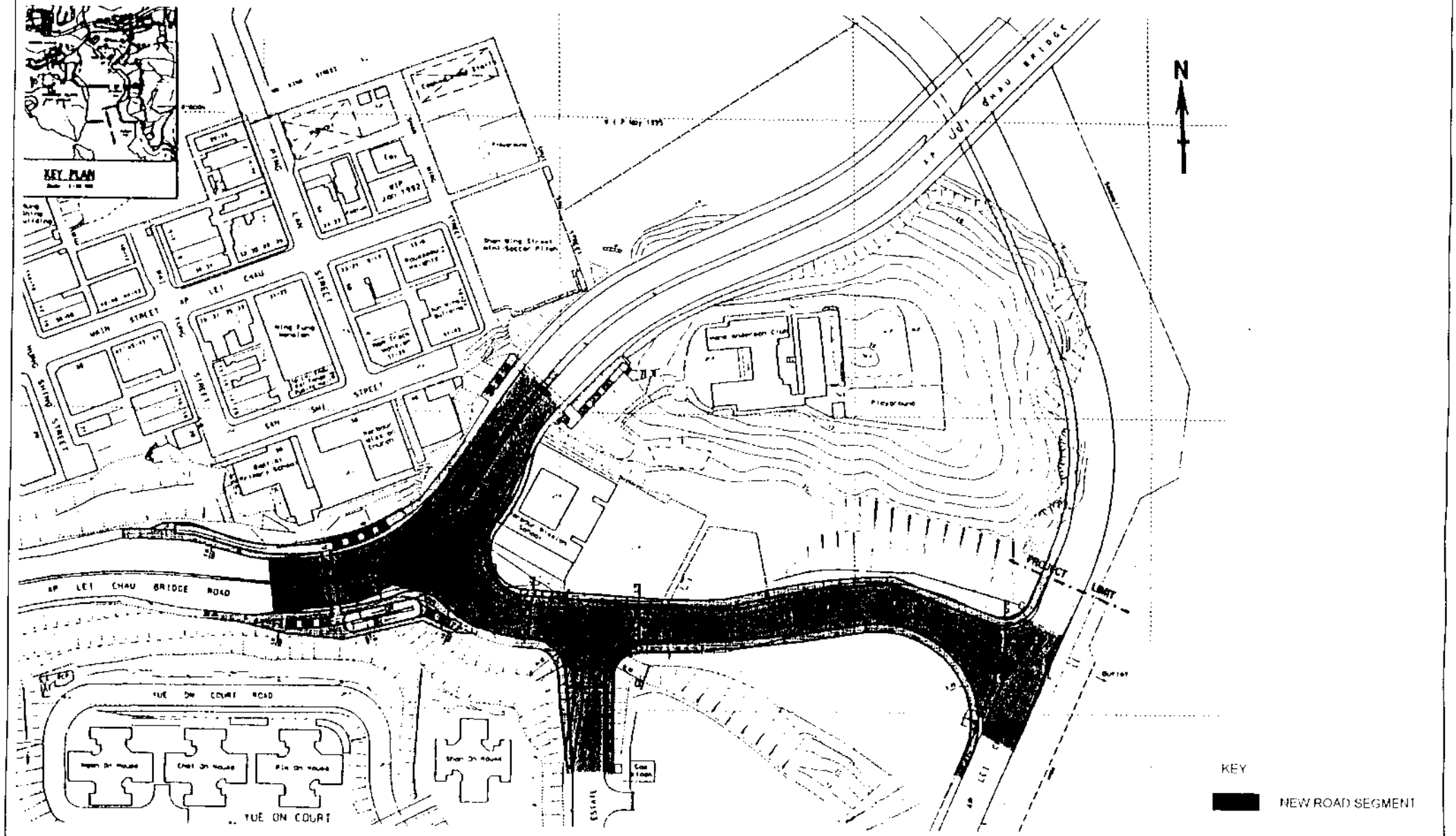

FIGURE 5.3c

NEW ROAD SEGMENTS CONSIDERED IN TRAFFIC NOISE ASSESSMENT

FILE: C1765/1765I
DATE: 11/98

Environmental Resources Management

ERM

- the predicted overall noise level from the new road together with other traffic in the vicinity must be above 70 dB(A) $L_{10\ (1\ hr)}$ for residential uses;

- the predicted overall noise level is at least 1.0 dB(A) more than the prevailing traffic noise level, ie. the total traffic noise level existing before the works to construct or improve the road were begun; and

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

5.3.3 *Prediction and Evaluation of Impacts*

The predicted road traffic noise levels at identified NSRs for the model years of 2000 and 2017 are discussed below. Assessment has been undertaken at three different receiver heights, unmitigated predicted noise levels are given in *Tables 5.3a* and *5.3b* for years 2000 and 2017 respectively. Detailed calculations on the assessment of traffic noise impacts are enclosed in *Annex E.*

Assessment of impacts associated with the Project during the worst prediction year (ie. 2017) would base on the prediction results and compare with the road traffic noise criteria stipulated in EIAO-TM. As refer to *Table 5.3b*, all the predicted noise levels at NSRs of residential uses would exceed the EIAO-TM road traffic noise criterion by 1-11 dB(A). A maximum noise level of 81 dB(A) was predicted at Wu On House of Yue On Court. Total number of dwellings affected by "new" roads classified under this Project was estimated to be 750. The estimated affected population would be about 3,000. These numbers are by and large no different from those being affected under prevailing conditions.

Regarding the educational uses, noise exceedances of up to 14 dB(A) were predicted by the year of 2017 at Hong Kong True Light College. It is noted that the planning proposal for this school was submitted in 1992, and it was completed and occupied in early 1995. Effective traffic noise mitigation measure in the form of steel-framed, double glazed windows with window-type air conditioning units have been incorporated into the design. A noise reduction of at least 25 dB(A) could be achieved with the use of secondary window glazing at sensitive façades. Given that the windows are in apparent good shape and are kept closed, with air-conditioning units on during normal school hours, noise impact on this sensitive use is not expected.

Classrooms on the first floor of Ap Lei Chau Baptist Kindergarten would be impacted by 2 dB(A) (ie. 67 dB(A)) during the operational phase, and the number of impacted classrooms in conjunction with the Project was approximately 6. Predicted noise levels at sensitive façades of classrooms located on the ground floor of Ap Lei Chau Baptist Kindergarten and Yan Oi Kindergarten were within the EIAO-TM road traffic noise criterion (ie. 65 dB(A)).

It should be noted that, for those receivers that are experiencing traffic noise levels over the HKPSG criteria, the differences between noise levels of the model years (2000 and 2017) are marginal at 1 dB(A) or below in most cases. The only exception being the former Harbour Mission School site whereby the future traffic noise levels would be 2 dB(A) above the prevailing level.

Table 5.3a Predicted Noise Levels $L_{10,1\text{-}hr}$ (dB(A)) for the Prevailing Year (2000)

Ref No.	Description	Lower Level		Middle Level		Higher Level	
		mPD level	dB	mPD level	dB	mPD level	dB
1	Coble Court	26.2	77	53.2	77	77.2	76
2	Manley House	26.2	75	38.2	77	47.2	77
3	Yen Ching Building	8.2	64	17.2	68	26.2	75
4	Sunny Court	26.5	74	50.5	76	71.5	75
5	Fortune Mansion	26.5	76	50.5	77	71.5	76
6	Hoi Lee Building	26.5	73	50.5	75	74.5	74
7	Residential Buildings (No. 14, 16 & 18, Wai Fung Street)	8.8	66	17.8	72	23.8	74
8	Shun King Court	29.8	73	53.8	74	80.8	74
9	Residential Buildings (No. 13, 15, 17 & 19, Wai Fung Street)	8.8	65	17.8	71	23.8	74
10	Ap Lei Chau Baptist Kindergarten (classrooms are located at lower and first floors only)	10.9	63	13.9	66	16.9	69
11	Ning Fung Mansion	26.7	74	47.7	76	68.7	76
12	Harbour Mission Church and Yan Oi Kindergarten (classrooms are located at lower floor only)	6.1	62	9.1	63	15.1	66
13	Nam Tack Mansion	8.7	64	14.7	68	20.7	74
14	Rousseau Heights	29.7	71	35.7	75	38.7	76
15	Sun Ming Building	8.7	66	17.7	72	26.7	78
16	Proposed Residential Development (R(A) zone, predicted at 10m setback from Ap Lei Chau Drive)	29.5	75	83.5	75	137.5	74
17	Hong Kong True Light College	31.0	78	41.5	79	52.0	78
18	Tung Ping House	40.5	71	88.5	69	139.5	68
19	Wu On House	38.4	81	86.4	77	137.4	74
20	Shan On House	38.4	78	86.4	76	137.4	74
21	Pik On House	47.0	76	95.0	75	146.0	73
22	Choi On House	47.0	75	95.0	75	146.0	73
23	Ngan On House	47.0	76	95.0	75	146.0	73
24	The Former Harbour Mission School Site	24.0	81	34.5	80	41.5	79
25	Residential use at lot ApIL 130	22.8	75	42.4	77	73.2	75
26	Toho Court	27.5	69	51.5	72	72.5	73
27	Hung Fook Court	27.5	64	51.5	69	75.5	69
28	Radiant Towers	62.7	68	92.7	68	122.7	69

Table 5.3b ***Predicted Noise Levels $L_{10,1\text{-}hr}$ (dB(A)) for the Future Year (2017)***

Ref No.	Description	Lower Level		Middle Level		Higher Level	
		mPD level	dB	mPD level	dB	mPD level	dB
1	Coble Court	26.2	77	53.2	77	77.2	76
2	Manley House	26.2	76	38.2	77	47.2	78
3	Yen Ching Building	8.2	64	17.2	69	26.2	76
4	Sunny Court	26.5	75	50.5	77	71.5	76
5	Fortune Mansion	26.5	77	50.5	78	71.5	77
6	Hoi Lee Building	26.5	74	50.5	76	74.5	75
7	Residential Buildings (No. 14, 16 & 18, Wai Fung Street)	8.8	67	17.8	73	23.8	75
8	Shun King Court	29.8	74	53.8	75	80.8	75
9	Residential Buildings (No. 13, 15, 17 & 19, Wai Fung Street)	8.8	65	17.8	72	23.8	75
10	Ap Lei Chau Baptist Kindergarten (classrooms are located at lower and first floors only)	10.9	64	13.9	67	16.9	70
11	Ning Fung Mansion	26.7	75	47.7	77	68.7	77
12	Harbour Mission Church and Yan Oi Kindergarten (classrooms are located at lower floor only)	6.1	62	9.1	63	15.1	67
13	Nam Tack Mansion	8.7	66	14.7	70	20.7	75
14	Rousseau Heights	29.7	72	35.7	76	38.7	77
15	Sun Ming Building	8.7	66	17.7	72	26.7	79
16	Proposed Residential Development (R(A) zone, predicted at 10m setback from Ap Lei Chau Drive)	29.5	75	83.5	75	137.5	74
17	Hong Kong True Light College	31.0	79	41.5	79	52.0	78
18	Tung Ping House	40.5	72	88.5	70	139.5	69
19	Wu On House	38.4	81	86.4	77	137.4	75
20	Shan On House	38.4	79	86.4	76	137.4	74
21	Pik On House	47.0	76	95.0	76	146.0	74
22	Choi On House	47.0	76	95.0	76	146.0	74
23	Ngan On House	47.0	77	95.0	76	146.0	74
24	The Former Harbour Mission School Site	24.0	83	34.5	80	41.5	79
25	Residential use at lot ApIL 130	22.8	76	42.4	77	73.2	76
26	Toho Court	27.5	69	51.5	72	72.5	73
27	Hung Fook Court	27.5	65	51.5	69	75.5	70
28	Radiant Towers	62.7	69	92.7	69	122.7	70

Noise impacts on the planned uses would also be likely, with exceedances of EIAO-TM road traffic noise criterion of up to 18 dB(A) at the school site. Noise exceedance of up to 5 dB(A) on the planned residential site were predicted. Both planned sensitive uses would be constrained by road traffic noise in the future operational phase.

Referring to the results enclosed in *Annex E*, NSRs located close to the junctions of Ap Lei Chau Bridge Road/Ap Lei Chau Drive and Ap Lei Chau Drive/Lei Tung Estate Road (NSRs along Main Street, Ap Lei Chau, ref. no. 6-15 and NSRs at Yue On Court, ref. no. 19-23) were impacted by the noise in association with the Project. Other NSRs which are relatively remote from the Project would be affected by existing roads. The applicability of direct mitigation measures on-site is evaluated in the following section.

5.3.4 *Mitigation Measures*

The assessment results in the preceding section indicated that most of the NSRs in the vicinity of the Project would be impacted by road traffic noise during the operational phase. Judging from the nature of improvement works and the scope of the Project, there are potential constraints which limit the application of roadside barriers on "new" road sections or similar direct measures for mitigating the identified impacts. These potential constraints include:

- The requirement of visibility splay at the junctions of Ap Lei Chau Bridge Road/Ap Lei Chau Drive, Ap Lei Chau Drive/Lei Tung Estate Road and Ap Lei Chau Drive/Ap Lei Chau Praya Road for maintaining road safety.

- The incorporation of barrier under the soffit of the footbridge stairs and ramp will inevitably greatly increase the wind load acting on the structure, which will ultimately be transferred to the foundation. However, the proposed foundation is sitting on an existing old counterfort retaining wall. Any substantial increase in load transfer through the base of the retaining wall will cause adverse effect on the stability of this retaining wall, and therefore is not recommended.

- The extension of existing wall for noise mitigation purposes at the back of Ap Lei Chau Bridge northern footpath will increase the loading to the retaining wall, which would ultimately be transferred to the wall of the existing old counterfort retaining wall, thereby causing undesirable effects to its stability.

- The provision of noise barrier along Ap Lei Chau Drive would also pose constraints, e.g. vehicle access, on the future developments, such as the PSPS site and the former Harbour Mission School Site.

- Provisions of measures such as off-site barriers near the receivers have been considered but are regarded as unsatisfactory.

Frequent turning traffic of buses and heavy vehicles near the junctions, together with the topographical factor of the site create difficulties to the installation of noise mitigation measures. Apart from the constraints described above, more justifications on direct technical remedies are given in *Noise Mitigation Works for Public Roads*, an information paper jointly published by the EPD and HyD. For district distributor road, noise barrier of up to 6m high and barrier wall on central reserve (for dual-3 or wider carriageways) with height not higher than 5m could be used for noise abatement purpose. Since that section of Ap Lei Chau Bridge

Road within the project limit has been classified as a dual-2 district distributor road, the use of barrier on central reserve is considered not practical. Given the potential constraints of the site and for the safety of road, the use of direct technical remedies for this Project is considered not feasible.

As direct technical remedies could not be incorporated into the design of the Project, further assessment on the eligibility of provision of noise insulation at existing residential NSRs, as a last resort, should be considered to minimize the predicted noise impacts. The assessment on the eligibility of provision of noise insulation is discussed in *Section 5.3.5*.

As kindergarten is not entitled to be provided with noise insulation under the noise abatement measures in schools program administered by the Education Department, further consideration of mitigation measure at the impacted NSRs (Ref. no. 10 & 12) is limited. Erection of barriers at the footpath on top of the existing retaining wall in the vicinity of these kindergartens requires extensive improvements works to the overall retaining structure such as enlargement of footing and widening of retaining wall. The width of footpath may also not be sufficient to accommodate any noise screening structure. Provision of higher barrier at the existing location to protect these sensitive uses is not considered further.

Two planned sensitive uses along Ap Lei Chau Drive have been identified, those are the PSPS site and the former Harbour Mission School site. In order to reduce the identified impacts from road traffic noise at these NSRs, adequate setback and adoption of suitable building design are recommended. Appropriate clauses should be incorporated in the relevant sales or lease conditions to stipulate that the developer would need to address such concerns in the detailed design stage of the developments. The Noise Impact Assessment Report conducted by Arup Acoustics in January 1996 for the PSPS site was reviewed and is found to be valid for this Project. It was recommended that either air-conditioners and window upgrading be provided to all affected flats or to use single aspect block layout to provide sufficient noise self-screening. As for the former Harbour Mission School site, it is recommended that air-conditioners and good quality windows (e.g. Type III window, 12 mm laminated pane) be provided as mitigation measures if the site is planned for educational use. Other mitigation measures such as the construction of a boundary wall to the school site can be effective in screening road traffic noise for the low floors.

5.3.5 *Noise Insulation Eligibility*

As discussed, the use of direct technical remedies for this Project is restricted by the potential constraints of the site. The noise impacts at existing NSRs were then assessed against the noise insulation criteria given in *Section 5.3.2*. The assessment was undertaken based on the predicted noise levels presented in *Annex E* and compared with the three noise criteria.

The eligibility of providing noise insulation for particular NSR, as a last resort to reduce the impacts from road traffic noise, was checked if these three criteria were satisfied. According to the results in *Annex E*, all the identified NSRs are not eligible to be considered for noise insulation.

5.4 CONCLUSIONS

Noise during the construction phase of the improvement works on Ap Lei Chau Bridge Road and Ap Lei Chau Drive would impact the surrounding environment. Unmitigated construction activities associated with the Project would cause exceedances of daytime construction noise standards stipulated in EIAO-TM at most of the nearby NSRs. Noise exceedance in the range of 1-17 dB(A) have been predicted, and critical noisy construction activities identified were excavation works during various construction stages and road paving in road construction.

Adequate control measures would be required for general construction works to meet the EIAO-TM daytime construction noise criteria. Mitigation measures including the use of quiet plant, control the number of plant operating concurrently and reduce the percentage of time of noisy equipment in operation were recommended. Regular monitoring of noise at NSRs would be required during the construction phase of the Project in order to ensure the environmental performance of the works. The monitoring requirements and implementation schedule for mitigation measures are addressed in *Sections 7* and *8* respectively.

With the adoption of appropriate measures as stated above and the implementation of an effective monitoring exercise which would draw the contractor's attention to any excessive impact and to trigger appropriate corrective actions, it is expected that the residual impacts can be reduced to acceptable levels in accordance with the EIAO-TM requirements.

Percussive piling may be employed on-site for retaining wall construction. Assessment results indicated that the permitted hours of operation for percussive piling depended on the type of piling drivers to be used.

Road traffic noise impact would be a key issue of this EIA Study. Based on the worst case traffic forecasts of year 2017, noise impacts would be likely at most of the identified NSRs in the vicinity of the Project. The use of direct technical remedies for the proposed scheme was considered not feasible given the potential constraints of the site, including visibility splay at junctions, presence of public light bus/taxi lay-by and the proposed footbridge.

Two planned sensitive uses along Ap Lei Chau Drive have been identified, those are the PSPS site and the former Harbour Mission School site. In order to reduce the identified impacts from road traffic noise at these NSRs, adequate setback and adoption of suitable building design are recommended. Provision of noise insulation such as air-conditioners and good quality windows are recommended to reduce traffic noise impact to these sensitive NSRs.

The noise impacts have been assessed against the noise insulation criteria. The results indicated that all the existing NSRs were not eligible to be considered for noise insulation.

6 AIR QUALITY IMPACT ASSESSMENT

6.1 INTRODUCTION

This section evaluates potential air quality impacts associated with the construction and operation of the Project. Air Sensitive Receivers (ASRs) have been identified for this EIA Study and are detailed in *Section 4*. Any adverse impacts on the ASRs will be identified and mitigation measures are recommended, where appropriate, to minimize the potential air quality impacts.

6.2 CONSTRUCTION PHASE

6.2.1 *Potential Source of Impacts*

The likely air quality impact arising from the Project is related to dust nuisance as well as gaseous emissions from the construction plant and vehicles. The improvement works at Ap Lei Chau Bridge Road and Ap Lei Chau Drive will involve road works, drainage works, retaining wall construction and footbridge construction.

Major dust generating activities associated with the retaining wall construction, road construction and drainage works are materials handling, excavation, road openings and filling of road base. The excavated fill materials will be transported off site and stockpiling, therefore, is not required. The existing roadways will be used as the route for transportation.

SO_2 and NO_2 will be emitted from the diesel-powered mechanical equipment used on-site. However, the number of such plant required on-site will be limited and gaseous emissions will be minor. It is therefore not expected to cause an exceedance of the AQO for these gases due to the limited construction plant on site.

Judging from the scale of works on Ap Lei Chau Bridge Road and Ap Lei Chau Drive, the volume of excavated material and the rate of excavation are anticipated to be low. However, in order to ensure the environmental performance of construction works, environmental control and mitigation measures are recommended and described in the following section.

6.2.2 *Environmental Control and Mitigation Measures*

To ensure the environmental performance of the works, there are some general requirements for air pollution control which are described below:

i) The Contractor shall observe and comply with the APCO and its subsidiary regulations, particularly the *Air Pollution Control (Open Burning) Regulation* and *Air Pollution Control (Construction Dust) Regulation*.

ii) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities.

iii) The Contractor shall ensure that there will be adequate water

supply/storage for dust suppression.

iv) The Contractor shall ensure that all plant, equipment and air pollution control system, to be used on the Site are properly maintained in good operating condition to avoid nuisance to any nearby sensitive receptors.

v) In the event of a malfunction or breakdown of any air pollution control system, the plant, process or activity concerned shall be stopped as soon as practicable until such time as the air pollution control system is restored to proper function.

vi) The Contractor shall devise, arrange methods of working and carrying out the works in such a manner so as to minimise dust impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

vii) Before the commencement of any work, the Engineer may require the methods of working, plant, equipment and air pollution control system to be used on the site to be made available for inspection and approval to ensure that they are suitable for the project.

In accordance with the *Air Pollution Control (Construction Dust) Regulation*, the following control requirements should be employed in the worksite and incorporated in the Contract Specification to minimise potential dust nuisance arising from the works:

- the heights from which materials are dropped should be controlled to a minimum practical height to control fugitive dust arising from unloading;
- materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport;
- water sprays should be applied to maintain the work site wet;
- all dusty materials should be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet;
- the load carried by the vehicle should be covered by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle; and
- the excavation working area should be sprayed with water after the operation so as to maintain the entire surface wet.

With the implementation of above suggested measures, the dust emissions from the site could be minimised and adverse impacts on the nearby sensitive receivers are not expected.

6.3 *OPERATIONAL PHASE*

According to the Study Brief, the likely air quality implications of any proposed noise mitigation measures for the Project should be addressed. As no noise mitigation measures are proposed, the assessment of air quality impact is not required.

6.4 CONCLUSIONS

During the construction phase, the major dust generating activities in association with the works of the Project are identified to be material handling and excavation during road construction, drainage works and retaining wall construction. It was envisaged that the volume of material to be handled on site and the excavation rate for road construction would be low. Adverse dust impact on the nearby ASRs was not expected.

Environmental control and mitigation measures have been recommended to improve the environmental performance of the works and to further reduce dust emissions from site operations.

An operational air quality impact assessment was considered not required as no direct technical remedies with regard to noise were recommended in the operational phase of the Project.

7 ENVIRONMENTAL MONITORING AND AUDIT

7.1 INTRODUCTION

This section presents the EM&A requirements that have been included into the EM&A Manual for the Project. This section describes the findings of impact assessment in the previous sections of this report and outlines the associated EM&A requirements. As discussed in *Section* 5.2, construction noise would lead to exceedances of environmental criteria and therefore EM&A at the affected sensitive receivers are recommended.

7.2 OBJECTIVES OF ENVIRONMENTAL MONITORING AND AUDIT

The objectives of carrying out EM&A for the Project include the following:

- to provide a database against which any short or long term environmental impacts of the Project can be determined;
- to provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- to monitor the performance of the Project and the effectiveness of mitigation measures;
- to verify the environmental impacts predicted in the EIA Study;
- to determine project compliance with regulatory requirements, standards and government policies;
- to take remedial action if unexpected problems or unacceptable impacts arise; and
- to provide data to enable an environmental audit to be performed.

The following sections summarise the recommended EM&A requirements proposed.

7.3 NOISE

Noise produced during the construction phase would impact upon nearby NSRs as assessed in *Section* 5.2. The primary noise sources include the use of winch, dump truck, asphalt paver, excavator and breaker during various construction stages. The EIAO-TM daytime construction noise criterion of 75 dB(A) for domestic premises would be exceeded at most of the representative NSRs if no mitigation measures would be imposed.

A set of broad mitigation measures, including the use of quiet plant and controlled usage of plant on site has been recommended to reduce the identified impacts. The effectiveness of recommended measures will be checked by the EM&A procedures set out in the EM&A Manual. It is anticipated that if the

mitigation measures described could be successfully applied, the noise levels experienced by the affected receivers will be reduced.

Noise monitoring requirements have been recommended in the EM&A Manual. It has been suggested that noise monitoring should be undertaken, as part of the EM&A programme during the construction period of the Project, at the Ap Lei Chau Baptist Kindergarten (Ref. no. 10), the Harbour Mission Church and Yan Oi Kindergarten (Ref. no. 12), the Hong Kong True Light College (Ref. no. 17) and Shan On House (Ref. no. 20) and lastly, at any additional locations considered necessary in agreement with the EPD.

7.3.1 *Baseline Monitoring*

Baseline noise monitoring should be carried out prior to the commencement of the construction works. The baseline monitoring should be carried out daily for a period of at least two weeks to setup the baseline noise condition.

7.3.2 *Impact Monitoring*

Noise monitoring should be carried out at all designated monitoring stations. The monitoring frequency should depend on the scale of the construction activities. As a initial guide, the frequency of monitoring should be undertaken once every six days at each monitoring station during the normal working hours (0700-1900 from Monday to Saturday) when noise generating activities are underway.

The monitoring is required to ensure the compliance with the EIAO-TM noise standards in providing feedback to the Contractors for the management of their operations. The EM&A programme will be presented separately in the EM&A Manual.

7.4 *Air Quality*

Dust would be the major air pollutant during the construction phase of the Project. Major dust generating activities associated with retaining wall construction, road construction and drainage works were identified to be materials handling, excavation, road openings and filling or road base.

Judging from the scale of works on Ap Lei Chau Bridge Road and Ap Lei Chau Drive, the volume of excavated material and the rate of excavation were anticipated to be low. In order to ensure the environmental performance of construction works, environmental control and mitigation measures in accordance with the *Air Pollution Control (Construction Dust) Regulation* have been recommended. No environmental monitoring on air quality was required.

8 IMPLEMENTATION SCHEDULE OF RECOMMENDED MITIGATION MEASURES

8.1 CONSTRUCTION PHASE

Impacts on the nearby sensitive receivers were identified during various construction stages. Appropriate mitigation measures such as use of quiet plant, reducing percentage on time, avoidance of simultaneous noisy activities have been recommended to reduce the associated impacts.

A practicable environmental implementation schedule of the Project during the construction phase has been proposed and can be referred to in the EM&A Manual. The effectiveness of the recommended measures will be monitored through the EM&A exercise during the construction period. The Engineer as well as the Contractor is responsible to act accordingly once the defined action and limit levels have been reached where appropriate.

8.2 OPERATION PHASE

Adverse noise impacts from road traffic were predicted at identified sensitive receivers. Given the potential site constraints and other engineering factors, the use of direct technical remedies were considered infeasible. In addition, all the identified NSRs are not eligible to be considered for noise insulation after assessing with the noise insulation criteria.

9 OVERALL CONCLUSION & RECOMMENDATIONS

9.1 CONSTRUCTION PHASE

9.1.1 *Findings*

Noise

Noise during the construction phase of the improvement works on Ap Lei Chau Bridge Road and Ap Lei Chau Drive would impact the surrounding environment. Unmitigated construction activities associated with the Project would cause exceedances of daytime construction noise standards stipulated in EIAO-TM at most of the nearby NSRs. Noise exceedance in the range of 1-17 dB(A) have been predicted, and critical noisy construction activities identified were road paving during road construction, excavation works during footbridge and retaining wall construction.

Percussive piling may be employed on-site for retaining wall construction. Assessment results indicated that the permitted hours of operation for percussive piling depended on the type of piling drivers to be used.

Air Quality

During the construction phase, the major dust generating activities in association with the works of the Project are identified to be material handling and excavation during road construction, drainage works and retaining wall construction. It was envisaged that the volume of material to be handled on site and the excavation rate for road construction would be low. Adverse dust impact on the nearby ASRs was not expected.

9.1.2 *Recommendations*

Noise

Adequate control measures would be required for general construction works to meet the EIAO-TM daytime construction noise criteria. Mitigation measures including the use quiet plant, control the number of plant operating concurrently and reduce the percentage of time of noisy equipment in operation were recommended. Regular monitoring of noise at NSRs would be required during the construction phase of the Project in order to ensure the environmental performance of the works. The monitoring requirements and implementation schedule for mitigation measures are addressed in *Sections 7* and *8* respectively.

With the adoption of appropriate measures as stated above and the implementation of an effective monitoring exercise which would draw the contractor's attention to any excessive impact and to trigger appropriate corrective actions, it is expected that the residual impacts can be reduced to acceptable levels in accordance with the EIAO-TM requirements.

Air Quality

Environmental control and mitigation measures have been recommended to improve the environmental performance of the works and to further reduce dust emissions from site operations.

9.2 OPERATIONAL PHASE

9.2.1 *Findings*

Noise

Road traffic noise impact would be a key issue of this EIA Study. Based on the worst case traffic forecasts of year 2017, noise impacts would be likely at most of the identified NSRs in the vicinity of the Project. The use of direct technical remedies for the proposed scheme was considered not feasible given the potential constraints of the site, including visibility splay at junctions and other engineering and related considerations.

The noise impacts have been assessed against the noise insulation criteria. The results indicated that all the existing NSRs were not eligible to be considered for noise insulation.

Air Quality

An operational air quality impact assessment was considered not required as no direct technical remedies were recommended in the operational phase of the Project.

9.2.2 *Recommendations*

For the identified planned sensitive uses along Ap Lei Chau Drive, mitigation measures such as provision of air-conditioners and good quality windows and adoption of suitable building design are recommended.