FINAL ASSESSMENT REPORT

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

Civil Engineering Department

Agreement No CE 5/97 : *Construction of Roads and Drains to Serve the Housing Development in Area 56, Tuen Mun: EIA*

18 February 1998

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Reference C1672/76860_2

For and on behalf of ERM-Hong Kong, Ltd

Approved by: FREEMAN CHEUNG

Signed:

Position: Deputy Managing Director

Date: 18 February 1998

CONTENTS:

1 INTRODUCTION

Hong Kong Housing Authority (HKHA) intends to develop Tuen Mun Area 56 in So Kwun Wat for a Private Sector Participation Scheme (PSPS) housing development. A Preliminary Project Feasibility Study (PPFS) for the "Construction of Roads and Drains to serve the Housing Development in Area 56" (hereinafter called "the Project") was carried out by Territory Development Department (TDD) in February 1996. It was concluded that an Environmental Impact Assessment Study (hereinafter called "the EIA") is required to assess the possible environmental impacts caused by the Project and advise on possible mitigation measures, if any, to be included in the Project. ERM Hong Kong, in association with Wilbur Smith Associates Limited (WSA), have been commissioned by the Civil Engineering Department (CED) to undertake the Study as part of the Project. The purpose of the Study is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project.

1.1 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 community and environment likely to be affected by the Project, and/or likely to cause adverse impacts on the Project, including both the natural and man-made environment;

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

iv) to identify and quantify any potential losses or damage to flora, fauna and natural habitats;

v) to identify existing landscape and visual quality in the study area and evaluate the landscape and visual impact of the project;

vi) to propose mitigation measures to minimize potential pollution, environmental disturbance and nuisance arising from the Project during its construction and operation;

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

viii) 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;

ix) 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;

x) to investigate the extent of side-effects of proposed mitigation measures that may lead to other forms of impacts;

xi) to identify constraints associated with the mitigation measures; and

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

1.2 *DESCRIPTION OF THE ASSIGNMENT*

The findings of EIA will contribute to decisions on whether:

- the predicted levels of any environmental impacts that are likely to arise as a result of the proposed roads and drains are within the established standards and guidelines;
- there are any specific conditions and requirements for environmental protection that should be applied to the detailed design, construction and operation of the Project; and
- any residual impacts identified in the EIA are within the established standards and guidelines after proposed mitigation measures are implemented.

1.3 *STUDY AREA*

Tuen Mun Area 56 lies east of Tuen Mun town and is located immediately north of Tuen Mun Road. Assess to the site is via Castle Peak Road - So Kwun Wat. According to the June 1994 edition of the Public Housing Development Programme, 5,000 PSPS flats have been proposed for the site.

For the purpose of this EIA, the Study Area boundary has generally been defined as 300 m from the road alignment, for the landscape and air quality assessment, a distance of 500 m from the road alignment has been defined. Regarding the visual impact, all sensitive receivers have been assessed regardless of the distance from the road alignment.

1.4 *STRUCTURE OF THE REPORT*

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

- *Section 2* identifies the main features of the Project.
- *Section 3* describes the potential noise impacts associated with the construction and operational phase of the Project
- *Section 4* describes the air quality impacts associated with the

construction and operational phase of the Project;

- Section 5 presents the ecological impacts associated with the Project;
- Section 6 presents the potential landscape, visual associated with the construction and operational phases of the Project.
- Section 7 presents the EM&A requirement for the Project.
- Section 8 reviews the findings and presents the overall conclusions of the EIA Report.

2 PROJECT DESCRIPTION

2.1 ROUTE ALIGNMENT

The Project comprises the improvement of Castle Peak Road/ So Kwun Wat Road junction at the west end, realigning and upgrading of the existing So Kwun Wat Road to dual two carriageway (Road B1), and extending the So Kwun Wat Road to the east end (Road L56A). A new local road (Road L56B) leading to the PSPS site is proposed and an additional vehicle underpasses (Road B11) will also be constructed beneath the Tuen Mun Road. Road B1 is a district distributor while Road L56B is a local distributor. The location of the new roads are shown in *Figure 2.1a.*

The key components of the Project are the:

- construction of approximately 900 m (14.6 m wide) and 850 m (7.3 m wide) of carriageways in Areas 55 and 56;
- construction of stormwater drains and foul sewers and associated services along the road carriageway;
- construction of approximately 30 m (11.65 m wide overall) of vehicular underpass across Tuen Mun road;
- construction of about 200 m of box culvert in Area 55 and 56;
- construction of about 40 m retaining walls in Area 55 and 56;
- design and incorporation of environmental impact mitigation measures; and
- landscape treatments along road sides.

2.2 SURROUNDING LANDUSE

The land surrounding the Study Area is rural in nature with village type buildings scattered around. Tai Lam Country Park is located to the north and the Hong Kong Gold Coast is located to the west of the site. Several container open storage areas are situated along the alignment.

In accordance with the Tuen Mun New Town Areas 55 & 57- Layout Plan (Plan L/TM55/A), the planning intention of Tuen Mun Area 55 is to change the area zoning to Comprehensive Development Area (CDA), Government/ Institution/ Community (G/IC), residential areas, village type developments and open space. The landuses of Tuen Mun Area 56 have been identified in the Tuen Mun New Town Area 56 - Layout Plan (Plan L/TM56/1) as residential areas and village type developments. It is understood that the existing open storage areas will be relocated, however the timing of the relocation have not been determined in this stage. The proposed landuses zoning of the Study Area is presented in *Figure 2.2a.*

2.3 PLANNED DEVELOPMENT

2.3.1 *PSPS Housing Development*

A PSPS development has been proposed by the HKHA in Tuen Mun Area 56, between Road L56B and Tuen Mun Road. Two alternative schemes, Scheme 5B and Scheme 7, have been proposed at the site.

Scheme 5B comprises 10 standard cruciform blocks and 6 single aspect blocks (SABs). These SABs are located along the PSPS site boundary to the south and west to mitigate the impacts of traffic noise from Tuen Mun Road. Each standard block has 40 storeys and 10 flats per floor, whilst the SABs have 25 storeys and 6 flats per floor. This scheme will provide a total of 4900 flats. The layout plan of the scheme is presented in *Figure 2.3a*.

Scheme 7 comprises 7 cruciform blocks and 10 SABs. The SABs will be distributed along the whole PSPS site boundary except to the east. The SABs located to the south-west quadrant of the site have been designed to mitigate the noise from Tuen Mun Road as in Scheme 5B, whilst other SABs located to the north are for mitigating the noise from the container storage areas. This scheme will provide a total of 4300 flats. *Figure 2.3b* presents the proposed layout scheme of the development.

2.3.2 *CDA Development, TMTL 374*

It is understood from the Planning Department that the CDA development in Tuen Mun Area 55, Site TMTL 374, has been approved by the Town Planning Board, however, details of the development are not available for this Study. It is assumed that the design of the CDA site will have taken into account the planning intention of the area. Mitigation measures have been incorporated in the layout of the CDA development.

2.4 CONSTRUCTION PHASE

The construction phase of the Project is anticipated to be carried out between January 1999 and January 2001. The main construction activities will be:

- site clearance;
- at grade road widening/ formation;
- storm drain works;
- box culvert works;
- vehicular underpass construction; and
- road pavement works.

These activities are described in more detail in the noise and air quality sections of this Report (*Sections* 3 and 4 respectively).

2.5 *OPERATIONAL PHASE*

In accordance with the Brief, traffic forecasts for the worst case scenario within 15 years of the commencement of operation of the Project, ie year 2016, shall be used for assessment. Traffic forecasts for this Study were derived from the *So Kwun Wat PSPS Tuen Mun Area 56 Traffic and Environmental Assessment Study, WSA, 1996* and the *Enhanced CTS-2 Transportation Model.* The traffic forecast details are given in *Annex A.*

The prevailing traffic flows of the Study Area are dominated by Tuen Mun Road and Castle Peak Road, the traffic flow of So Kwun Wat Road is low. However, with the development of Tuen Mun Areas 55 and 56, the local traffic will be increased. The prevailing traffic flows of the Study Area are given in *Figure 2.5a* and the predicted peak hours traffic flows for the year 2016 are presented in *Figures 2.5b and c.*

For the purpose of this Study, the traffic forecast for the PM peak hour for the year 2016 have been identified as the worst case scenario in relation to vehicle exhaust emissions and noise impacts.

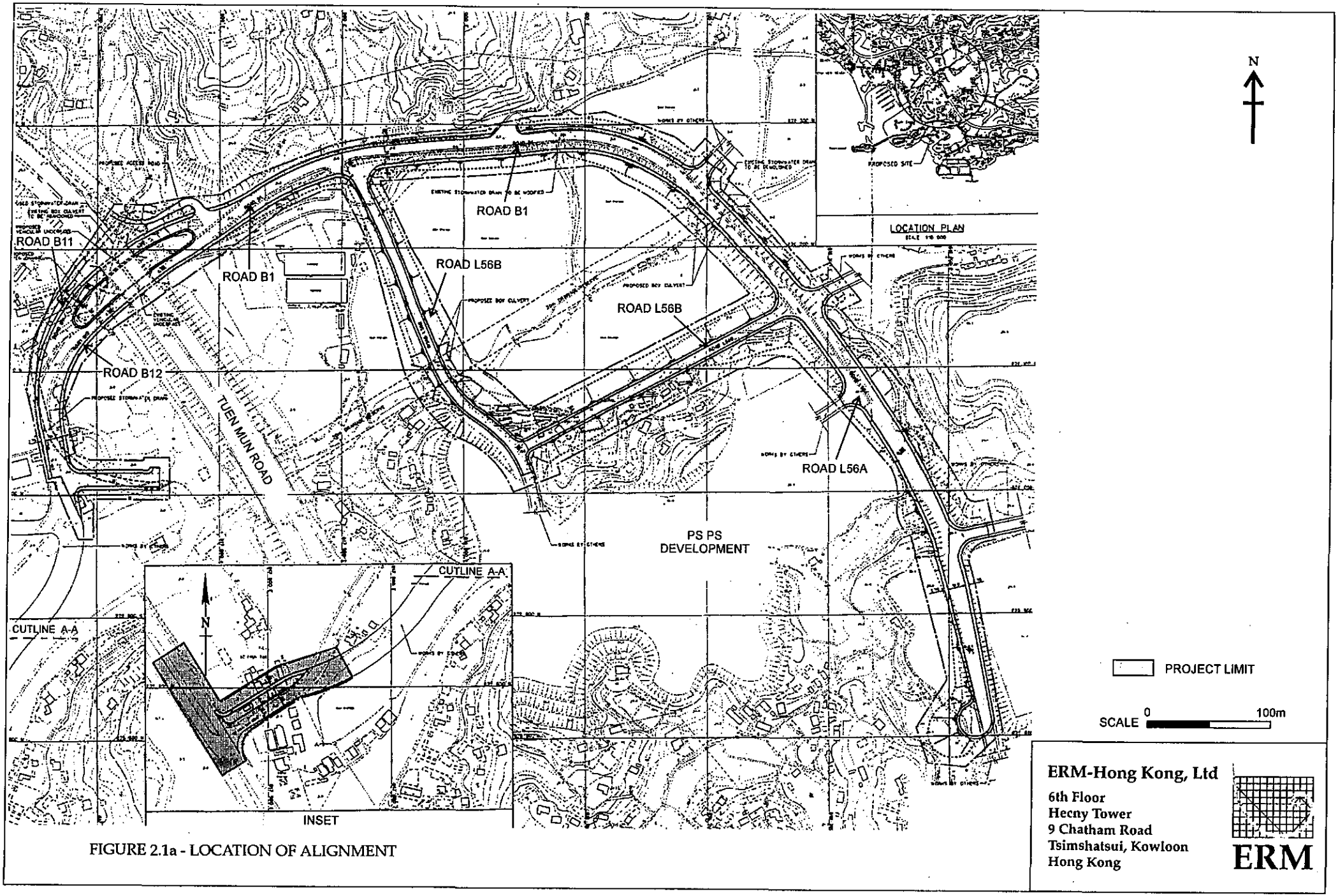

FIGURE 2.1a - LOCATION OF ALIGNMENT

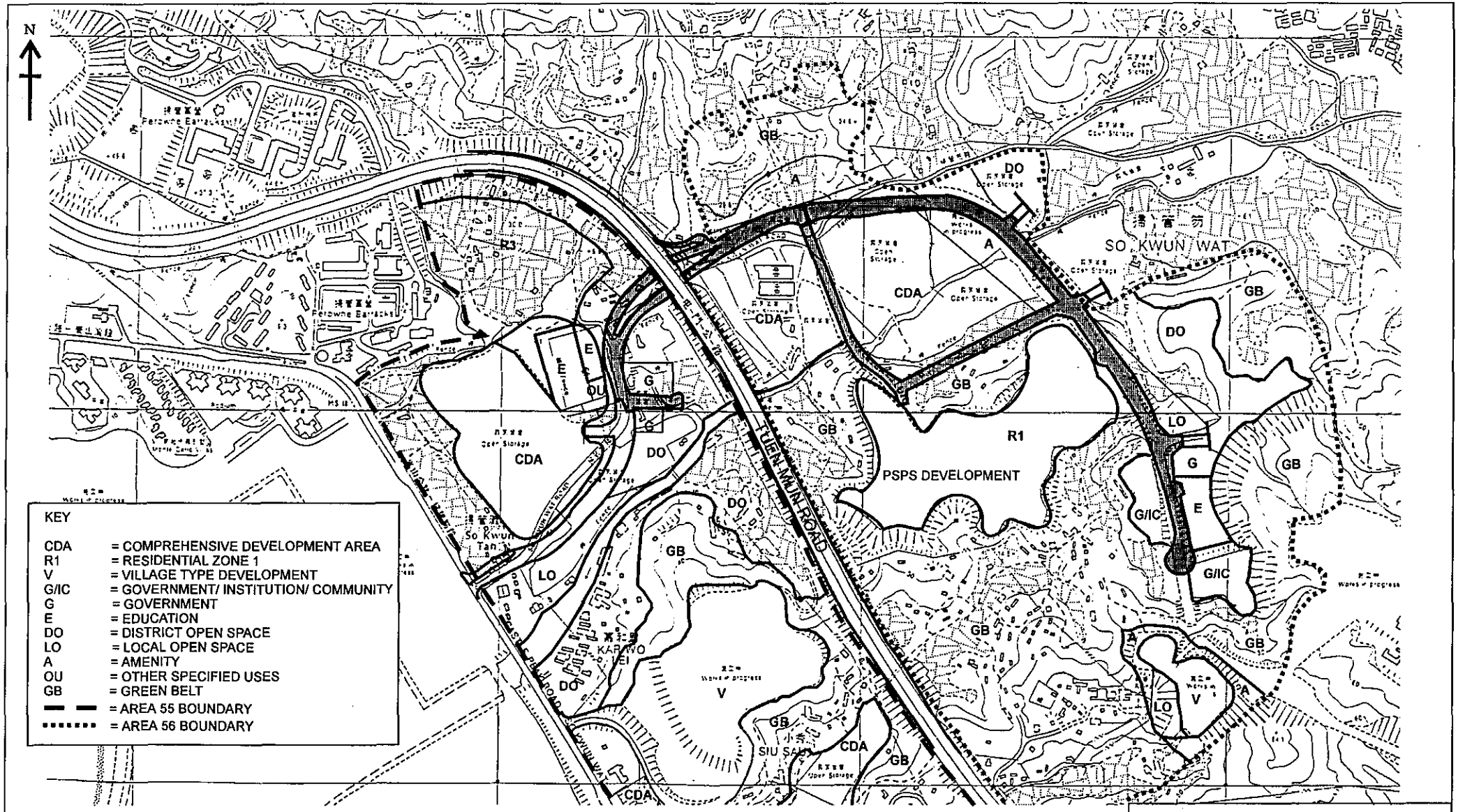

FIGURE 2.2a - ZONING OF STUDY AREA

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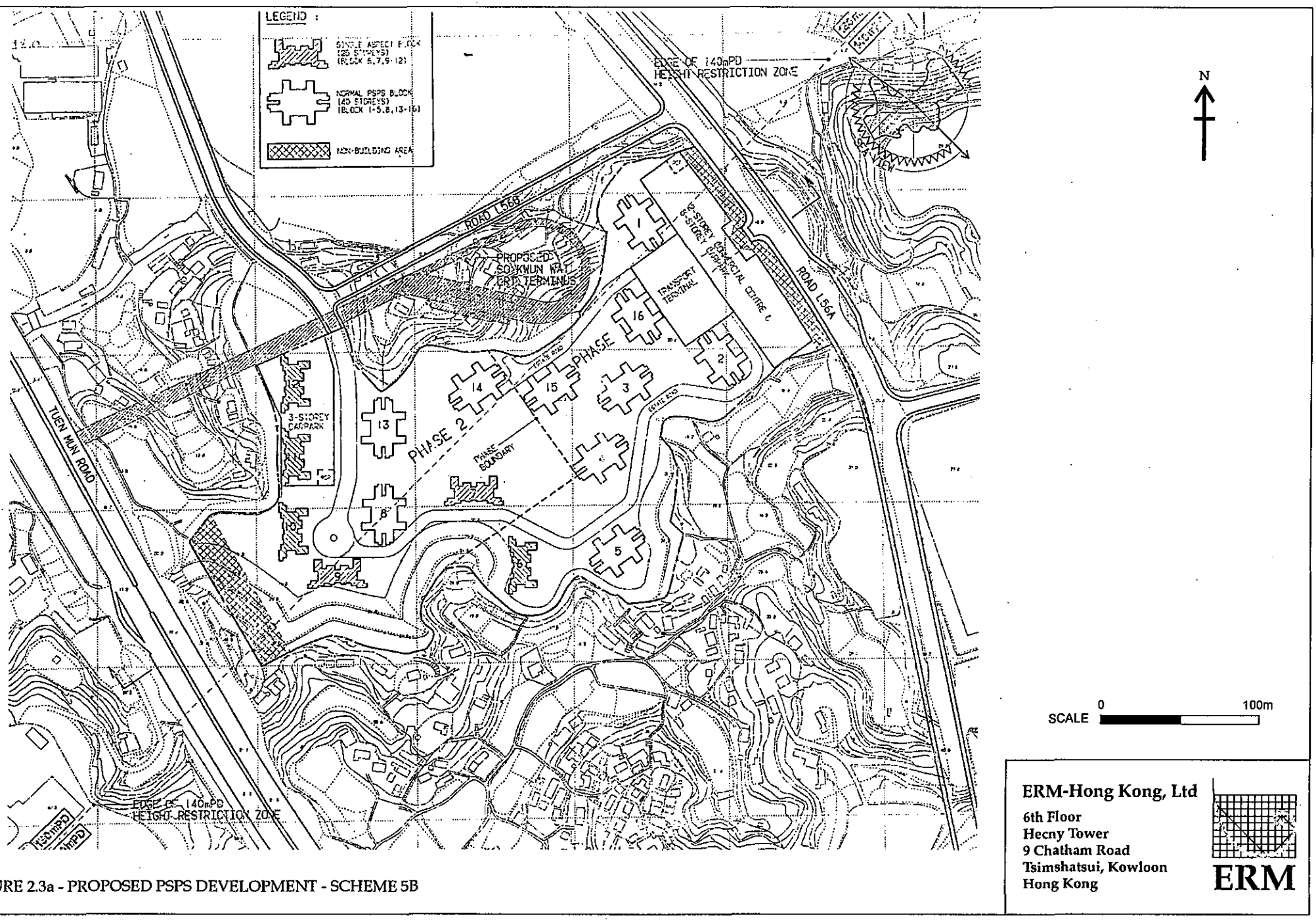

FIGURE 2.3a - PROPOSED PSPS DEVELOPMENT - SCHEME 5B

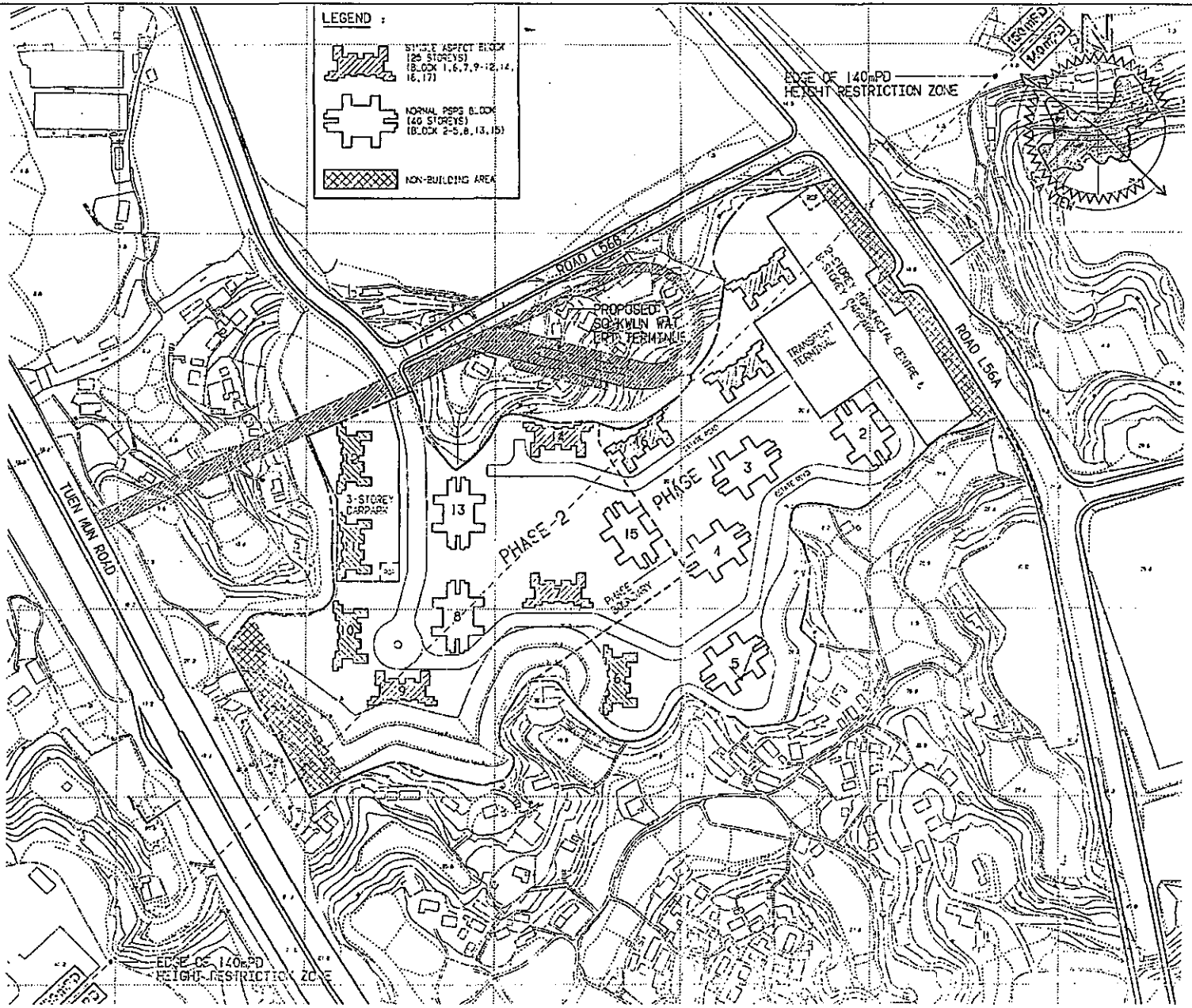

FIGURE 2.3b - PROPOSED PSPS DEVELOPMENT - SCHEME 7

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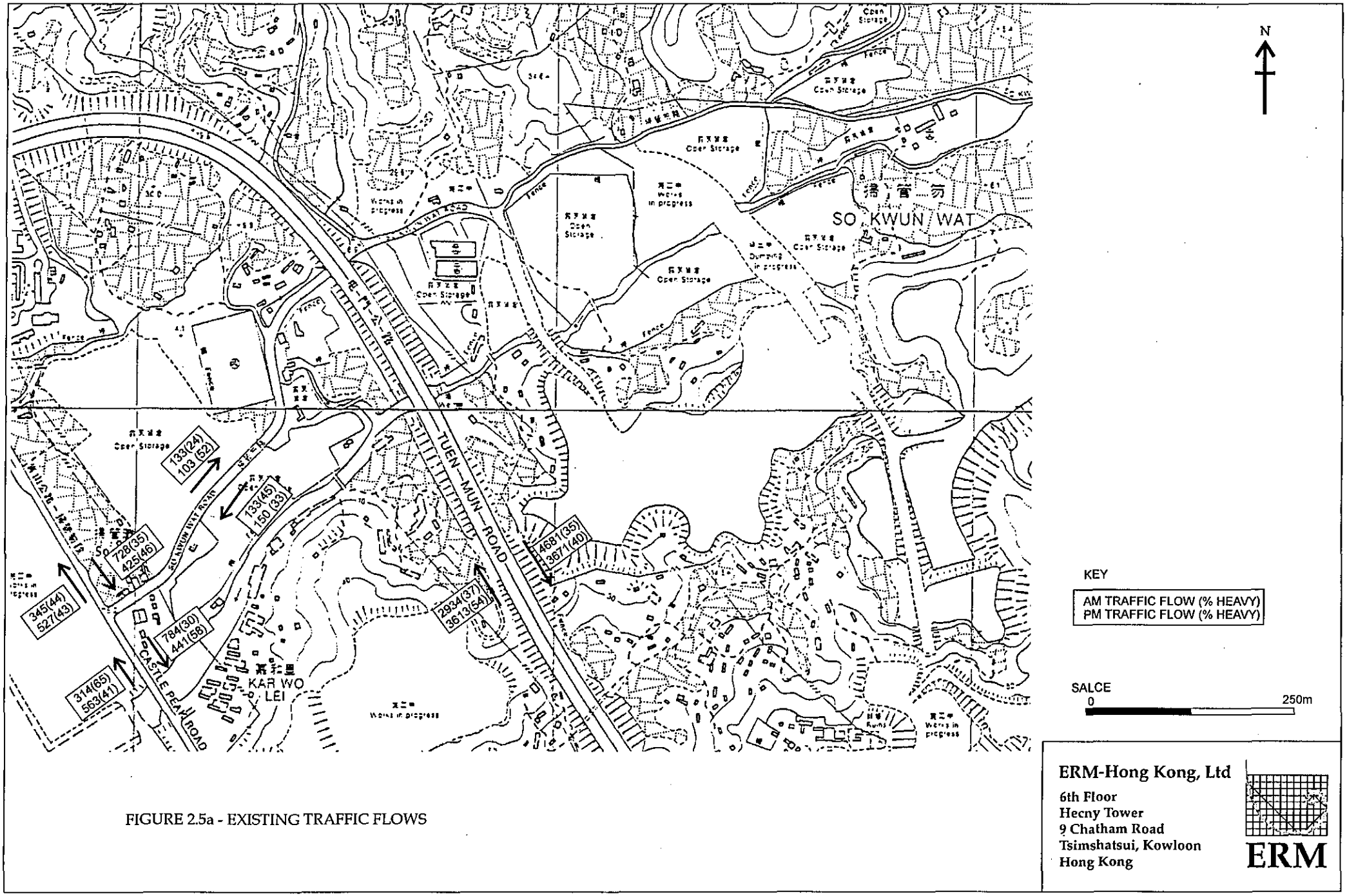

FIGURE 2.5a - EXISTING TRAFFIC FLOWS

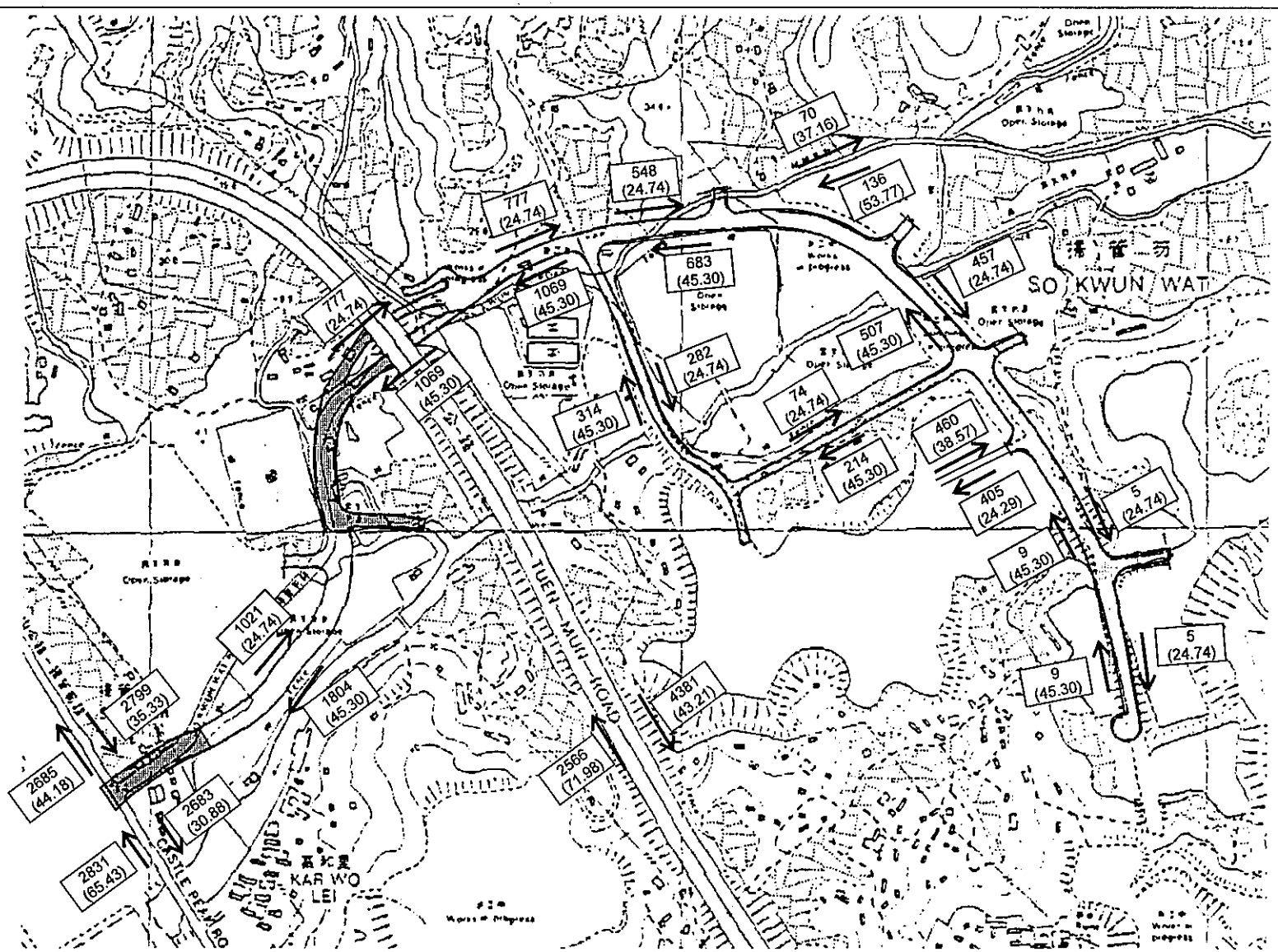

FIGURE 2.5b - PREDICTED TRAFFIC (AM PEAK) FOR 2016 (VEHICLE/HR)

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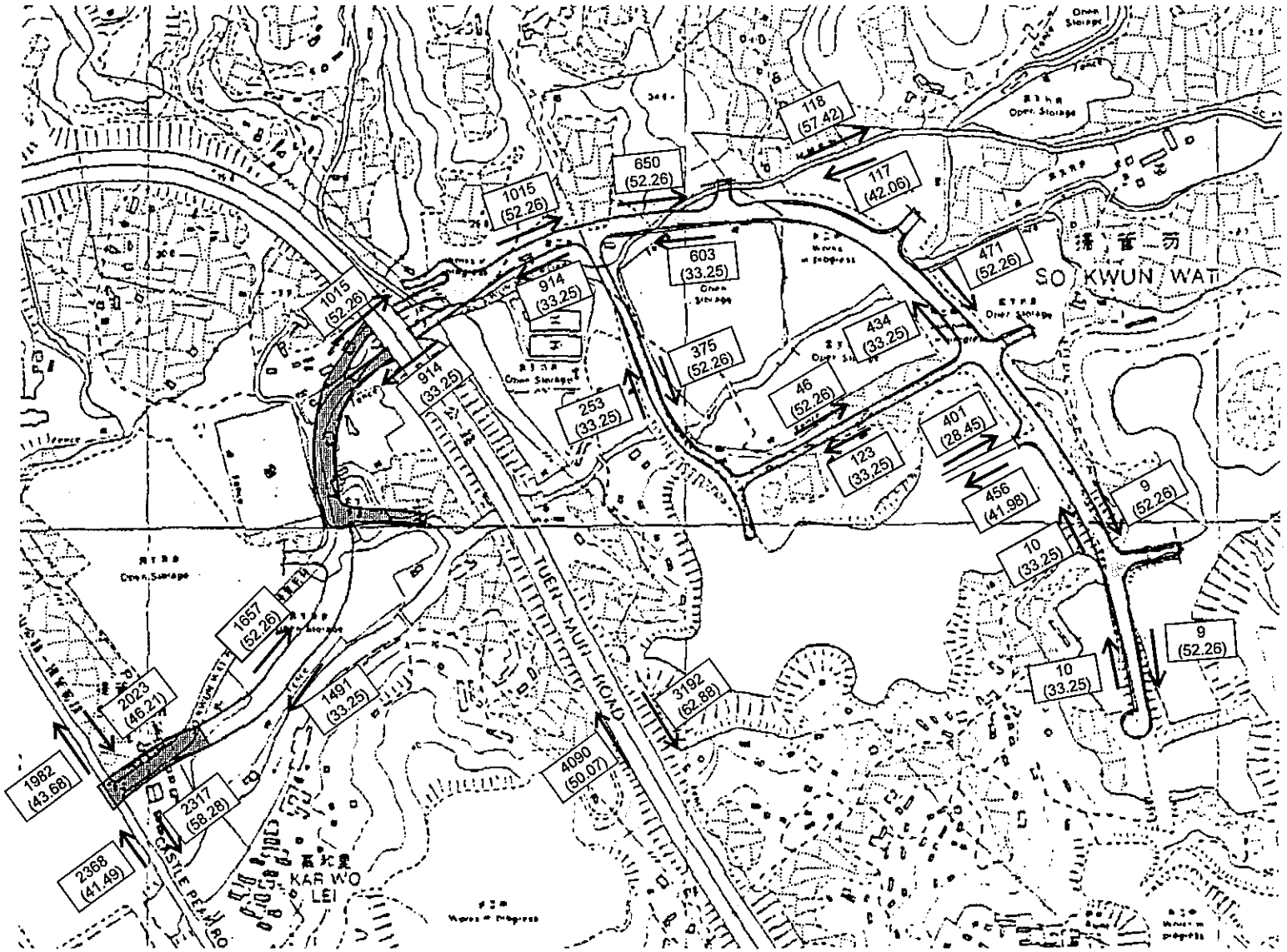

FIGURE 2.5c - PREDICTED TRAFFIC (PM PEAK) FOR 2016 (VEHICLE/HR)

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3 NOISE IMPACT

3.1 INTRODUCTION

This section assesses the potential noise impact associated with construction and operational phases. Practical mitigation measures are recommended, where necessary, to reduce the noise impacts at the nearby noise sensitive premises to acceptable levels.

3.2 GOVERNMENTAL LEGISLATION AND STANDARDS

Construction Phase

In Hong Kong the control of construction noise other than percussive piling during restricted hours (19:00-07:00 hours and all day on Sundays and Public Holidays), is governed by the Noise Control Ordinance (NCO) and the subsidiary technical memoranda namely *Technical Memorandum on Noise From Construction Work Other than Percussive Piling* (TM1). The control of percussive piling (all day) is governed by the *Technical Memorandum on Noise From Percussive Piling* (TM2). These technical memoranda prescribe the permitted noise levels for construction work depending upon working hours and the existing noise climate.

A subsidiary technical memorandum, *Technical Memorandum on Noise from Construction Work in Designated Areas* (TM3), applies to Construction Works during restricted hours, within designated areas, as defined by the Noise Control (Construction Work Designated Areas) Notice, Legal Supplement No. 2 to Gazette No. 2/1996, 12 January 1996.

TM3 covers the use of the following specified powered mechanical equipment (SPME): hand-held breaker; bulldozer; concrete lorry mixer; dump truck; and hand-held poker vibrator. The prescribed construction works are: erection of dismantling formworks or scaffolding; loading, unloading or handling or rubble, wooden boards, steel bars, wood or scaffolding material; and hammering. As the project site is within the noise control designated area, TM3 will be applicable in the event of evening and night-time working.

The construction activities of the Project should be planned and controlled in accordance with the NCO. Works requiring the use of powered mechanical equipment (PME), SPME and prescribed construction works during restricted hours will require a Construction Noise Permit (CNP) and will need to achieve the applicable Acceptable Noise Levels (ANL) as stated in the TM1 & TM3 (see *Table 3.2a & b*).

Table 3.2a *Acceptable Noise Levels for Construction Noise Other than Percussive Piling ($L_{eq, 5\,min}$ dB(A))*

Time Period	Area Sensitivity Rating "A"	Area Sensitivity Rating "B"	Area Sensitivity Rating "C"
All days during the evening (19:00-23:00 hrs) and general holidays (including Sundays) during day and evening (07:00-23:00 hrs)	60	65	70
All days during the night-time (23:00-07:00 hrs)	45	50	55

Table 3.2b *Acceptable Noise Levels for Construction Noise in Designated Areas ($L_{eq, 5\,min}$ dB(A))*

Time Period	Area Sensitivity Rating "A"	Area Sensitivity Rating "B"	Area Sensitivity Rating "C"
All days during the evening (19:00-23:00 hrs) and general holidays (including Sundays) during day and evening (07:00-23:00 hrs)	45	50	55
All days during the night-time (23:00-07:00 hrs)	30	35	40

It is anticipated that the construction works will only be undertaken within the period of 07:00 to 19:00 hours Monday to Saturday except public holidays, ie normal working hours. There are currently no legislative standards in Hong Kong for the control of construction activities during normal working hours. A limit of $L_{eq, 30min}$ 75 dB(A) for dwellings and 70 dB(A) for educational institutions (65 dB(A) during examination period) have been proposed in the *Practice Note for Professional Persons - Noise from Construction Activities - Non-statutory Controls, Environmental Protection Department, June 1993* (ProPECC PN2/93) for Noise Sensitive Receivers (NSRs) and will be adopted in this assessment in order to protect NSRs to an appropriate extent.

There are further subsidiary regulations, *Noise Control (Hand Held Percussive Breakers) Regulations* and *Noise Control (Air Compressors) Regulations* controlling the noise from hand held breakers and air compressors which require compliance with the relevant noise emission standards and the fixing of *Noise Emission Labels* to the plant (i.e. 114 dB(A) for hand-held breakers and 109 dB(A) for air compressors).

Percussive piling is only permitted within the constraints of a CNP. TM2 sets out the requirements for working under a CNP and determination of the permitted hours of operations and other conditions, where necessary. Percussive piling is prohibited during the restricted periods unless specifically exempted. ANLs for percussive piling are set out in TM2 and are dependent on the type of NSR. The ANLs for daytime percussive piling are presented in *Table 3.2c*.

Table 3.2c *Acceptable Noise Levels for Daytime Percussive Piling*

Type of Receptor	Acceptable Noise Level (dB(A))
Noise Sensitive Receiver (NSR) with no windows or other openings	100
NSR with central air conditioning systems	90
NSR with windows or other openings but without central air conditioning system	85

It should be noted that for hospitals, clinics, schools, courts of law or other particularly sensitive receivers, the ANL is 10 dB(A) below that quoted in *Table 3.2c*.

The permitted hours of operations are determined by comparing the Corrected Noise Level (CNL) and the ANL at the NSR. *Table 3.2d* presents the permitted hours of operation for the use of hydraulic percussive piling machine. According to TM2, a more stringent criterion will be applied to the use of diesel, pneumatic and steam hammer pile drivers. However, it is understood that only the hydraulic pile drivers will be used in this Project and the more stringent criterion would not be applicable in this assessment.

Table 3.2d ***Permitted Hours of Operation for the Carrying Out of Piling Work Not Involving the Use of Diesel, Pneumatic and/or Steam Hammers***

Amount by which CNL exceeds ANL	Permitted hours of operation on any day note being a holiday
more than 10 dB(A)	08:00 to 09:00 AND 12:30 to 13:30 AND 17:00 to 18:00 hours
between 1 dB(A) and 10 dB(A)	08:00 to 09:30 AND 12:00 to 14:00 AND 16:30 to 18:00 hours
no exceedance	07:00 to 19:00 hours

Operational Phase

Traffic noise impacts are assessed against the Hong Kong Planning Standards and guidelines (HKPSG) noise levels of $L_{10, peak\ hour}$ 70 dB(A) for residential area and $L_{10, peak\ hour}$ 65 dB(A) for education institutions, 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 HKPSG levels are considered to constitute significant impacts and practicable direct mitigation measures will be recommended in order to alleviate the noise impact to acceptable levels.

In cases where practical direct mitigation are not available or the identified measures cannot provide adequate protection, provision of indirect technical remedies in the form of acoustic insulation and air-conditioning for existing residential dwellings should be considered under the ExCo directive "Equitable Redress for Persons Exposed to Increased Noise Resulting from the use of New Roads". The eligibility for indirect technical remedies should be tested against the following three criteria and recommendations should be presented to ExCo for approval.

i) The predicted overall noise level from the new road together with other traffic noise in the vicinity must be above a specified noise level (eg, $L_{10, peak\ hour}$ 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; ie the total traffic noise level existing before the works to construct or improve the road were commenced; and

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

For the purpose of this Study, all roads are described as either:

- 'existing' which are unchanged by the proposed project except for possibly taking additional traffic (ie Tuen Mun Road, Castle Peak Road and roadworks by other project); or

- 'new' which in the context of this report describes all roads that are completely new or are substantially altered by the proposed project (eg when an existing road section undergoes major modification which will directly result in 25% increase in lanes or substantial changes in alignment or characters).

The 'new' road adopted for this Study are shown in *Figure 3.2a*.

3.3 *IDENTIFIED NOISE SENSITIVE RECEIVERS*

Existing Noise Sensitive Receivers (NSRs) in the vicinity of the Study Area, as defined by the HKPSG, are scattered low rise village type houses, typically two to three storeys high. There are three committed future developments within the Study Area, Area 56 PSPS housing development, a primary school in Area 56 and a comprehensive development area (CDA) in TMTL 374, Tuen Mun Area 55 located to the north of Castle Peak Road and So Kwun Wat Road junction. Other potential future developments planned include a low density residential (R3) development in Area 55 located to the west of Tuen Mun Road and So Kwun Wat Road intersection; two Educational areas in Area 55 and two CDA sites in Tuen Mun Area 56. Although layout plans for these potential developments are unavailable at this stage, operational noise levels will be predicted at 10m from the site boundary to provide an indication of the likely noise impacts at these development (see *Figure 3.3a*).

It is expected with the future development of planned landuse, the scattered low rise village houses will be resumed. However as there are no definite time schedule for these developments, all the existing NSRs are assumed to be present.

As discussed in *Section 2*, on site mitigation measures have been assumed for the CDA site at TMTL 374 to protect road traffic noise from Castle Peak Road and So Kwun Wat Road. Hence, it is anticipated that the Alignment would not cause adverse impacts to this site.

Representative existing and planned NSRs within the Study Area based on recent site visits and layout plans (Plan No. L/TM 55/A & L/TM 56/1) are shown in *Table 3.3a* and *Figures 3.3a to b*.

Table 3.3a *Location of Worst Case Representative Noise Sensitive Receivers*

NSRs	Sensitive Use	Representative Floors	mPD of Assessment Point (m)	No of dwellings represents by NSR
Existing Use				
N1 Low rise village type house	Residential	1st/2nd/3rd	4.8/7.8/10.8	3
N2 Low rise village type house	Residential	1st/2nd/3rd	4.7/7.7/10.7	3
N3 Low rise village type house	Residential	1st/2nd/3rd	4.8/7.8/10.8	3
N4 Low rise village type house	Residential	1st/2nd	4.8/7.8	2
N5 Low rise village type house	Residential	1st/2nd	4.8/7.8	2
N6 Low rise village type house	Residential	1st/2nd/3rd	4.6/7.6/10.6	3
N7 Low rise village type house	Residential	1st/2nd/3rd	4.6/7.6/10.6	3
N9 Low rise village type house	Residential	1st/2nd	6.8/9.8	6
N10 Low rise village type house	Residential	1st/2nd	6.8/9.8	2
N11 Low rise village type house	Residential	1st/2nd	17.9/20.9	2
N12 Low rise village type house	Residential	1st/2nd	23.4/26.4	2
N13 Low rise village type house	Residential	1st/2nd	23.4/26.4	2
N14 Low rise village type house	Residential	1st/2nd	8.3/11.3	2
N15 Low rise village type house	Residential	1st/2nd	8.3/11.3	2
N16 Low rise village type house	Residential	1st/2nd/3rd	5.9/8.9/11.9	3
N17 Low rise village type house	Residential	1st/2nd/3rd	5.9/8.9/11.9	3
N18 Low rise village type house	Residential	1st/2nd	9.4/12.4	2
N19 Low rise village type house	Residential	1st/2nd	21.4/24.4	2
N20 Low rise village type house	Residential	1st/2nd	15.4/18.4	2
N21 Low rise village type house	Residential	1st/2nd	15.4/18.4	2
N22 Low rise village type house	Residential	1st/2nd	30.4/33.4	2
N23 Low rise village type house	Residential	1st/2nd	31.4/34.4	2
N24 Low rise village type house	Residential	1st/2nd	23.4/26.4	2
N25 Low rise village type house	Residential	1st/2nd	23.4/26.4	2
N26 Low rise village type house	Residential	1st/2nd	19.4/22.4	2
N27 Low rise village type house	Residential	1st/2nd	11.4/14.4	2
N28 Low rise village type house	Residential	1st/2nd/3rd	4.8/7.8/10.8	6
Planned Landuses				
School site 1 in Area 55	Education	1st/6th	11.2/28.5	-
School site 2 in Area 55	Education	1st/6th	11.2/28.5	-
CDA site 1 in Area 56	Residential	1st/10th	13.9/39.1	-

NSRs	Sensitive Use	Representative Floors	mPD of Assessment Point (m)	No of dwellings represents by NSR
CDA site 2 in Area 56	Residential	1st/10th	13.9/39.1	-
PSPS site in Area 56	Residential	1st/20th/40th	25.9/79.1/130	-
School site 3 in Area 56	Education	1st/6th	35.6/52.6	-

3.4 CONSTRUCTION NOISE IMPACTS

3.4.1 *Assessment Methodology*

A methodology for assessing construction noise other than percussive piling has been developed based on TM1. In general, the methodology is as follows:

- locate representative NSRs that may affected by the works;
- calculate distance attenuation to NSRs from the notional noise source point position; and
- predicted construction noise levels at NSRs in the absence of any mitigation measures.

The distance correction for each NSR with respect to each construction activity is calculated from the distance between the NSR and the worksite notional point. The notional point is established in accordance with TM1.

If the predicted construction noise levels are exceeded at NSRs, mitigation measures will be considered. A re-evaluation of the total SWL for activities will be made assuming the use of practical mitigation measures such as silenced PME, movable barriers and reducing the number of noisy plant working simultaneously.

For noise from percussive piling, a methodology for assessing percussive piling has been based on TM2. The CNL at the NSRs is calculated and the permitted hours of operation are determined by the amount by which the CNL exceeds the ANL.

3.4.2 *Source of Impact*

The construction sites could be separate into two main areas, the junction improvement at So Kwun Wat Road and Castle Peak Road and the construction of roads and drains for So Kwun Wat Road.

Based on available information, seven main construction activities associated with the construction of the junction improvement and construction of roads and drains have been identified. It is expected that each construction activities will be carried out at different stages, and hence no cumulative impacts are assumed.

- site clearance;
- storm drains construction;

- at grade road widening and/or formation;
- box culvert construction;
- retaining wall;
- vehicular underpass; and
- road pavement and finishes.

Each construction activities will involve the use of different PME. An assumed plant inventory has been identified and is summarized in *Annex B (Table B1)*, together with SWLs obtained from TM1. The use of hydraulic hammer steel sheet pile driver has been assumed for the construction of box culvert.

3.4.3 *Evaluation of Impacts*

Non - Percussive Piling Construction Works

The area sensitivity rating for the worst case representative NSRs has been assigned in accordance with TM1 and are presented in *Table 3.4a* below.

Table 3.4a ***Area Sensitivity Ratings for Identified NSRs***

NSRs	Influencing Factors	Area Sensitivity Ratings
N1	No influencing factors	A
N6	No influencing factors	A
N9	Indirectly affected by Tuen Mun Road (AADT 1996: 102,790)	B
N12	Indirectly affected by Tuen Mun Road (AADT 1996: 102,790)	B
N14	No influencing factors	A
N18	No influencing factors	A
N20	No influencing factors	A
N22	No influencing factors	A

The unmitigated predicted noise levels at the worst case representative NSRs for each construction stage have been predicted and are shown in *Table C1 (Annex C)*. Only the NSRs with direct line of sight to the appropriate construction activity are included in this assessment and no correction for screening is applied to the predicted noise levels.

Owing to the proximity of the construction activities, all NSRs are exposed to high levels of construction noise, up to 93 dB(A). Mitigation measures are therefore required for all NSRs in order to alleviate the noise impacts during the construction phase.

Percussive Piling

Table C2 (Annex C) shows that noise levels up to 80 dB(A) are predicted at the worst case representative NSRs. *Table 3.2c* indicates that the ANL for NSRs with openable windows is 85 dB(A). The predicted noise levels at all NSRs are within the NCO criteria. The permitted hours of operation on any day, other than a general holiday, will therefore be from 07:00 to 19:00 hours, ie. twelve hours per day.

3.4.4 *Mitigation Measures*

Recommended Mitigation Measures

Mitigation measures for each construction site are detailed below, and the following forms of mitigation are recommended and should be incorporated into the Contract Specifications:

- good site practice to limit noise emissions at source;
- selection of quieter plant and working methods; and
- reduction in number of plant operating in critical areas close to NSRs.

General Mitigation Measures

The Contractor may develop a different package of mitigation measures to meet the required noise standards, but the following illustrates one such package to demonstrate an approach to mitigation that would be adequate.

Good Site Practice

Good site practice and noise management can considerably reduce the impact of the construction sites' 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 (such as trucks, excavators) 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 so that the noise is directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction works; and
- mobile plant should be sited as far away from NSRs as possible.

Selecting Quieter Plant and Working Methods

The Contractor may be able to obtain particular models of plant that are quieter than standard types given in TM1. The benefits achievable in this way will depend on the details of the Contractor 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 sound power level 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 valued specified in TM1 for the same piece of equipment. Examples of SWLs for specific silenced PME, which are known to be used, are given below:

Bulldozer:	100 dB(A) max;
Breaker (Hand):	110 dB(A) max;
Compressors:	100 dB(A) max;
Concrete Pumps:	105 dB(A) max;
Dump Truck:	110 dB(A) max;
Excavator:	105 dB(A) max;
Generator:	100 dB(A) max;
Lorry:	105 dB(A) max;
Loader:	105 dB(A) max; and
Poker Vibrator:	110 dB(A) max.

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

With the above quiet plant substituted in the equipment inventories given in *Table B2* (*Annex B*), the mitigated noise levels at each NSR would be as shown in *Table C2* (*Annex C*).

With the use of the above quiet plant, the noise levels could be reduced by 3 to 10 dB(A), depending on the type of construction activities operating. The construction noise levels at the NSRs have generally been reduced.

However for the construction of junction improvements, high levels of construction noise impacts, in the region of 81 to 84 dB(A), are predicted at the NSRs (NSRs N1 & N6) during all construction activities.

For the construction of roads and drains, high levels of construction noise levels, up to 76 to 88 dB(A), are still predicted at the nearby NSRs (NSRs N9, N12, N14, N18, N20 & N22) during all construction stages except for the retaining wall and vehicular underpass (open cut) construction activities.

Further mitigation measures are therefore necessary to alleviate the noise impacts.

Reducing the Numbers of Plant Operating in Critical Areas Close to NSRs

For NSRs adjacent to the junction improvement, it has already been assumed that only a limited number of plant could work simultaneously on the worksite area (see *Table B1*). However, exceedances of the daytime noise criteria, up to 9 dB(A), are still predicted at NSRs N1 and N6. Further mitigation measures are therefore essential to protect these NSRs from adverse construction noise impacts.

In general the number of plants should be left to the choice of the Contractor. However, in some cases it may be appropriate to restrict the number of particularly noisy plant operating within certain parts of the site that are very close to the NSRs. The effect of limited the number of plants working concurrently have been investigated and the results are presented in *Table C3*.

Results indicated that with the incorporation of quiet plant and limited the number of plant operating concurrently, the noise impacts from the site clearance activities could be mitigated to comply with the daytime construction noise criteria at all NSRs. However, exceedances of the daytime construction noise criteria, in the region of 4 to 12 dB(A), are still predicted at all NSRs (NSRs N9,

N12, N14, N18, N20 and N22) during the at grade road widening, storm drains, box culvert, vehicular underpass (tunnelling method) and road pavement construction activities. Further mitigation measures are therefore necessary.

Constructing Temporary Noise Barriers

In general, vertical noise barriers between 3m to 5m high located along the site boundaries between noisy construction activities and NSRs could give up to 5 dB(A) reduction from screening (estimated in accordance with TM1).

Owing to the low rise nature and site geometry of NSRs adjacent to the road junction improvement, NSRs N1 and N6, a 5 dB(A) reduction is considered to be achievable by using 5m high temporary noise barrier, in the form of site hoardings, located along worksite boundary. Predicted noise levels indicated that with the incorporation of quiet plant and temporary noise barriers, NSR N6 is within the daytime construction noise criteria (see *Table C4*). However exceedances of the daytime construction noise criteria, in the region of 1 to 4 dB(A), are still predicted at NSR N1 during all construction stages. Summary of the noise exceedances are presented in *Table 3.4b* below.

Based on the site geometry, other NSRs in the vicinity of the Alignment construction are not expected to be protected by the use of temporary noise barriers located along site boundaries. However, movable barriers could be very effective in providing noise screening from a particular plant. It is anticipated that a 3m high movable noise barrier with a skid footing and a small cantilevered upper portion can be located with a few meters of static plant and within about 5m of more mobile plant such as excavators, bulldozers, loaders, etc. It is estimated that movable noise barrier of this type, if carefully located, can produce at least 10 dB(A) screening for static plant and 5 dB(A) for mobile plant. The noise screening benefit for each plant considered in this assessment is listed as follows:

- stationary plant - assuming 10 dB(A) reduction: vibratory poker, compressor, concrete pump, drilling rigs, generator, various hand tools; and

- mobile plant - assuming 5 dB(A) reduction: bulldozer, excavator, scraper, grader, truck, roller, asphalt paver, loader and crane.

The predicted noise levels for NSRs N9, N12, N14, N18, N20 and N22 incorporating the use of quiet plant and movable noise barriers are presented in *Table C4*. Results indicated that with the incorporation of the above mitigation measures, the noise impacts from the box culvert construction could be mitigated to comply with the daytime construction noise criteria at all NSRs.
However, predicted results indicate that for NSRs that are in proximity of the worksite areas, exceedances of the noise criteria (ie NSRs N9, N14, N18, N20 and N22), in the region of 1 to 10 dB(A), are still predicted at all NSRs during the at grade road widening, storm drains construction, vehicular underpass (tunnelling) and road pavement construction activities.

As can been seen from *Table C4*, the use of the above described mitigation measures are insufficient in reducing the construction noise levels at NSRs to below the daytime noise criteria. These predictions however, represent the theoretically worst possible scenario, but are in fact unlikely as it would required all noisy plant to be operating concurrently at the nearest notional point of each works area (all worksite areas are long and thin) to the NSRs, and to all be fully

active at exactly the same time. However, it is possible that these levels of impact, or impacts approaching these, could occur at for a short duration. Summary of the noise exceedances are presented in *Table 3.4b* below.

Table 3.4b *Predicted Noise Levels - with mitigation measures ($L_{eq,\ 30\ min}$ dB(A))*

NSR	Construction Activities	Predicted Noise Levels	Duration (Month)
Junction Improvement			
N1	Site clearance	77	3
	At grade road widening	79	2
	Storm drains construction	78	1
	Road pavement and finished	76	1
Construction of Alignment			
N9	At grade road widening	85	3
	Storm drains construction	81	2
	Vehicular underpass (tunnelling)	77	4
	Road pavement and finishes	80	1
N14	At grade road widening	80	3
	Storm drains construction	76	2
	Road pavement and finishes	76	1
N18	At grade road widening	81	3
	Storm drains construction	77	2
	Road pavement and finishes	76	1
N20	At grade road widening	84	3
	Storm drains construction	80	2
	Road pavement and finishes	79	1
N22	At grade road widening	76	3

It has been assumed in the assessment that each construction stage would last for 4 months at each works area. However, it is expected not all noisy plant assumed in this assessment would be operating concurrently during the full construction period at the nearest notional point of each works area. Therefore, the duration or the levels of noise impact at the affected NSRs listed in *Table* 3.4*b* only present the theoretically worst possible scenario.

Therefore additional mitigation measures such as avoidance of simultaneous noisy activities and further reduction in the numbers of plant teams operating in critical areas close to NSRs may be required from time to time. Since it is difficult to provide quantitative predictions for these effects and to identify when they will occur, regular monitoring of noise at the NSRs reported in *Table C4*, will be required during the construction phases. This will enable the contractor to react if the assessment criteria are approached and to reduce noise emission at specific areas.

If there is any construction work during the restricted hours, it is the

responsibility of the contractors to comply with NCO and relevant TMs. The contractor should submit CNPs application and will be assessed by the Noise Control Authority. Conditions stipulated in CNPs should be strictly followed.

A summary of the recommended mitigation measures for each construction activities are summaries in *Table 3.4c & d* below.

Table 3.4c ***Summary of Proposed Mitigation Measures for Junction Improvement***

Task	Mitigation Measures
Site clearance	Use of quiet plant, reducing the number of each type of PME to one unit, installation of 5m hoarding along site boundary and EM&A monitoring
At grade road widening	Use of quiet plant, reducing the number of each type of PME to one unit, installation of 5m hoarding along site boundary and EM&A monitoring
Storm drains construction	Use of quiet plant, reducing the number of each type of PME to one unit, installation of 5m hoarding along site boundary and EM&A monitoring
Road pavement and finishes	Use of quiet plant, reducing the number of each type of PME to one unit, installation of 5m hoarding along site boundary and EM&A monitoring

Table 3.4d ***Summary of Proposed Mitigation Measures for Construction of Alignment***

Task	Mitigation Measures
Site clearance	Use of quiet plant and reducing the number of each type of PME to one unit
At grade road widening	Use of quiet plant, reducing the number of each type of PME to one unit, the use of movable noise barrier and EM&A monitoring
Storm drains construction	Use of quiet plant, reducing the number of each type of PME to one unit, the use of movable noise barrier and EM&A monitoring
Box culvert construction	Use of quiet plant, reducing the number of each type of PME to one unit and the use of movable noise barrier
Retaining wall	Use of quiet plant
Vehicular underpass (open cut)	Use of quiet plant
Vehicular underpass (tunnelling method)	Use of quiet plant, reducing the number of each type of PME to one unit, the use of movable noise barrier and EM&A monitoring
Road pavement and finishes	Use of quiet plant, reducing the number of each type of PME to one unit, the use of movable noise barrier and EM&A monitoring

3.4.5 *EM&A Requirements*

It is recommended that noise monitoring be carried out during the construction period of the Project at NSRs N1, N9, N14, N18, N20 and N22. The monitoring is required to ensure compliance with the ProPECC guidelines in providing feedback to the Contractors for the management of their operations. The EM&A programme for the Project has been developed and is presented in *Section 7*.

3.5 OPERATIONAL NOISE IMPACTS

3.5.1 *Assessment Methodology*

The surrounding road scheme was divided up into 103 road segments, each of which was assigned one of 21 road layouts. A road layout defines the road width, surface type, traffic conditions and (if applicable) the height and location or roadside barriers. The segmentation process was carried out in accordance with Calculation of Road Traffic Noise (CRTN) procedures and the noise model was built using the HFANoise traffic noise model which fully implements CRTN procedures and methodologies. Hard ground as defined in CRTN was assumed throughout the Study Area except for vegetated areas. All other features that could add noise screening or reflection to the modelling process were included.

The peak hour traffic flows, for both the year 1997 and 2016, including the percentage of heavy vehicles are shown in *Figures 2.5a* and *2.5b & c* respectively. The latter is the worst case year scenario within 15 years after the commissioning of the Alignment. Traffic speeds of 50 kph at all roads have been assumed in this assessment except for Tuen Mun Road where traffic speed of 70 kph is adopted.

The predicted road traffic noise levels at the identified NSRs have been compared with the HKPSG criteria of $L_{10, \text{peak hour}}$ of 70 dB(A) for residential use and 65 dB(A) for educational institutions.

3.5.2 *Evaluation of Impacts*

The unmitigated predicted noise impacts at the NSRs with the operation of proposed Alignment are present in *Annex D* (*Table D1*).

As indicated in *Table D1*, the noise levels at NSRs N4, N5, N10, N11 and N12 are dominated by road traffic noise from the existing road network (Tuen Mun Road, Castle Peak Road or roadworks by other projects). The noise levels from the existing road will already exceed the HKPSG $L_{10, \text{peak hour}}$ 70 dB(A) noise limits. *Table D1* indicates that the noise contribution from the Alignment are in general 8 to 15 dB(A) below the existing road networks. These NSRs are therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on the Alignment.

For other existing NSRs assessed in the vicinity of the Alignment (NSRs N 1 to N3, N6, N7, N9, N13 to N18), results indicate that exceedance of the HKPSG criteria, in the region of 1 to 9 dB(A), are predicted. Therefore, mitigation measures will be necessary to alleviate the noise impacts from the Alignment.

For the NSRs located near the end of the Alignment (NSRs N20-N24), the unmitigated noise levels are also within the HKPSG $L_{10, \text{peak hour}}$ 70 dB(A) criteria. Hence, mitigation measures are not required and these NSRs are excluded from the following assessment.

For the committed primary school in Area 56, the unmitigated noise levels are within the HKPSG $L_{10, \text{peak hour}}$ 65 dB(A) criteria (see *Figure 3.5a & c*). Mitigation measures are therefore not required.

For the PSPS housing development, the unmitigated noise levels at 10m from the site boundary have been predicted for the low, mid and top floor receivers.

Predicted results indicate that the unmitigated noise levels of this development is in the region of 62 to 77 dB(A) (see *Figure 3.5 a to c*). Although exceedances of the HKPSG noise criteria are predicted at the mid and top floor receivers of the southern, western and northern facades, the noise levels at these locations are dominated by road traffic noise from the existing road network (Tuen Mun Road and Castle Peak Road).

For the future planned developments, two CDA sites in Area 56, the unmitigated noise levels at 10m from the site boundary of these developments are in the region of 67 to 84 dB(A). For the CDA Site 1, located west of Road L56B, the southern, western and northern facades are dominated by road traffic noise from the existing road network, Tuen Mun Road (noise contribution from Tuen Mun Road alone is in the region of 72 to 81 dB(A)). For the CDA Site 2, located east of Road L56B, the western facade are dominate by both the Alignment and the distance Tuen Mun road (noise contribution from Tuen Mun Road and Alignment are in the region of 73 to 75 and 73 to 74 dB(A) respectively) (see *Figure 3.5a & c*).

The northern and western facade of the two schools in Area 55 are dominate by road traffic noise from the existing road network, Tuen Mun Road (noise contribution from Tuen Mun Road alone is in the region of 75 to 83 dB(A)). For facades facing the Alignment, the NSRs are dominate by both the Alignment and the distance Tuen Mun Road (noise contribution from Tuen Mun Road and Alignment are in the region of 76 to 80 and 72 to 80 dB(A) respectively) (see *Figures 3.5a & c*).

3.5.3 *Mitigation Measures*

Direct Mitigation Measures

The assessment in the above section indicates that the areas adjacent to the Castle Peak Road and So Kwun Wat Road Junction, along Road L56B and area to the north of Road B1 will be affected by the Alignment. Therefore, mitigation measures will be necessary to alleviate the noise impacts from the Alignment.

A number of ingress and egress would have to be provided for each planned landuse area:

- at least one ingress and egress along Road B11 for the school area in Area 55, located between the proposed school site and substation area;
- two ingress and egress along Road L56B for the two CDA sites; and
- a new ingress and egress will be provided along Road B1, giving an access point for the existing open storage area.

Although the exact designs of these ingresses and egresses are not confirmed yet, the most practicable locations of these ingress and egresses are shown in *Figure 3.5d*, taking into consideration of highway design and road safety. As Road B1 and Road L56B are on embankment, the ingresses and egresses are located where safe road gradient is maintained with the vertical height differences between the road and the CDA sites minimised. In addition, in terms of traffic safety, location of ingress/egress is preferred to be located away from main road junctions.

3m and 5m high noise barriers located at 1m from the roadside carriageway are considered to be the maximum practicable height for local roads (Road L56B & L56A) and district distributor (Road B1, B11 & B12) respectively. As required by Transport Department and Highways Department, visibility splays and sight lines at road junctions must comply with the requirements in Chapters 3 & 4 of the Transport Planning and Design Manual (TPDM). It is stated that a minimum sight line of 70m is required for a junction or a curved section with a speed limit of 50 kph. The use of barriers at 1m from road carriageway would therefore have to stop short at these junction approximately 70m away. Alternatively, if noise barriers are located at back of footpath (ie 2m from road kerb), the use of barriers would have to be stop short at these junctions approximately 50m away. It is expected that if the distance between the roadside barrier and the road are increased, the sight line clearance could be reduced.

In order to allow for sight line constraint, a minimum setback distance of 10m is required between the roadside noise barrier and road kerb. As the width of the footpath along Road B11 is limited by the spacing between the alignment and the proposed open channel, widening of the footpath is not considered to be feasible near the school sites in Area 55. In addition, to maintain safe slope stability, the embankment could not be further widened without additional land take. Since the site area for the CDA sites have already been defined, the widening of the embankment is therefore considered to be impracticable. Hence, the use of 3m or 5m high roadside noise barriers is not recommended.

Therefore, owing to sight line safety constraints as illustrated in *Figure 3.5e*, mitigation measures in the form of barrier will be extremely limited. The only feasible location is a 5m high roadside noise barrier located at 1m from roadside carriageway along Road B1 for the protection of NSRs N13(see *Figure 3.5f* in *Annex D*). The predicted noise levels for the worst affected NSRs N13 with the 5m barrier are shown in *Annex D* (*Table D2*). Owing to the difference in elevation of the NSR and Road B1 (approximately 22m difference), results indicated that the effect of the 5m high roadside noise barrier along Road B1 for NSR N13 are not acoustically effective in reducing the noise levels from the alignment (the overall noise reduction from the noise barrier is less than 1 dB(A)). In view of the above conditions, this barrier is not recommended.

The benefit of a 0.8m high roadside noise barrier located at 0.5m from kerbside have also been investigated, as such barriers are not constrained by sight line requirement as discussed above. *Figure 3.5g* shows the location of 0.8m barrier tested and the predicted noise levels for the existing and planned NSRs with the are shown in *Annex D* (*Tables D3 & 4*).

For the existing NSRs in the vicinity of the Castle Peak Road/So Kwun Wat Road Junction (N1 to N3, N6, N7 & N28), total noise reduction of up to 4 dB(A) will be achieved with the use of 0.8m high roadside noise barrier. However, due to the close proximity of N1 & N28 (approx 5m from road kerb), noise reduction from the 0.8m high barriers for top floor receivers are limited.

For the NSRs located near Road B11 (N9 & 10), noise reduction of 1 to 2 dB(A) will be achieved with the use of 0.8m high roadside noise barrier. However, due to the close proximity of the NSRs to the Alignment (approx 5m from road kerb), total noise reduction from the 0.8m high noise barriers for top floor receivers are limited.

As discussed in *Section 3.5.2*, the noise levels at N11 & N12 are dominated from

Tuen Mun Road, therefore the noise benefit of the 0.8m noise barrier are limited.

For N25 & N26, noise reduction of 4 dB(A) will be achieved.

As the elevation of N13 is higher than the Alignment by approximately 12m, noise reduction from the 0.8m high barrier at N13 is limited.

For N14 & N15, total noise reduction of up to 3 to 5 dB(A) will be achieved with the use of 0.8m high roadside noise barrier.

The existing NSRs located within the future CDA site (NSRs N16 to 18) will benefit from the 0.8m high noise barrier. Total noise reduction of 3 to 7 dB(A) will be achieved.

As shown in *Table D3*, low level receivers of the planned NSRs C, D, F, G, H, L & M will benefit from the use of 0.8m barriers with a total noise reductions of 1 dB(A). However, owing to similar elevation levels between NSR J and surrounding Alignment, noise reduction from 0.8m barriers adjacent to NSR J are expected to be acoustically ineffective.

Although direct mitigation measures have been recommended, residual impacts are still predicted, it is therefore recommended that the new developments should take account of the noise constraints of the Alignment in their design in accordance with HKPSG to mitigate the road traffic impact.

The 0.8m noise barrier along Road B1, Road L56B and near the Junction of Castle Peak Road and So Kwun Wat Road have been recommended (see *Figure 3.5g*). It is considered that the 0.8m high barrier could be in the form of planter along the road kerb. A typical cross section of the 0.8m high barrier are shown in *Figure 3.5h.*

Residual Impacts

As discussed above, the use of direct mitigation measures is evaluated. However, owing to design and safety constraints or high existing background noise levels, residual impacts are predicted at some NSRs. The residual impacts at these receivers have been assessed against the criteria as stated in *Section* 3.2 above. In order to assess the number of existing dwellings that could be qualified for noise insulation as a last resort, the predicted noise levels will be compared with the three noise insulation eligibility criteria as presented in *Annex D* (*Table D5*).

From the assessment results presented in *Table D5*, it is found that NSRs N1, N9, N13 and N28 will meet the criteria in Section 3.2 for noise insulation (see *Figure 3.5i*). Predicted results indicated that approximately 17 existing dwellings will be eligible for consideration for indirect technical remedies in the form of window insulation and air conditioning subject to ExCo approval. Pending on ExCo's approval, it is recommended that a Detailed Noise Insulation Works study be carried out at the Detailed Design stage to identify the exact requirement of noise insulations. In addition, as some of the existing village houses are scheduled for resumption, it is recommended that the status of the eligible NSRs should be checked during the Detailed Noise Insulation Works study.

For the PSPS site in Area 56, the predicted noise levels at the northern and western facades (NSRs K, L, M & N) are dominated by Tuen Mun Road rather than from the Alignment (noise contribution from the Alignment are within the

HKPSG criteria of 70 dB(A)). For NSRs J, noise exceedances from the Alignment are still predicted as the use of direct mitigation measures could not further reduce the noise impacts. It is recommended that the eastern facade of the PSPS developments (NSR J) should take account of the noise constraints in their design in accordance with HKPSG to mitigate the road traffic noise impact. Several options could be considered to mitigate the noise impacts to comply with the HKPSG criterion.

- the use of a minimum 30m set back distance from Road L56A together with restricting the total angle of view of roads to 90° along the eastern facade facing Road L56A; alternatively the use of a minimum 50m set back distance from Road L56A without angle of view restriction; or

- the use of noise tolerant building as screening structures, such as multi-storey car parks, commercial building or recreational facilities, adjacent to Road L56A.

For the CDA Site 1, located west of Road L56B, exceedances of the HKPSG criteria are predicted at all four facades. The use of 0.8m high roadside noise barriers would not be acoustically effective in reducing the noise levels at high level receivers. In addition, due to the high noise exceedances at these facades (73 to 82 dB(A)), and the site are affected by noise from four different directions (ie Tuen Mun Road, Road B1 and Road L56B), increasing the set back distance from the road traffic noise sources would not be viable. It is therefore recommended that the new developments should take account of the noise constraints in their design in accordance with HKPSG to mitigate the road traffic noise impact. Several options could be considered:

- the use of noise tolerant building as screening structures, such as multi-storey car parks, commercial buildings or recreational facilities, adjacent Road L56B (NSR D); and

- the use of suitable building design to mitigate the residual road traffic noise along the northern, western and southern facade (NSRs A, B, C & E) facing Tuen Mun Road and Road B1.

It is envisaged that a combination of these options could mitigate the traffic noise levels to comply with the HKPSG criterion.

For the CDA Site 2, located east of Road L56B, exceedances of the HKPSG criteria are predicted at the northern, eastern and western facades. Similarly, the use of 0.8m high roadside noise barriers would not be effective in reducing the noise levels at high level receivers. It is considered that if the setback distance is further increased by 30m at the north-eastern facade (ie NSR H), the traffic noise levels at the north-eastern facade would comply with the HKPSG criterion. However, for the northern and western facade, increasing the setback distance to reduce the noise impact from road traffic noise is not considered viable. It is therefore recommended that the new developments should take account of the noise constraints in their design in accordance with HKPSG to mitigate the road traffic noise impact. Several options could be considered:

- the use of noise tolerant building as screening structures, such as multi-storey car parks, commercial buildings or recreational facilities, along Road L56B and other affected facades; and

- the use of suitable building design to mitigate the residual road traffic noise along the northern and western facade (NSRs F & G) facing Road B1 and Road L56B.

It is envisaged that a combination of these options could mitigate the traffic noise levels to comply with the HKPSG criterion.

For the two school sites in Area 55, exceedances of the HKPSG criteria are predicted at all facades for all levels. However, as the use of roadside noise barriers are not feasible for these schools, the new developments are recommended to take account of the noise constraints in their design in accordance with HKPSG. As both sites are affected by noise from two different directions, increasing the set back distance from the road traffic noise sources would not be viable. In view of the above conditions, the use of noise insulation would be the most practicable solution to mitigate the road traffic noise.

3.6 CONCLUSIONS

Construction Phase

The noise levels of the representative NSRs have been predicted during each construction stage. Owing to the close proximity of the NSRs to the worksite, NSRs will potentially be adversely impacted by construction noise. Mitigation measures, including the use of quiet plant, on-site movable noise barriers, limited the number of plant operating concurrently are required. It is also recommended that regular monitoring of noise at the NSRs will be required during the construction phases.

Operational Phase

For the NSRs facing existing roads (ie Tuen Mun Road and Castle Peak Road), the assessment indicates that the future noise levels at these NSRs are dominated by high levels of traffic noise from existing roads, in the region of 76 to 89 dB(A), rather than by the Alignment. For the planned Area 56 PSPS housing development and the two school sites in Area 55, exceedances of the HKPSG noise criteria are also predicted due mainly to road traffic noise from the existing road network.

Owing to the road junctions arrangement, ingress and egress, the extent of high noise barriers that could be provided are extremely limited by road design and sightline constraints, and the series of discontinuous 3m & 5m of noise barriers along the Alignment that was tested was found to be ineffective.

The use of 0.8m roadside noise barrier will not be constrained by sightline requirement and is recommended in the form of planters located along the junction of Castle Peak Road/So Kwun Wat Road, Road B1 and Road L56B for noise mitigation, as the best practicable at-source mitigation.

The residual impacts at the existing receivers have been assessed. The assessment indicates that NSRs N1, N9, N13 and N28, approximately 17 existing dwellings, will be eligible for consideration for indirect technical remedies in the form of window insulation and air conditioning subject to ExCo approval, as a last resort. Pending on ExCo's approval, it is recommended that a Detailed Noise Insulation Works study be carried out at the Detailed Design stage to identify the exact requirement of noise insulations.

Residual impacts at the planned NSRs have been assessed which indicates that both the Area 56 PSPS development and the CDA sites will still be affected by road traffic noise from the Alignment. However, it is considered that the noise exceedances could be mitigated by careful building layout and design such as increasing setback distance and use of noise tolerant building structures for screening.

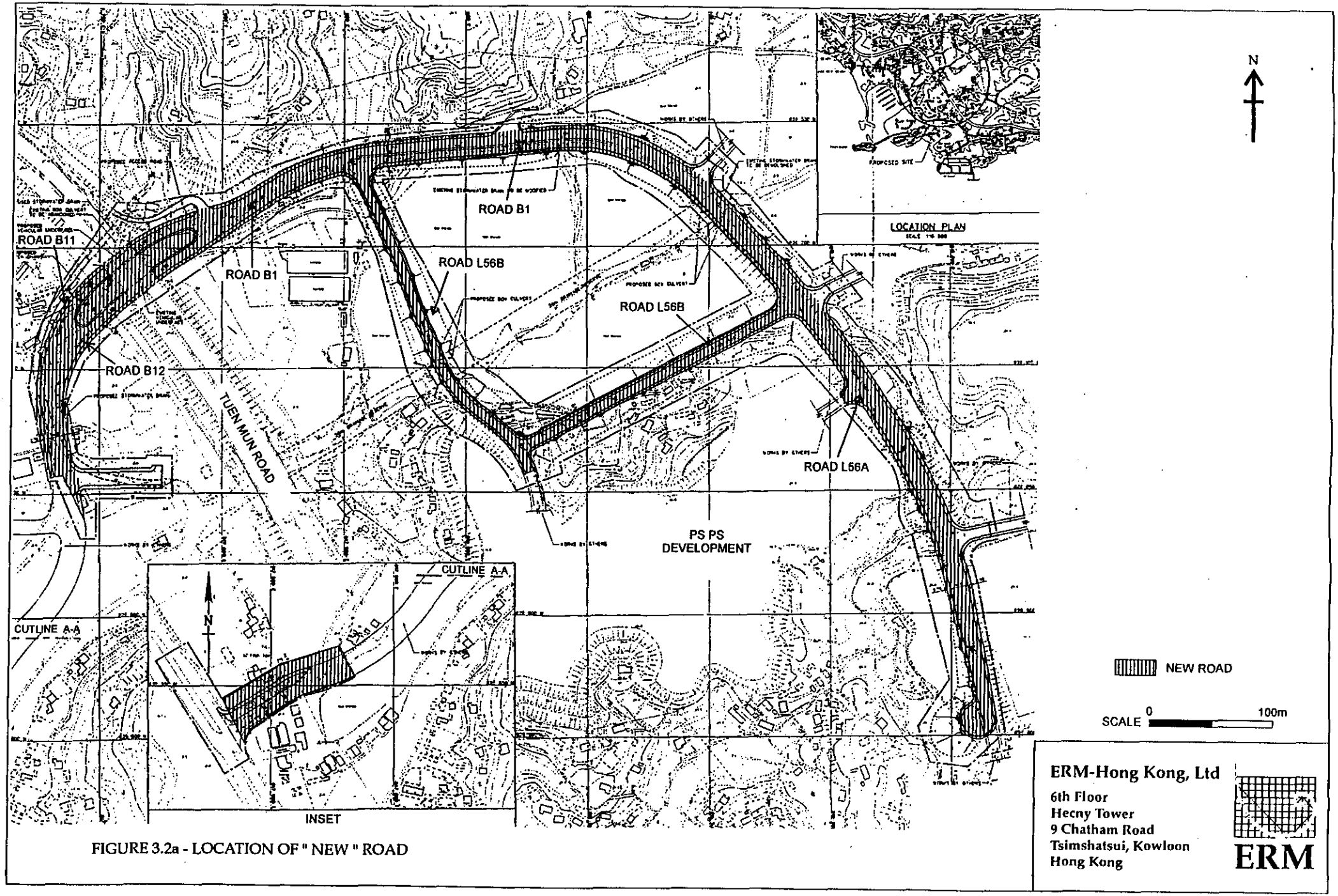


FIGURE 3.2a - LOCATION OF " NEW " ROAD

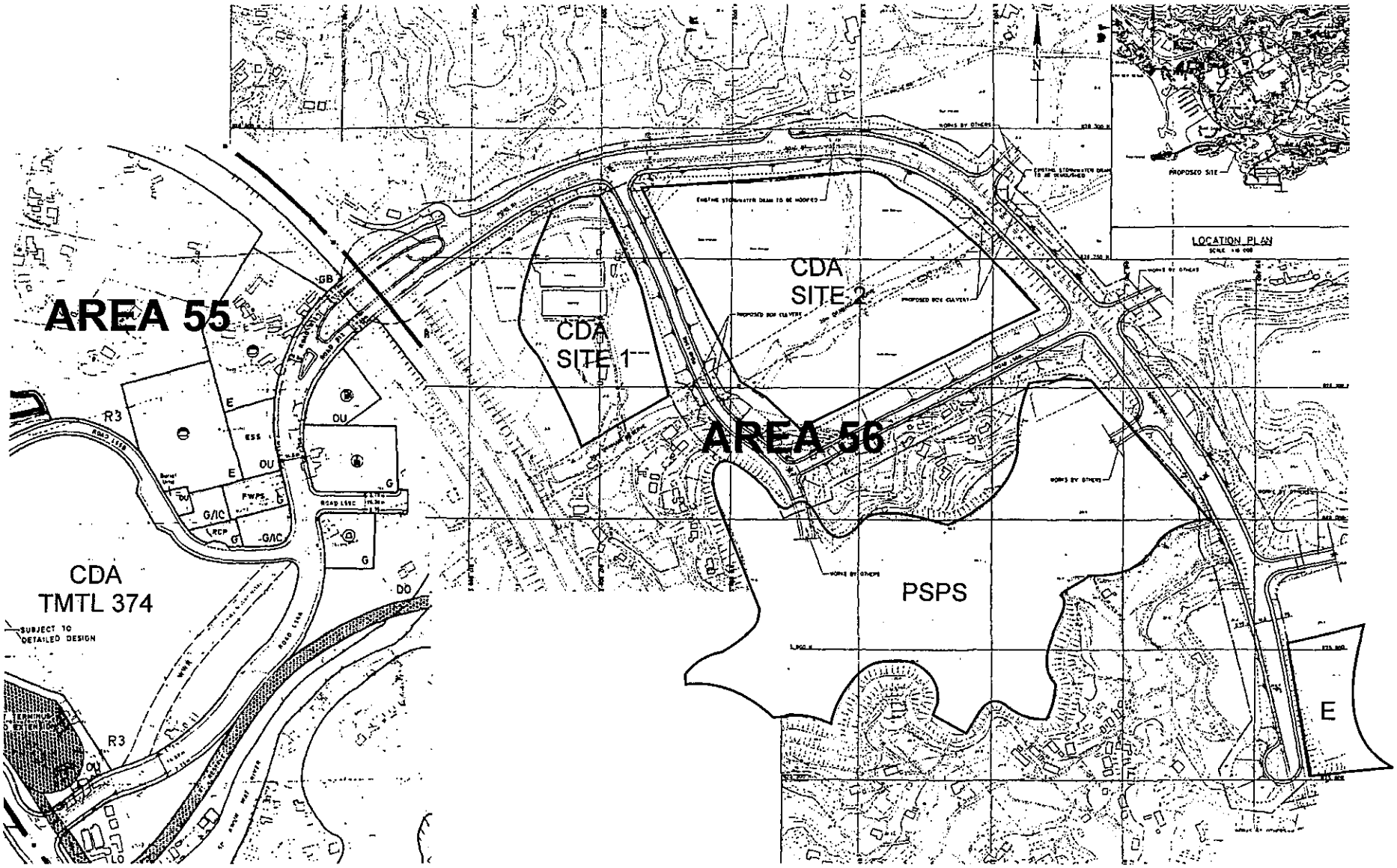


FIGURE 3.3a - LOCATION OF FUTURE DEVELOPMENTS (AREA 55 +56)

Environmental Resources Management

6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

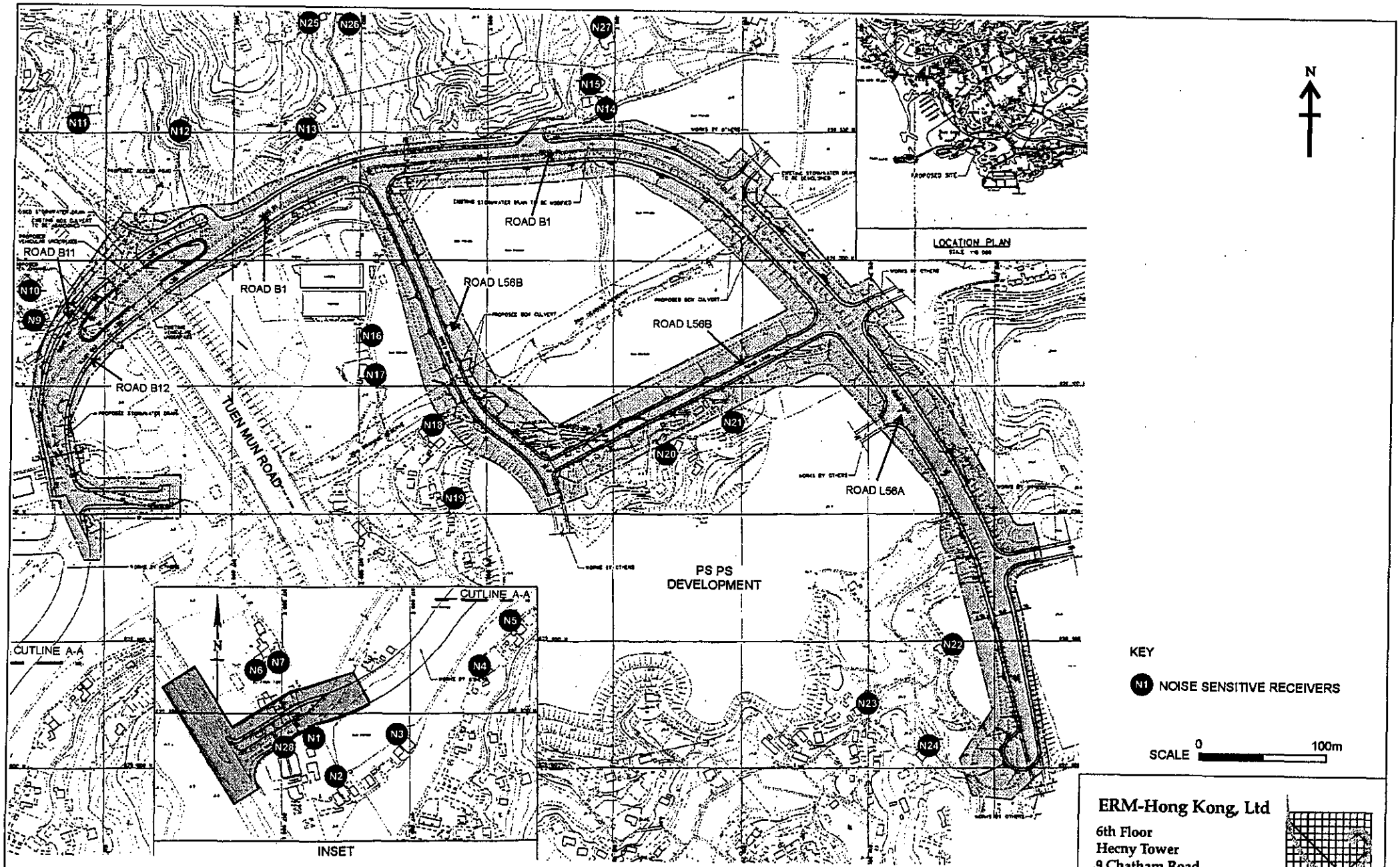
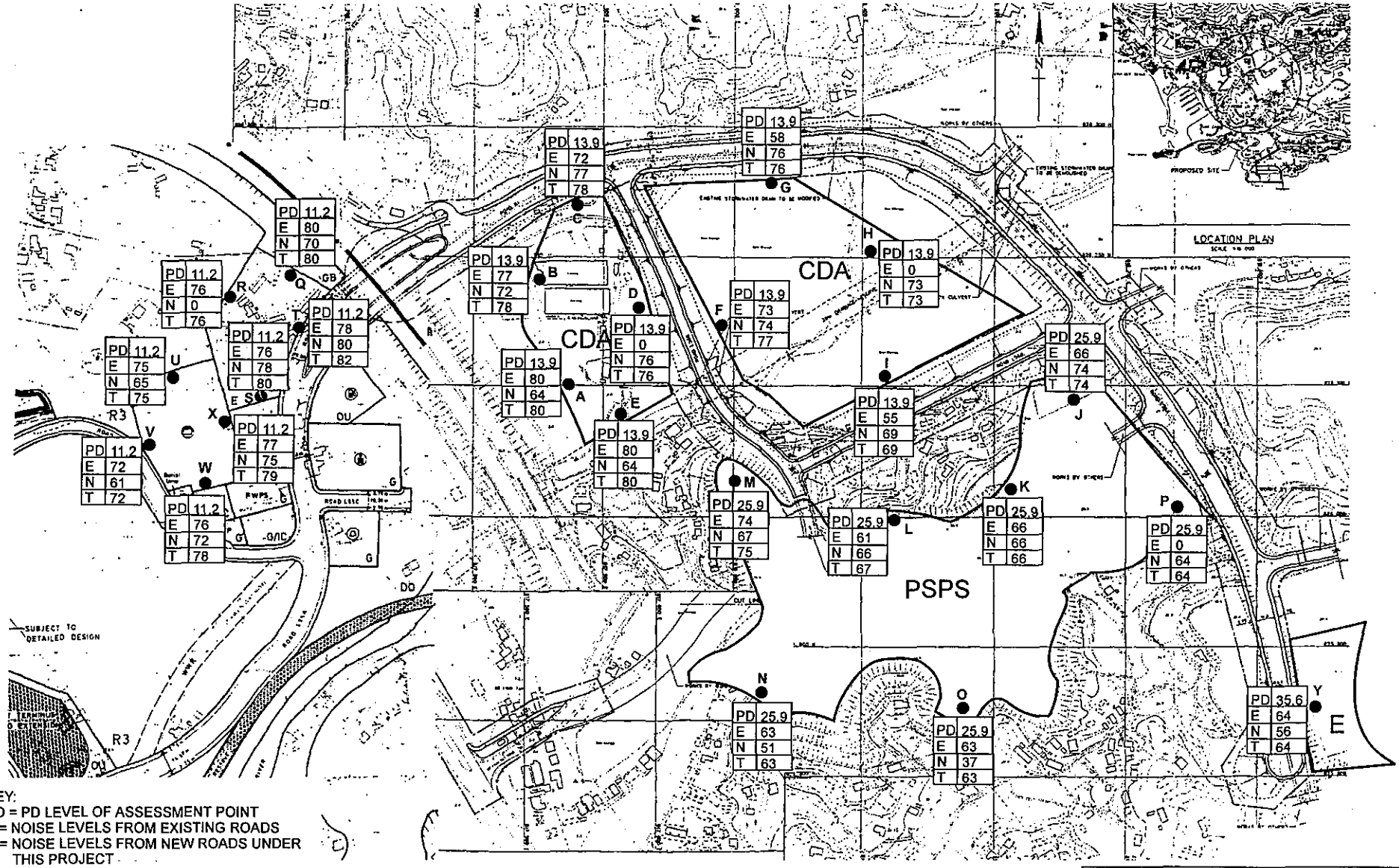


FIGURE 3.3b - LOCATION OF EXISTING NOISE SENSITIVE RECEIVERS



KEY:
PD = PD LEVEL OF ASSESSMENT POINT
E = NOISE LEVELS FROM EXISTING ROADS
N = NOISE LEVELS FROM NEW ROADS UNDER THIS PROJECT
T = TOTAL NOISE LEVELS

FIGURE 3.5a - UNMITIGATED TRAFFIC NOISE LEVELS (L_{10}, PEAK HOUR dB(A)) - LOW FLOOR

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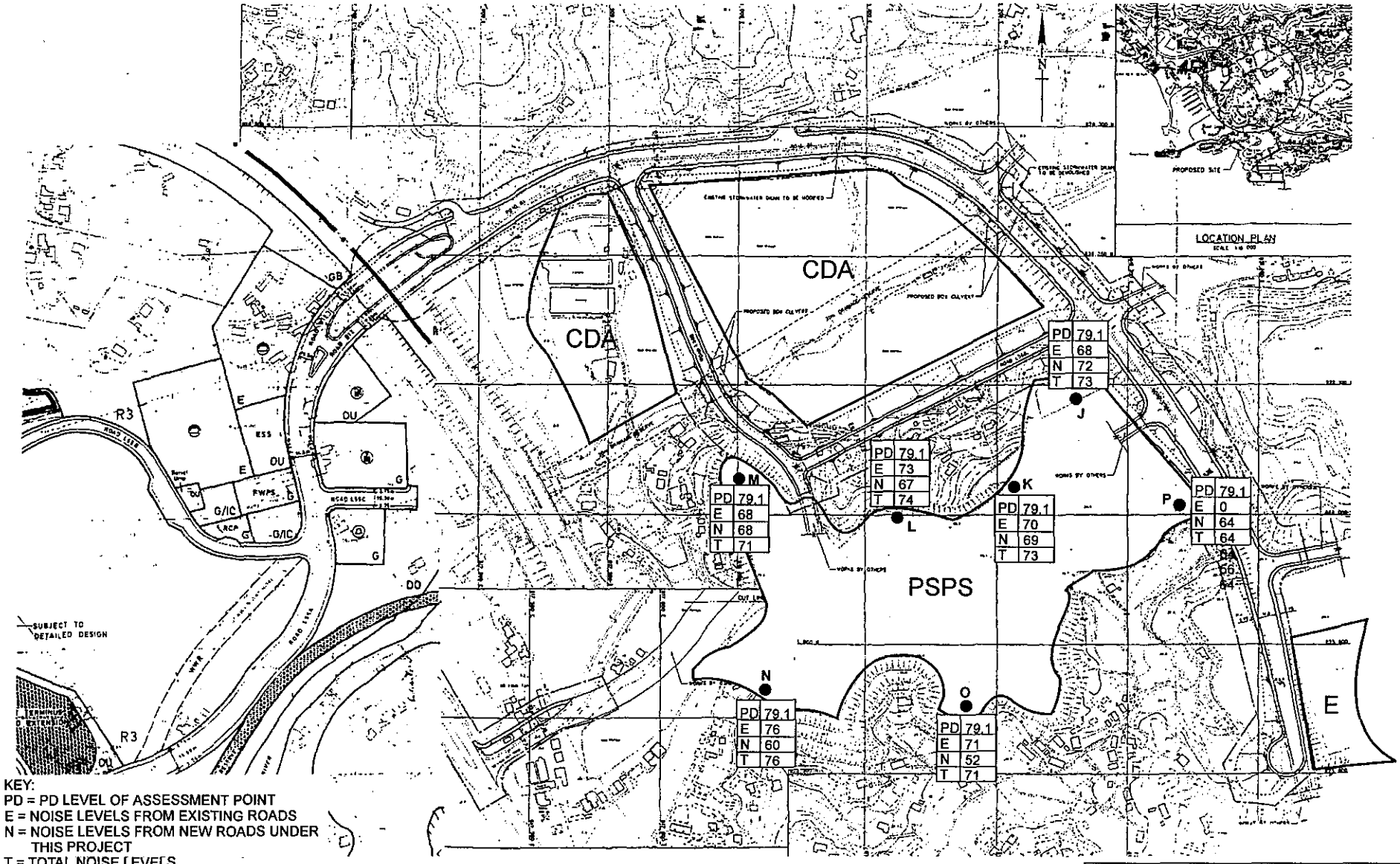

KEY:
PD = PD LEVEL OF ASSESSMENT POINT
E = NOISE LEVELS FROM EXISTING ROADS
N = NOISE LEVELS FROM NEW ROADS UNDER THIS PROJECT
T = TOTAL NOISE LEVELS

FIGURE 3.5b - UNMITIGATED TRAFFIC NOISE LEVELS (L10, PEAK HOUR dB(A)) - MID FLOOR

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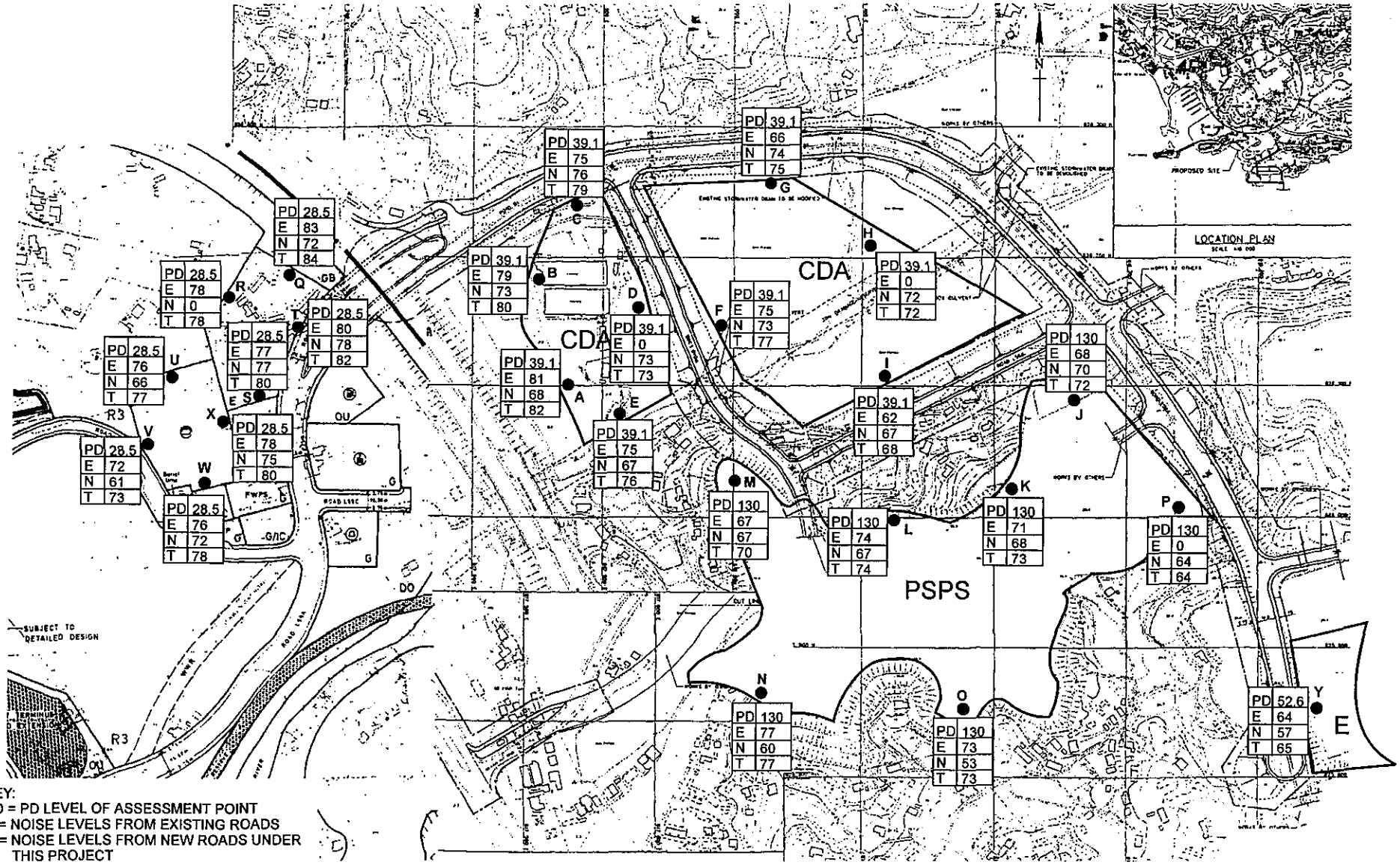

KEY:
PD = PD LEVEL OF ASSESSMENT POINT
E = NOISE LEVELS FROM EXISTING ROADS
N = NOISE LEVELS FROM NEW ROADS UNDER THIS PROJECT
T = TOTAL NOISE LEVELS

FIGURE 3.5c - UNMITIGATED TRAFFIC NOISE LEVELS (L_{10}, PEAK HOUR dB(A)) - TOP FLOOR

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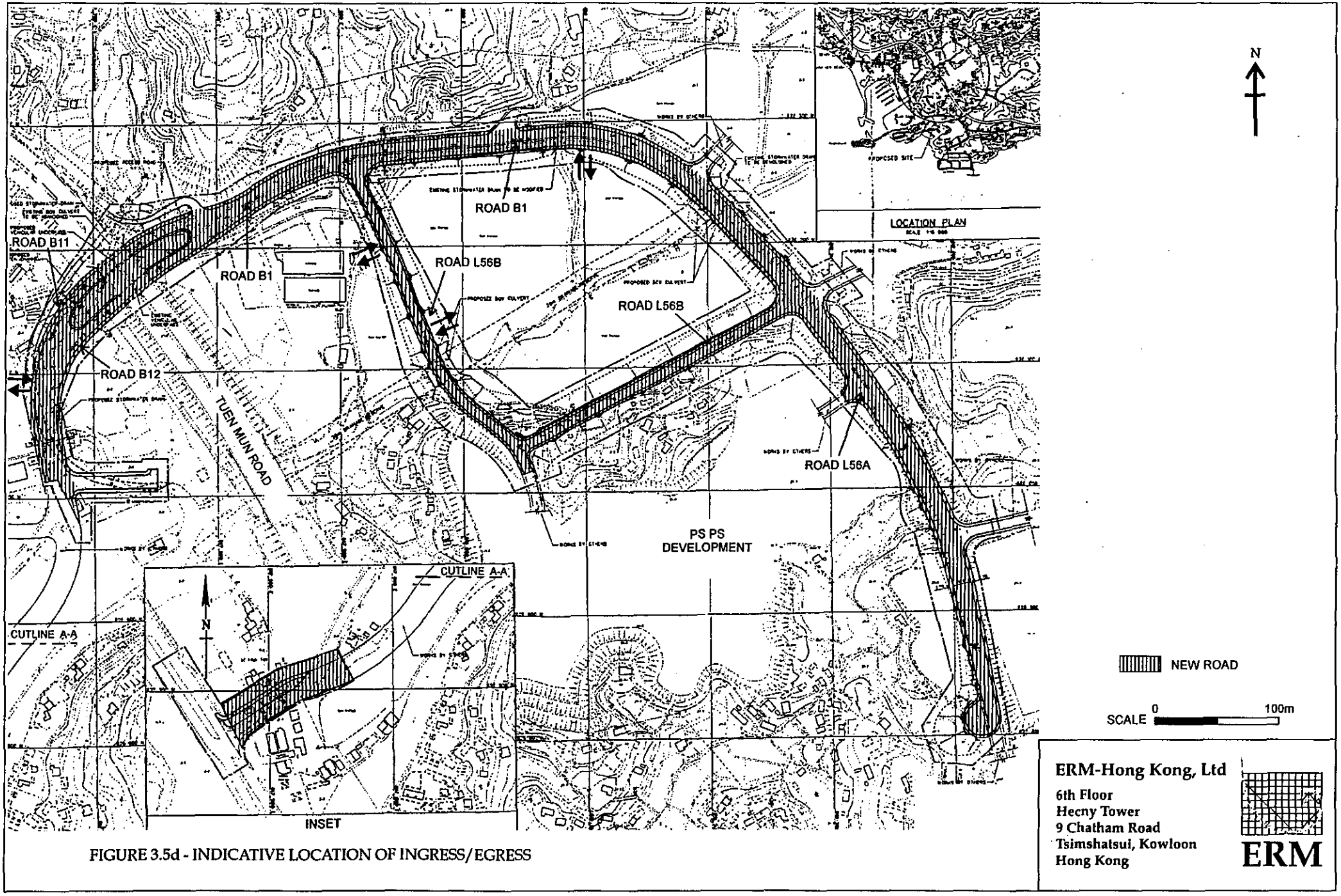

FIGURE 3.5d - INDICATIVE LOCATION OF INGRESS/EGRESS

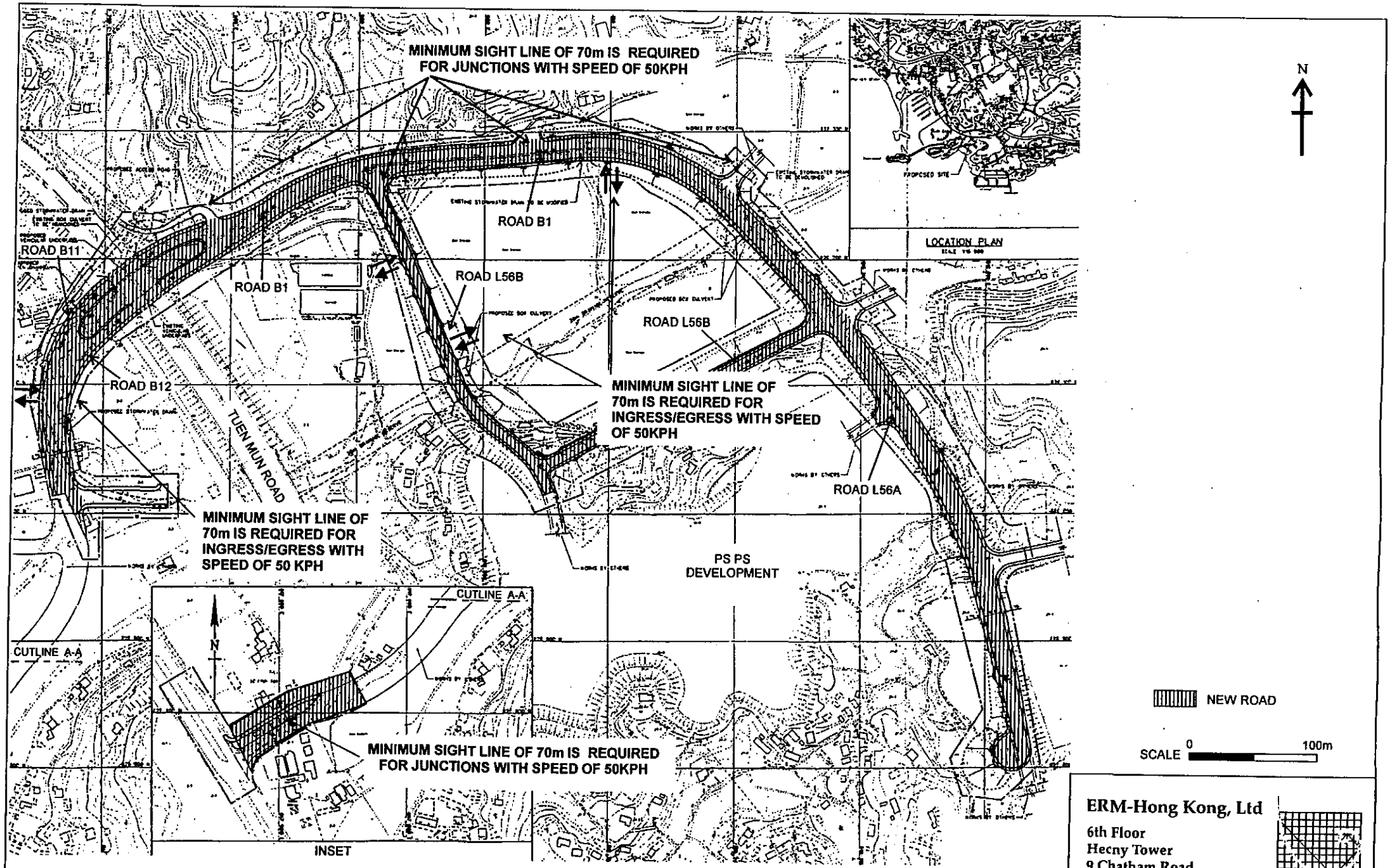

FIGURE 3.5e - SIGHT LINE CONSTRAINTS FOR DIRECT TECHNICAL REMEDIES

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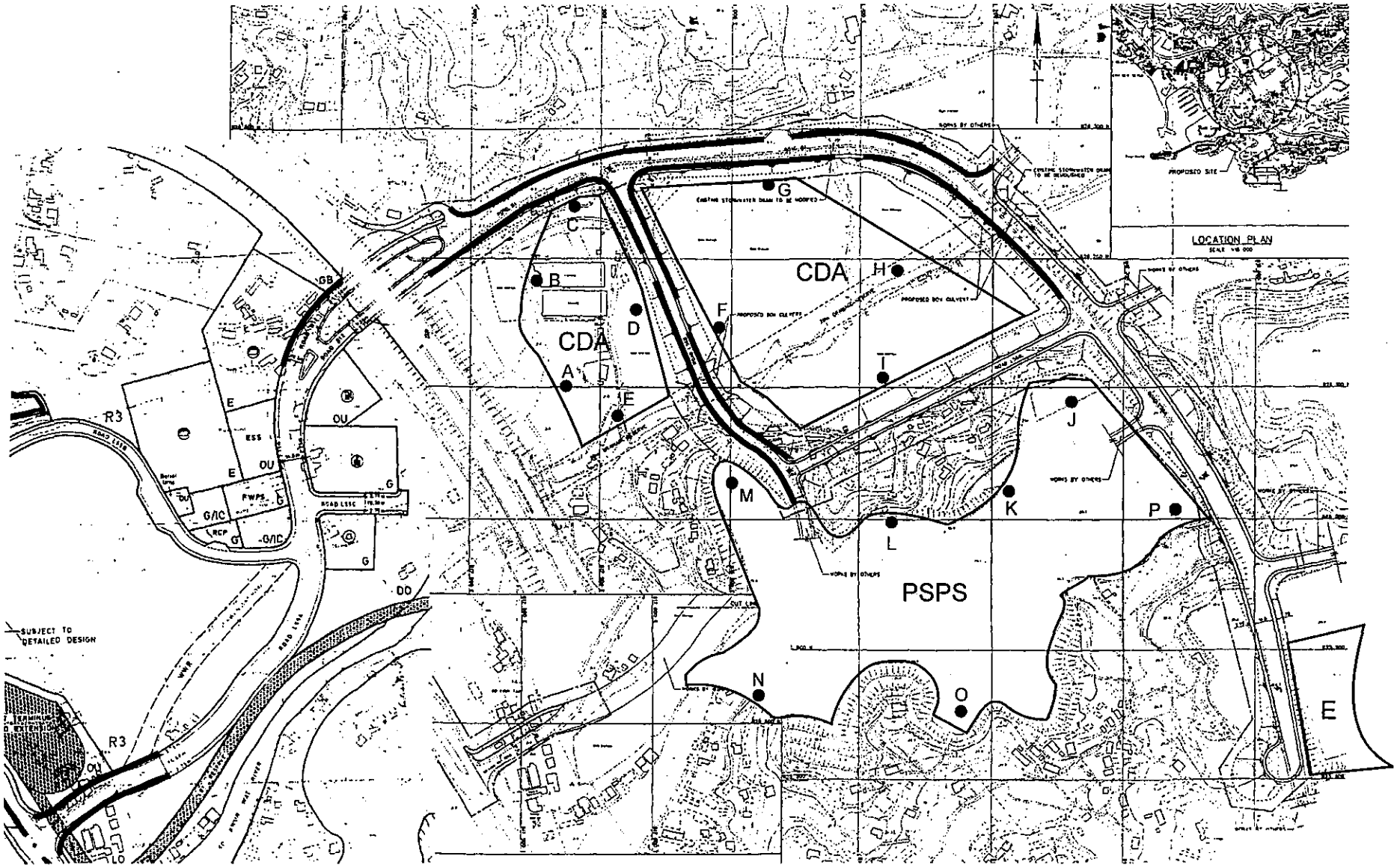

FIGURE 3.5g - LOCATION OF 0.8m HIGH NOISE BARRIER RECOMMENDED FOR INPLEMENTATION

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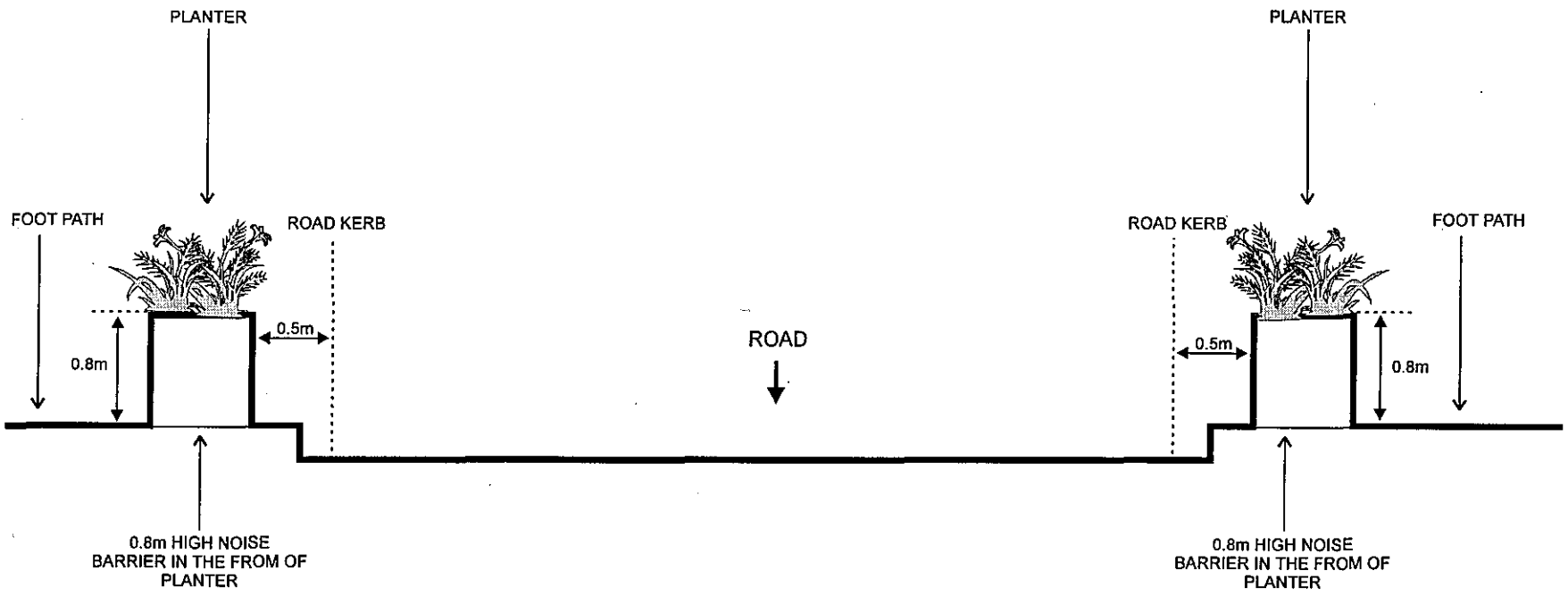

FIGURE 3.5h - TYPICAL CROSS SECTION OF A 0.8m HIGH PLANTER

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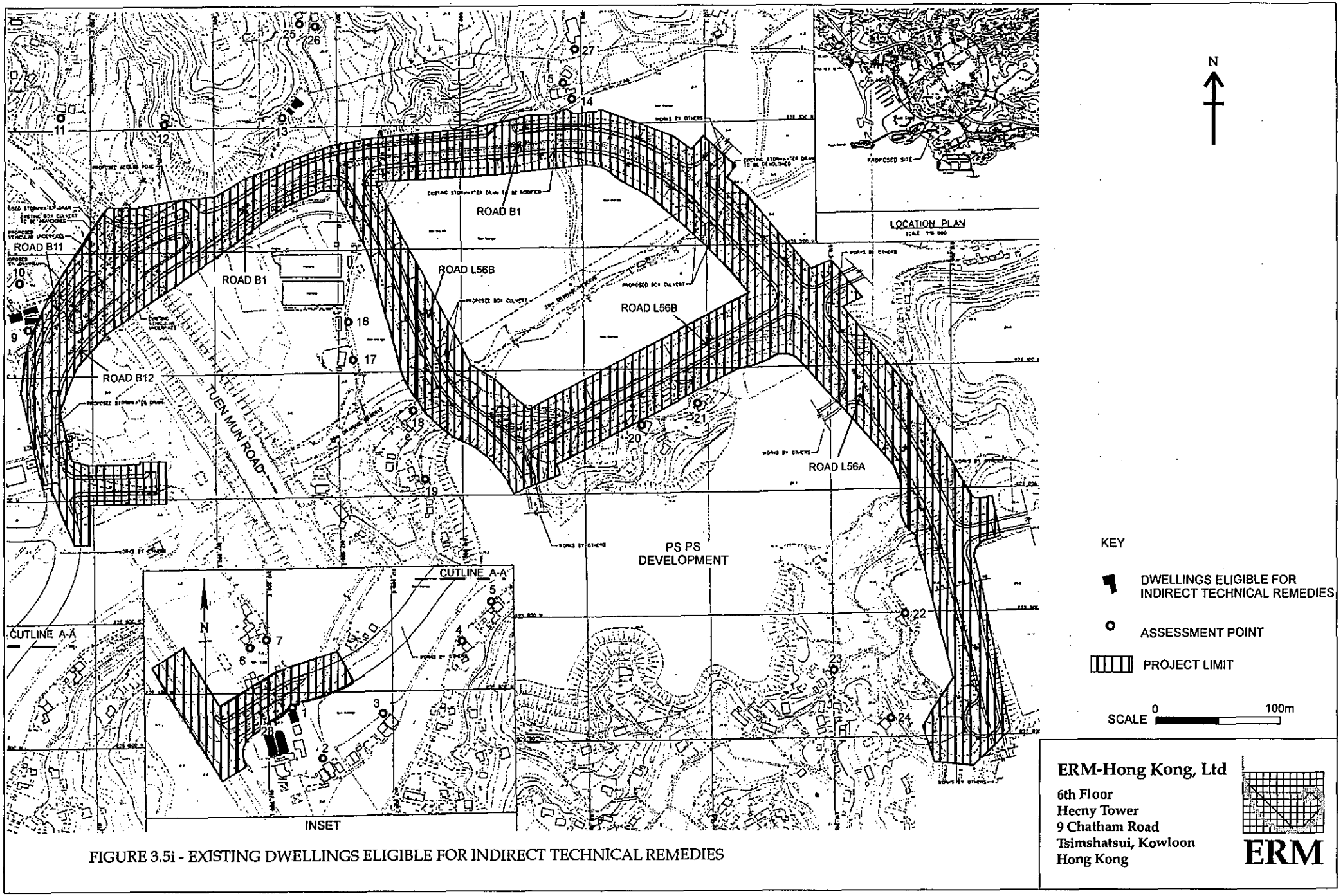

FIGURE 3.5i - EXISTING DWELLINGS ELIGIBLE FOR INDIRECT TECHNICAL REMEDIES

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4 AIR QUALITY IMPACTS

4.1 INTRODUCTION

This Section provides a quantitative assessment of the air quality impacts associated with the construction and operation of the proposed Alignment. Air Sensitive Receivers (ASRs) have been identified and worst case impacts on these receivers have been modelled and the results assessed with reference to established criteria.

Dust impacts upon the ASRs is the major concern during construction phase. Vehicular exhaust emissions from the Alignment, in addition to the surrounding roads, are the major sources of pollutants during operational phase. Mitigation measures required to protect the ASRs are recommended, where necessary, for any exceedance of environmental criteria.

4.2 GOVERNMENT LEGISLATION AND STANDARDS

The principal legislation for the management of air quality is the *Air Pollution Control Ordinance* (APCO) (Cap 311). The whole of the Hong Kong Territory 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 4.2a* below.

Table 4.2a 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
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.

In addition, the *Technical Memorandum of Environmental Impact Assessment Process* (TMEIA) stipulates a maximum construction dust level of 500 $\mu g\ m^{-3}$ (1 hr averaging time) at the sensitive receiver should be achieved.

4.3 BASELINE CONDITIONS

The existing landuse of the site is a mixture of container storage areas with a scattering of village houses. Vehicle exhaust emissions from Castle Peak Road and Tuen Mun Road are the major pollutant sources. The current traffic flow of So Kwun Wat Road is low and its associated emissions minor. Small amounts of industrial pollutants from the factories at So Kwun Wat and the diesel plant used in the container storage areas are also emitted from the site.

No fixed air monitoring station is located near the Study Area. Short term monitoring of NO_2, TSP and RSP has been conducted at the podium of Sea Crest Villa Phase IV between 1 May 1995 and 30 May 1995 [1]. Vehicle exhaust emissions from traffic on Castle Peak Road and Tuen Mun Road are the major sources of pollutants. A summary of the monitoring results are shown in *Table 4.3a* below. Air quality data from the EPD's Tsuen Wan monitoring station for 1994 are also presented in the table.

Table 4.3a *Background Air Quality ($\mu g\, m^{-3}$)*

Pollutant	Sea Crest Villa Phase IV [1]		Tsuen Wan Monitoring Station	
	Mean	95th percentile	Mean	95th percentile
TSP	53	105	101	-
RSP	45	99	62	-
NO_2	53	118	59	120
CO	-	-	500 [2]	1110 [2]

Note: [1] Final Report, EIA: Improvement to Castle Peak Road between Ka Loon Tsuen and Area 2, Tsuen Wan, 1996, CES.
[2] Kwai Chung Monitoring Station.

In order to assess the cumulative air quality impact of the Study Area, the 95th percentiles for TSP, RSP and NO_2 monitored at Sea Crest Villa and the 95th percentile monitored at Kwai Chung station, were taken as the background air quality of the Study Area.

As the Castle Peak Road/So Kwun Wat Road interchange improvement work is located over 400 m from Tuen Mun Road, the major pollutant sources of Tuen Mun Area 56, the background pollutant levels adopted are TSP: 100 $\mu g\, m^{-3}$, RSP: 60 $\mu g\, m^{-3}$ and NO_2: 36 $\mu g\, m^{-3}$, as agreed with EPD.

4.4 AIR SENSITIVE RECEIVERS

In accordance with the TMEIA, domestic premises, factories and active recreation areas are classified as ASRs. The villages houses scattered around the Study Area and the small factories in So Kwun Wat have been identified as ASRs for this Study. In addition, the planned PSPS development and the school within Area 56 are also classified as ASRs. Although two different schemes (Scheme 5B and Scheme 7) have been developed for the PSPS site (See *Section* 2.3), the building

[1] Final Report, Environmental Impact Assessment:: Improvement to Castle Peak Road between Ka Loon Tsuen and Area 2, Tuen Mun, 1996, CES

blocks are in similar locations and have similar setback distances from the Alignment. It is expected that the air quality impacts upon the two schemes will be similar, and only one layout, Scheme 5B, has been assessed in this Study.

As discussed in *Section* 2.3, the design of the CDA site at TMTL 373 should have taken account of the planning intentions for the Study Area and it is assumed in this Study that the design of the CDA site will have incorporated appropriate mitigation measures. Air quality impact upon the CDA site will not, therefore, be further assessed in this Study. A few village houses are located within the TMTL 373 CDA site near the Castle Peak Road/So Kwun Wat Road Interchange. It is understood that the houses will be removed prior to the construction works of the Interchange. The houses within TMTL 373 CDA site will therefore not be affected by the Project and will not be considered as an ASR in this Assessment.

Table 4.4a lists the identified ASRs, both existing and planned, and their horizontal distances from the Alignment. The locations of ASRs are shown in *Figures 4.4a-b.*

Table 4.4a ***Locations of Air Sensitive Receivers***

ASR	Type	Horizontal Distance from the Alignment (m)
A1	Village House	35
A2	Village House	15
A3	Village House	5
A5	Village House	5
A6	Village House	40
A7	Village House	60
A8	Village House	40
A9	Factory	50
A10	Village House	40
A11	Village House	30
A12	Village House	25
A13	Village House	95
A14	Village House	20
A15	Village House	30
A16	Village House	65
A17	Village House	55
A18	Village House	95
A19	Village House	40
A20	Village House	60
A21	Village House	65
A22	Proposed School in Area 56[1]	10
A23	Block 12, PSPS Development[1]	25
A24	Block 14, PSPS Development[1]	75
A25	Block 1, PSPS Development[1]	25

ASR	Type	Horizontal Distance from the Alignment (m)
A26	Commercial Complex, PSPS Development[1]	10

Note: [1] Planned development, ASRs for operational phase only.

4.5 CONSTRUCTION PHASE

4.5.1 *Potential Sources of Impact*

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.

Major dust generating activities associate with the road construction are cut & fill, land clearing, excavation, material handling, road construction and truck haulage within the construction site. Stockpiling of excavated fill materials is not expected.

SO_2 and NO_2 will be emitted from the diesel-powered mechanical equipment used. However, since the number of such plant required on-site will be limited, 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.

4.5.2 *Assessment Methodology*

The quantity of dust emissions from road construction is proportional to the area of land being worked and the level of construction activity. Dust emission rates for the Project were determined based on the *Compilation of Air Pollutant Emission Factors, 5th Edition, USEPA (AP-42),* and presented in *Table 4.5a* below.

Table 4.5a *Air Emission Factors*

Construction Activities	Emission Factor[1]	Remark
Road Construction	2.4908×10^{-4} g m^{-2} s^{-1}	• 30 working days a month and 10 working hours a day; • 30% active construction area; • moderate silt content.

Note: [1] Reference: Compilation of Air Pollutant Emission Factors (AP-42)

The Fugitive Dust Model (FDM) was used to predict the likely dust impacts at the ASRs from the Project. Particle size distribution for the construction activities were obtained from the AP-42. Dust impacts at two different elevations, ground level and 5 m above ground level, were modelled.

As the construction works will be carried out during normal working hours in the daytime, worst case daytime meterological data of neutral stability class D with a wind speed of 1 m s^{-1} were assumed in the model.

4.5.3 *Evaluation of Impacts*

The likely dust impacts for the Project on the ASRs were modelled and the results are presented in *Table 4.5b* below.

Table 4.5b *Predicted 1-Hour TSP Concentrations ($\mu g\ m^{-3}$)*[1]

ASR	Ground Level	5 m Above Ground Level
A1	241	244
A2	361	255
A3	232	212
A5	354	325
A6	381	348
A7	278	245
A8	248	219
A9	**610**[2]	**540**[2]
A10	**712**[2]	**606**[2]
A11	**719**[2]	**731**[2]
A12	**768**[2]	**631**[2]
A13	399	357
A14	**599**[2]	406
A15	474	340
A16	**554**[2]	**501**[2]
A17	**599**[2]	560
A18	262	232
A19	298	250
A20	238	217
A21	234	216

Note: [1] Background TSP concentration included in the results.
[2] Figures in **bold** exceeded dust criteria.

Due to the close proximity of the ASRs to the site and the extent of construction works, dust levels at the ASRs are high and the TMEIA dust criteria will be exceeded at some receivers with the highest dust level of 768 $\mu g\ m^{-3}$ predicted at A12. Dust mitigation control measures are, therefore, recommended to reduce the high dust impact.

4.5.4 *Mitigation Measures*

As presented above, the construction work is likely cause high dust impacts at all ASRs. The following dust control measures should be incorporated in the Contract Specification and implemented to minimise dust nuisance to within acceptable levels 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;
- effective water sprays should be used on the site at potential dust emission sources such as unpaved areas, and active construction area; and
- wheel washing facilities should be provided at the exit of the site.

In order to assess the effectiveness of the mitigation measures, the dust suppression efficiency adopted in AP-42 was employed. It is assumed that regular watering on active construction areas would reduce dust emissions by 50%.

The mitigated dust levels at the ASRs have been modelled, and the predicted results were tabulated in *Table 4.5c* below.

Table 4.5c *Predicted Mitigated TSP Concentrations ($\mu g\ m^{-3}$)*

ASR	Hourly TSP [1]	
	Ground	5 m above ground
A1	170	172
A2	231	177
A3	166	156
A5	230	215
A6	243	226
A7	191	175
A8	177	162
A9	357	322
A10	408	356
A11	412	418
A12	436	368
A13	252	231
A14	352	255
A15	289	222
A16	330	303
A17	352	332
A18	184	168
A19	202	178
A20	172	161
A21	170	161

Note: [1] Background TSP concentration included in the results.

As presented above, the adopted mitigation measures will effectively reduce the predicted hourly TSP to levels within the dust criteria.

Environmental monitoring and audit (EM&A) for dust generated during the construction phase should also be undertaken at appropriate ASRs to ensure that the dust criteria will not be exceeded. The EM&A programme is presented in *Section 7*.

4.6 OPERATIONAL PHASE

4.6.1 *Potential Sources of Impact*

The background air quality of the Study Area is dominated by the exhaust emissions of vehicles on Tuen Mun Road and Castle Peak Road, as discussed in *Section 4.3*. Additional exhaust emission from vehicles on the Alignment will also affect the air quality of the Study Area. NO_2, CO and RSP have been identified as the major components of vehicle exhaust for this EIA Study.

4.6.2 *Assessment Methodology*

The air dispersion mode, *CALINE4*, was used to predict the pollutant levels of NO_2, RSP and CO.

Projected traffic flow for the worst case scenario, afternoon peak hour traffic for the year 2016, were used as presented in *Section 2.5*.

As only emission factors for NO_x, RSP and CO for each vehicular type for the year 2011 were available, the assessment was therefore based on the 2011 emissions factors and 2016 traffic flow to model the worst case scenario. It is however believed that the 2016 emission rates will be lower than that of 2011 as more vehicles will be fitted with advanced emission control system in the future. The predicted results were, therefore, conservative.

Peak hour traffic in the Study Area will occur during daytime and a worst case scenario of neutral meterological conditions were assumed in the model. Typical worst case input parameters for the model are listed below:

- wind speed — 1 m s^{-1}
- wind direction — worst case for each receivers
- stability class — D
- mixing height — 500 m
- standard deviation of wind direction — 18 degree
- temperature — 25°C

In the model, NO_x gas was assumed to be inert gas and levels of NO_2 were taken as 20% of total NO_x emissions.

4.6.3 *Assessment Results*

Exhaust emissions from vehicles using the Alignment are the major sources of pollutants in the operational phase. Pollutant levels at the worst affected heights, ground level and 5 m above ground, have been modelled and the results are presented in *Table 4.6a*.

Table 4.6a *Air Quality Impacts of Vehicle Exhaust Emissions ($\mu g\ m^{-3}$)*

ASR	Predicted Concentration [1]					
	Ground level			5 m above ground		
	NO_2	CO	RSP	NO_2	CO	RSP
Criteria	300	30,000	180	300	30,000	180
A1	156	2835	78	149	2720	77
A2	254	4215	94	198	3410	87
A3	262	4445	95	190	3295	84
A5	242	2828	146	231	2713	141
A6	197	2255	129	193	2141	127
A7	185	2026	124	182	2026	123
A8	193	2141	127	189	2141	126
A9	159	1683	114	155	1683	113
A10	152	1568	111	148	1568	111
A11	148	1454	110	144	1454	109
A12	182	2026	123	178	2026	122
A13	159	1683	114	159	1683	114
A14	144	1454	108	140	1454	108
A15	140	1454	107	140	1454	107
A16	148	1568	110	148	1568	110
A17	148	1568	110	148	1568	110
A18	133	1339	104	133	1339	104
A19	129	1339	103	129	1225	103
A20	129	1225	103	129	1225	103
A21	129	1225	103	129	1225	103
A22	129	1339	103	129	1339	103
A23	148	1568	111	148	1568	110
A24	140	1454	108	140	1454	107
A25	140	1454	107	140	1454	107
A26	137	1339	105	137	1339	105

Note: [1] Background included in the predicted results.
[2] Figures in **bold** exceed AQO criteria.

It can be seen from the above Table that the predicted levels of pollutants at the ASRs are low and within the AQO. The predicted NO_2 levels range from 113 $\mu g\ m^{-3}$ to 262 $\mu g\ m^{-3}$ at ground level and 129 $\mu g\ m^{-3}$ to 198 $\mu g\ m^{-3}$ at 5 m above ground. Highest NO_2 levels of 262 $\mu g\ m^{-3}$ are predicted at ASR A3.

Figures 4.6a - c show the isopleths of NO_2, CO and RSP at the worst affected level, ground level. It can be seen that the AQO will be complied within the Study

Area. As the traffic flows on the Alignment will gradually decrease from the western ends towards the eastern end, the pollutant levels will also decrease correspondingly as depicted in the isopleths.

It is confirmed from the isopleths that the air quality of the planned developments in Area 55 including the TMTL 374 CDA site and G/IC sites will also comply with the AQO.

4.6.4 *Mitigation Measures*

The predicted results show that the air quality at the ASRs will satisfy the AQO and mitigation measures are therefore not required.

4.7 *CONCLUSIONS*

4.7.1 *Construction Phase*

Dust is the major pollutant during construction of the alignment, the FDM was employed to predict the impact upon ASRs.

Due to the proximity of some ASRs, dust impacts during some construction periods will be high: major dust generating activities will be excavation and materials handling. Dust suppression measures are recommended to reduce the dust impacts to meet the TMEIA criteria.

4.7.2 *Operational Phase*

Air quality impacts from the exhaust emissions of vehicles on the Alignment have been modelled and it is predicted that the AQO will be satisfied at all ASRs in the assessment.

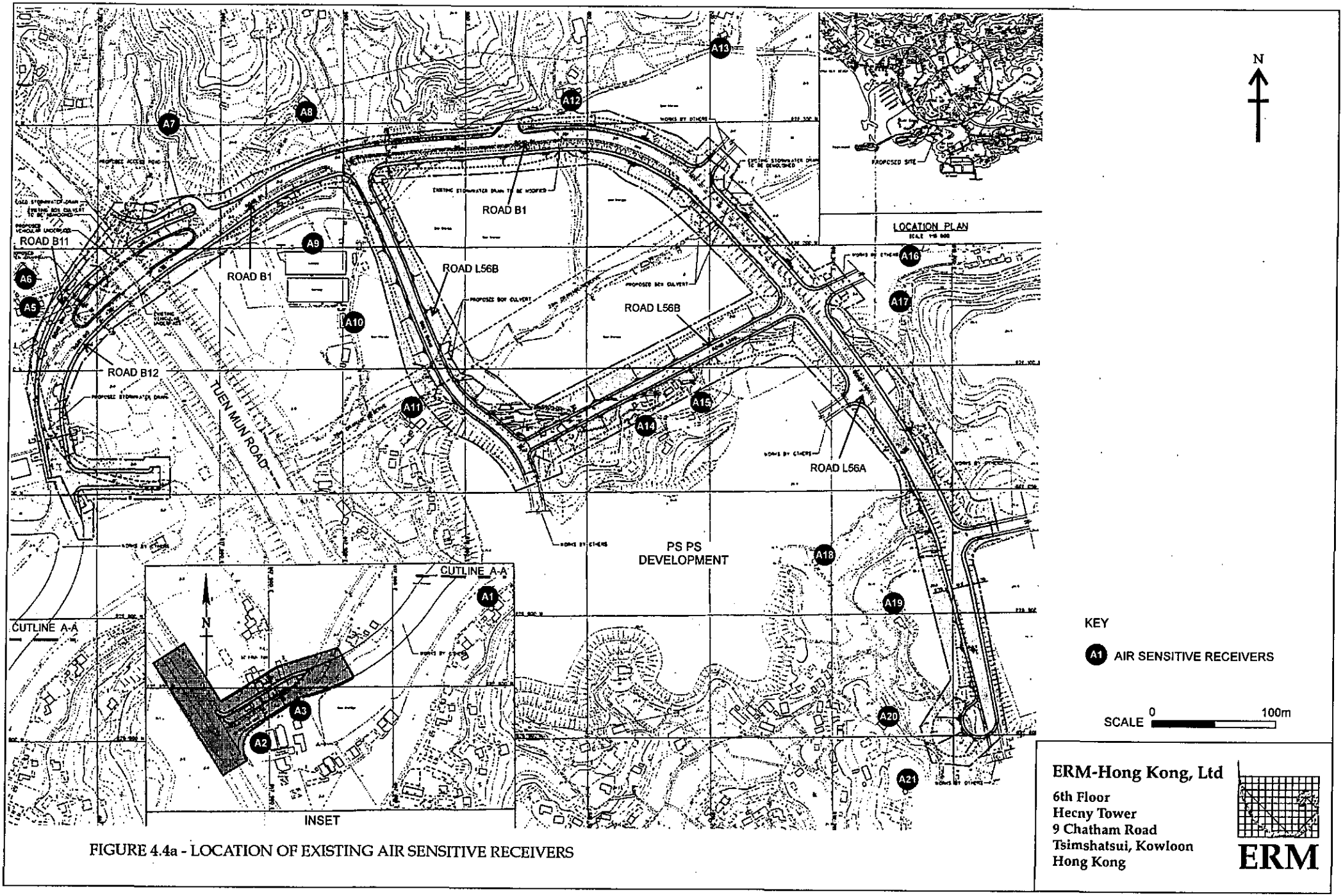

FIGURE 4.4a - LOCATION OF EXISTING AIR SENSITIVE RECEIVERS

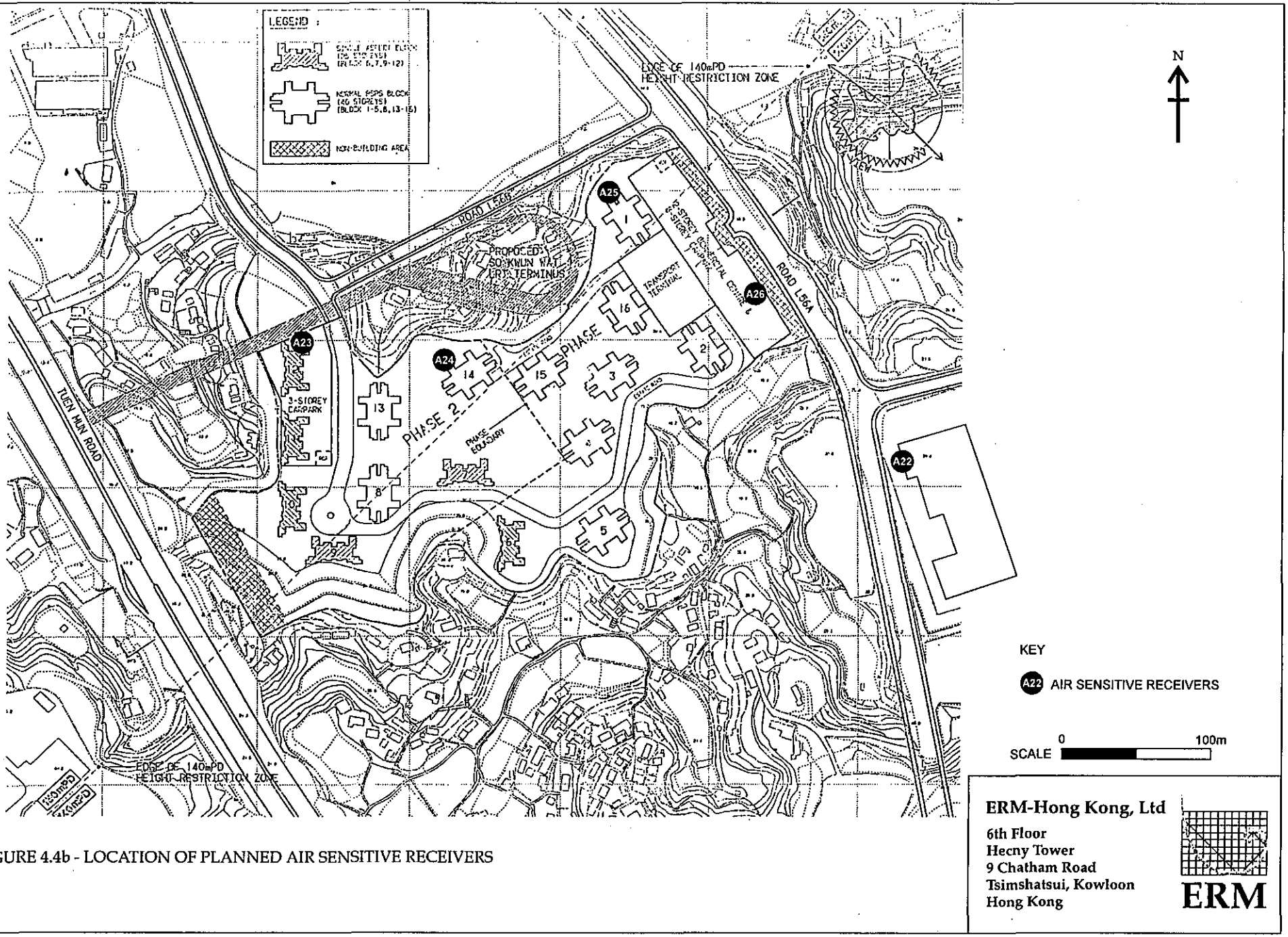

FIGURE 4.4b - LOCATION OF PLANNED AIR SENSITIVE RECEIVERS

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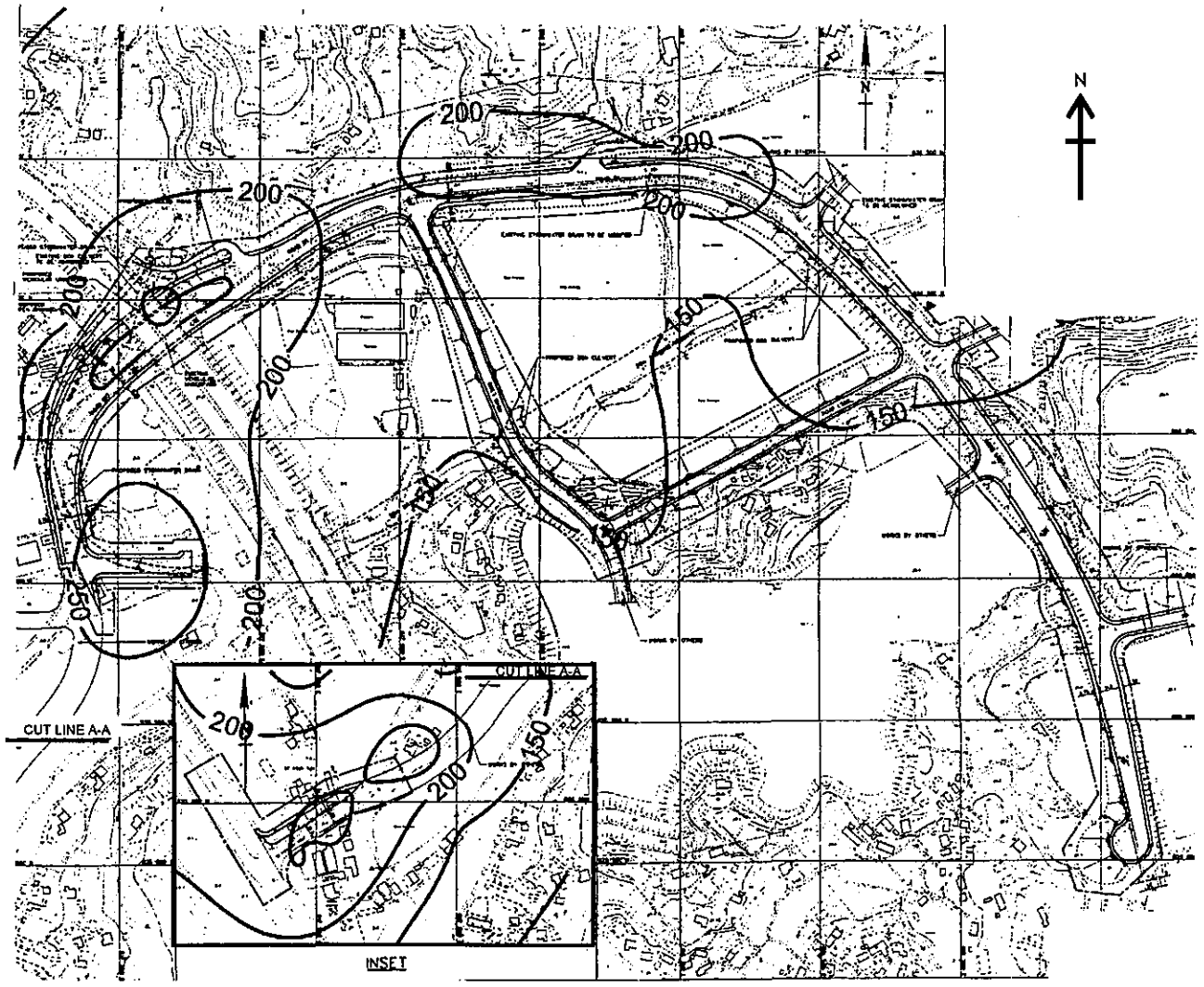

AQO CRITERIA (NO_2)
300 $\mu g/m^3$

SCALE 1:5000

FIGURE 4.6a - ISOPLETHS OF NO2 AT ALIGNMENT LEVEL IN $\mu g/m^3$

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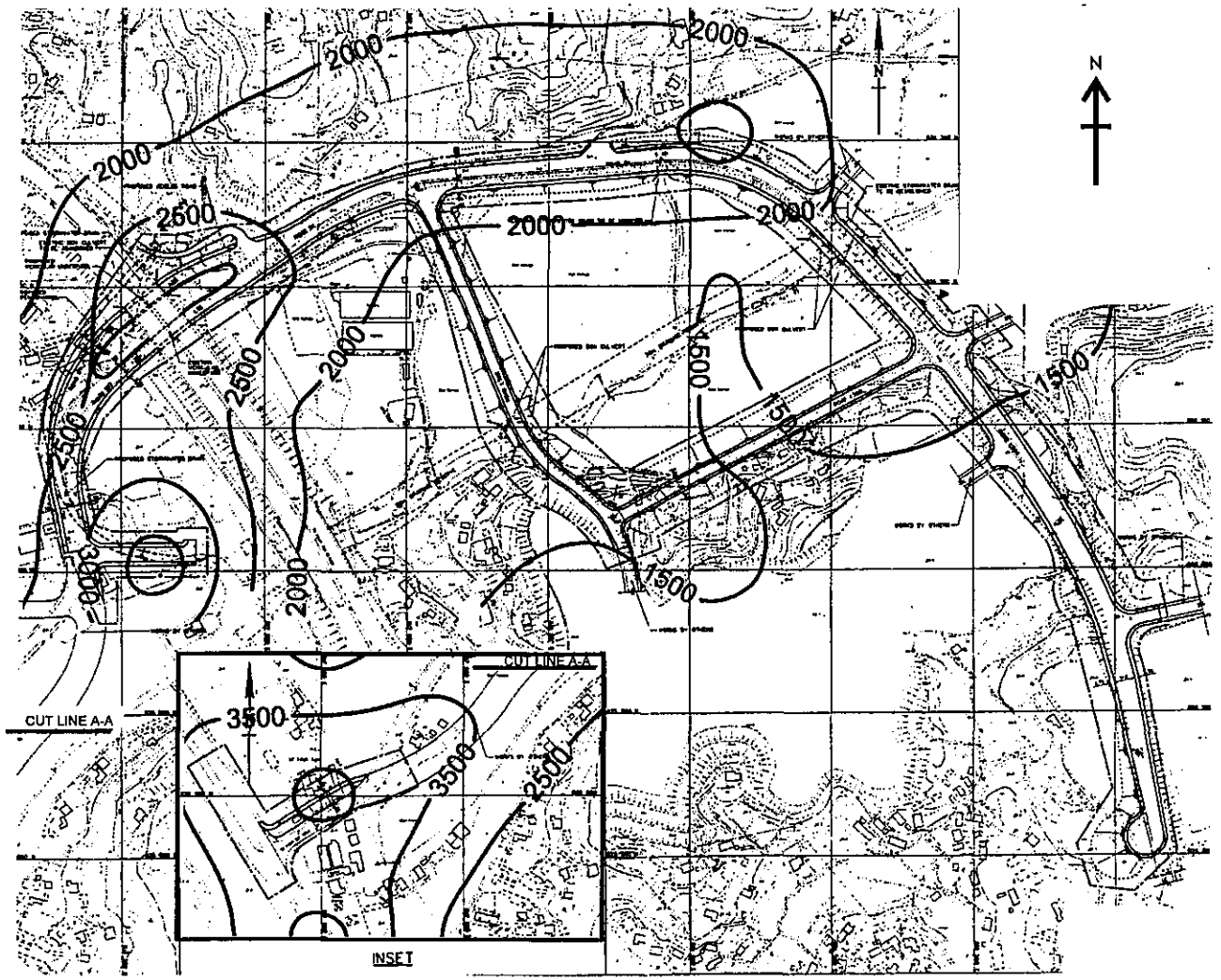

AQO CRITERIA (CO)
30000 µg/m³

SCALE 1:5000

FIGURE 4.6b - ISOPLETHS OF CO AT ALIGNMENT LEVEL IN µg/m³

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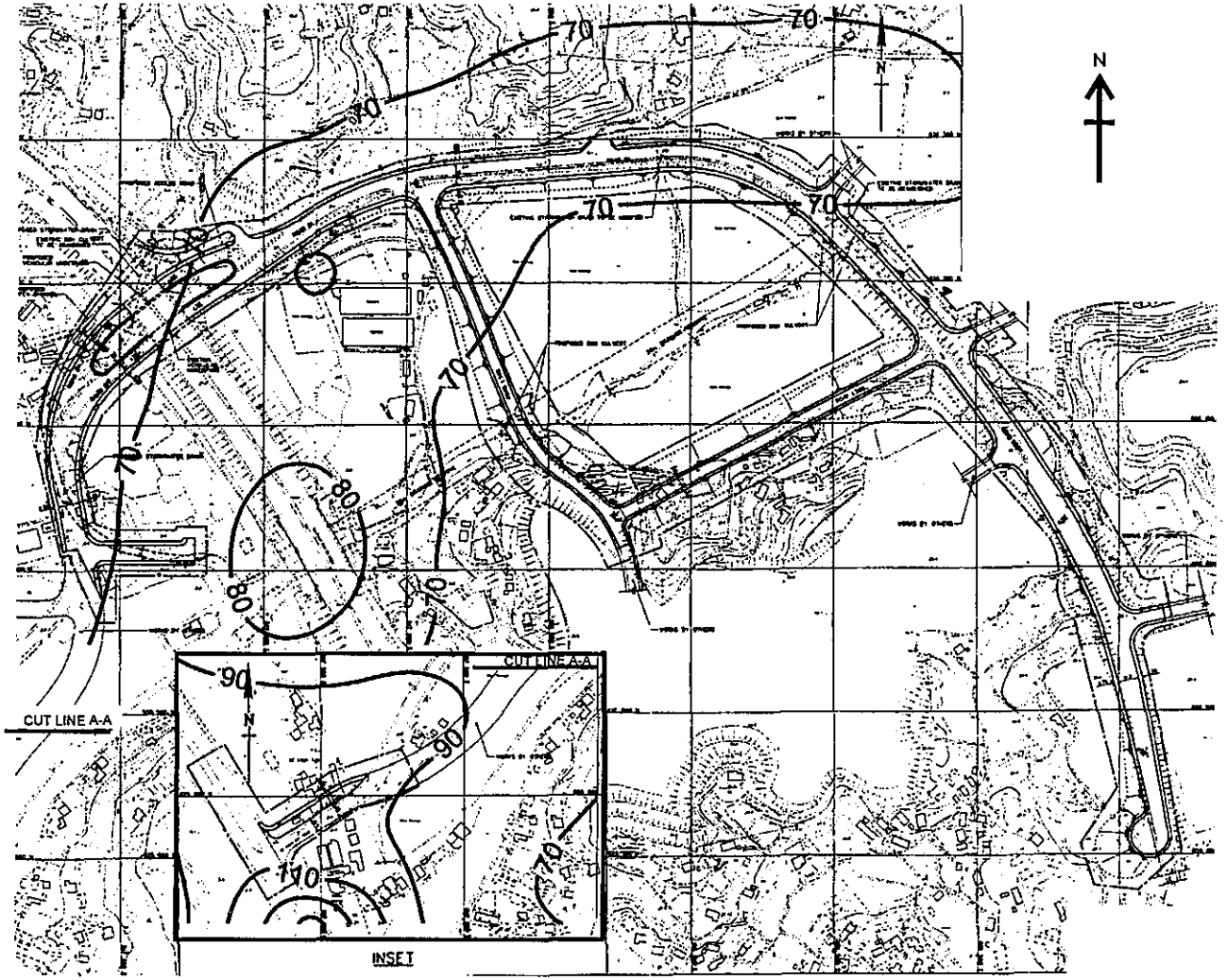

AQO CRITERIA (RSP)
180 µg/m³

SCALE 1:5000

FIGURE 4.6c - ISOPLETHS OF RSP AT ALIGNMENT LEVEL IN µg/m³

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5 TERRESTRIAL ECOLOGY

5.1 INTRODUCTION

This section presents the baseline ecological information for the area to be affected by the Project "Construction of Roads and Drains to serve the Housing Development in Areas 56, Tuen Mun". Field surveys were undertaken in August 1997 to establish the ecological importance of the Project area, and the potential ecological impact associated with the Project was evaluated. Mitigation measures are recommended where necessary to minimise any adverse impacts on the terrestrial ecology.

5.2 GOVERNMENT LEGISLATION AND STANDARDS

There are a number of international and local regulations, legislation and guidelines in Hong Kong which provide the framework for the protection of animals and plants species, and habitats of ecological importance, including:

- *Forests and Countryside Ordinance (Cap 96) of the Revised Edition 1994;*
- *Wild Animals Protection Ordinance (Cap 170) of the Revised Edition 1994;*
- *Technical Memorandum on Environmental Impact Assessment Process EIA Ordinance (Cap 499) (TMEIA);*
- *Town Planning Ordinance (Cap 131);*
- *Hong Kong Planning Standards and Guidelines* (HKPSG); and
- *United Nations Convention on Biological Diversity.*

The *Forests and Countryside Ordinance (Cap 96)* prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on government land. Its subsidiary Regulations prohibit the picking, felling or possession of listed rare and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was last amended in 1994 under the *Forestry (Amendment) Regulation 1994* made under *Section* 3 of the *Forests and Countryside Ordinance (Cap 96).*

Under the *Wild Animals Protection Ordinance (Cap 170),* designated wild animals are protected from hunting, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals are protected under this Ordinance. Prior approval from the Director of Agriculture and Fisheries is required for permission to destroy any of the protected wild animals listed in the Ordinance. The Second Schedule of the Ordinance which lists all the animals protected was last revised in June 1994.

Annex 16 of the *Technical Memorandum of the EIA Ordinance* sets out the general approach and methodology for the assessment of ecological impacts arising from a project or proposal to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. Annex 8 recommends a list of criteria that can be used for evaluating ecological impact.

The amended *Town Planning Ordinance* (TPO) provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Green Belt or other specified uses that promote conservation or protection of the environment, eg conservation areas. Where SSSIs are covered by statutory town plans, the land

uses therein are controlled by the provision of the Town Planning Ordinance. The authority responsible for administering the TPO is the Town Planning Board (Planning Department).

The new revised *Chapter 10* of the *Hong Kong Planning Standards and Guidelines* (HKPSG) covers "Conservation". This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.

The PRC are Contracting Parties to the *United Nations Convention on Biological Diversity* of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. The Hong Kong Government has stated that it will be "committed to meeting the environmental objectives" of the Convention in 1996.

5.3 BASELINE INFORMATION

The proposed roads and drains project serving the housing development at Tuen Mun Area 56 is located at So Kwun Wat. The surrounding environment of the project area comprises mainly rural villages, open container storage, and other bare ground that were all disturbed in nature. Potential ecological habitat, such as woodland and wasteland, were mainly found scattering along the proposed work alignment. Owing to the scope of development of the project, the size of the area to be affected, as well as the physical environment of the project area, the potential ecological impact is believed to be localised, and the study area for ecology will focus on the immediate vicinity of the project area.

5.3.1 *Habitat / Vegetation*

Habitat types found along the proposed work alignment included secondary and plantation woodlands, shrub-grass mosaic, seasonal wetland, open area and urbanised area. A map showing the Study Area and the locations of various habitat types, is shown in *Figure 5.1a*.

According to the field survey, area along the proposed B11 and B12 were either disturbed or urbanised with the presence of open storage areas and wasteland. Only commo landscaping trees such as *Macarange tanarius* and *Celtis sinensis* were found along the existing road. It is considered that the ecological value of these area should be limited and will not discussed further in the following sections. For the other part of the project work area, a detailed descriptions of the various habitat types are given below.

Plantation Woodland

Two types of plantation woodland were found within the Study Area. The first one is an Acacia plantation located at the end of LB1 in between the open storage and the existing road. The height and average diameter at breast height (dbh) of the *Acacia confusa* found within the woodland ranged from 5-7 m and 12-14 cm respectively. Except for some common herbaceous plants, which are mostly weedy in nature, little under-storey growth was observed during the field surveys. This patch of plantation is quite young with respect to the habitat

structure and species diversity, it is believed to have been planted for landscaping purposes. Nevertheless, seedings of some pioneer species such as *Bredelia tomentosa* can be found on the edge of the woodland.

Two patches of Tristania planation were identified, to the south of L56B and on the north-east of end of the B1. The *Tristania* plantations are comparatively more mature than the *Acacia* plantation mentioned above. These woodlands have closed canopies ranged from 4 - 12 meter high, and the understorey growth is vigrous with many shade tolerant shrubs and young tree saplings including *Litsea rotundifolia, Desmos cochinchinesis* and *Bridelia tomentosa*. Many large specimens of some native pioneer tree species, such as *Sapium discolor, Sapium sebiferum* and *Mallotus panicualatus* were also present within this woodland. A list of plant species is shown in *Annex E, Table E1*.

Secondary Woodland

There are several patches of secondary woodland scattered along the whole work alignment, except the one on the hill-slope opposite to the valley north east of L56A, this habitat patches are mainly small in size, with little under-storey growth and a low canopy of 3-6 m. All of the secondary woodlands along the existing road are either established on previously disturbed ground or suffer frequent disturbance. Pioneer tree species such as *Mallotus paniculatus* and *Sapium discolor, Rhus succedanea* and *Ficus hispida* are the dominant species found within these woodland habitat.

On the contractary, the secondary woodland on the hill-slope was much more intact and mature, with a mix of native tree species of different ages and dense under-storey growth. The upper-storey of these woodland is ranged from 6 -14 m tall and the under-storey layer is covered by shade-tolerant shrubs and trees. Species found are all typical of such habitat in lowland Hong Kong, including *Ficus hispida, Ficus microcarpa, Cartoxylon liquestrum, Bridelia tomentosa* and *Rhus succedanea*. A species list of secondary woodland is shown in *Annex E, Table E2*.

Since all of these woodlands are fragmented in nature and surrounded by heavily disturbed areas or area of low ecological quality, their importance in supporting wildlife of ecological importance is believed to be limited. However, the presence of dense native tree cover in the secondary woodland on the fill-slope might provide feeding and roosting ground for some wildlife.

Orchard

An orchard planted with common fruit tree species, such as Chinese Wampee (*Clausena lansium*), Longan (*Dimocarpus longan*) and Banana (*Musa paradisiaca*) was found along the northern edge of the Tristania plantation in between the open storage and the plantation. Although this orchard is small in size, it forms a contiguous tree cover with the plantation woodland behind, and some common tree saplings and shade tolerant shrubs can be found on the edge of the orchard. However, due to the active management of the orchard, very little growth was found in the ground layer, and weedy species *Mikania micrantha* and *Ipomea carica* were abundant in open areas.

Shrub-Grass Mosaic

The shrub-grass mosaic is located on the north-east side of the northern end of L56A, forming a dense vegetation cover 1 - 2 m tall. The fire indicator,

Dicranepteris linearis, was found dominated the ground floor suggesting that these area has been suffered from frequent hill-fires, and the habitat as resulted from natural succession process. Dominant species for each vegetation life form include the trees *Cratoxylom liquestrum, Litsea glutinosa* and *Schefflera octophylla*; the shrubs *Rhodomyrtus tomentosa, Eurya japonica* and *Rhapiolepis indica*, the climbers *Gnetum montana* and *Milletia nitida*, the herbs *Dianella ensifolia* and *Asparagus cochinchinensis*; as well as the grasses *Ischaemum spp.* and *Cymbopogon spp.*. A list of species is shown in *Annex E, Table E3.*

Wasteland

Wasteland habitat is mainly along the proposed work alignment, established on previous disturbed ground and open in nature. Vegetation cover is mostly dominated by common and wide-spread weedy plants species that are typical to other disturbed areas in rural Hong Kong, such as the grass *Panicum maxima*, the shrub *Lantana camara* and the herb *Mikania micrantha*. Owing to the disturbed nature of the wasteland, no important wildlife is expected to be supported by this habitat type. A species list of wasteland is shown in *Annex E, Table E4.*

Aquatic Habitat

Several patches of "seasonal wetlands" were found on the bare surface along the eastern end of the proposed work alignment. This type of habitat is formed after rain water being retained in the depressed area of the bare surface; or floods out from drainage trenches. The maximum water depth of these "seasonal wetlands" ranges from 2 -8 cm, and vegetation remains sparse with less than 20 % grassy cover over the water body. It is believed that such transient habitats support opportunist species which can utilize such variable resources.

Another aquatic habitat is the tidal channel running south-west across the open storage area in between Road L56B and Road B1. This channel is completely lined with concrete and regularly flushed with brackish water. Although some riparian vegetation (*Ficus hispida* and *Ficus superba*) were found along the bank side, terrestrial ecological resources, with the possible exception of some brackish water fish, are presumably absent.

5.3.2 *Animal Wildlife*

Very little wildlife was observed during the site visits. Only five common and wild-spread species of bird (Black-eared Kite, Chinese Bulbul, Magpie Robin, Spotted Doves and Magpie) were sighted. More than 100 tadpole of an unknown species were also found in those seasonal wetlands mentioned above. However, given the disturbed nature of the surrounding environment, as well as the fragmented and simple structure of the habitats, no animals of recognised conservation or ecological importance are expected to be supported within the study area, but the presence of fruit bats (*Rousettur leschenaulti* and *Cynopterus sphinx*) dispersed trees, *Schefflera octophylla, Ficus superba* and *F. microcarpa* in the secondary woodland indicated that bats may occur within the study area. All bats are protected under the Wild Animal Protection Ordinance in Hong Kong.

5.4 *Ecological Importance*

The current study shows that except for the secondary woodland on the hill-slope opposite to the valley north-east of Road L56A, all of the habitats found along the

proposed alignment are either established on previous disturbed ground or suffer frequent disturbance, and are all small in size and fragmented in nature with a simple structural complexity and poor species diversity. None of the species observed are rare or protected under the current legislation in Hong Kong, and it has been noted that the utilization of these habitats by wildlife is likely to be limited due to the disturbed physical environment and poor quality of the existing habitat.

Based on the survey results and making reference to the evaluation criteria recommended in the Annex 8 of the *TMEIA*, namely naturalness, size, species diversity, rarity, representativeness, fragmentation, potential value and typicalness; the ecological value of the secondary woodland situated on the hill-slope is considered to be moderate, whilst that of the other areas is considered to be poor.

5.5 IMPACT ASSESSMENT

5.5.1 *Construction Phase*

The major source of ecological impacts associated with the proposed Project in Area 56 will be direct habitat loss resulted from landtake for the construction of the new carriageways, stormwater drains, box culvert, retaining walls and landscape replanting along the roadsides, which will also indirectly affect the wildlife associated with the habitats. Habitats that would be affected include wasteland, scrub-grass mosaic, plantation woodland orchard, and young secondary woodland. Since it is identified in *Section 5.4* that these habitats are all poor in ecology; the severity of the impact arising from the project during construction in terms of ecology should be limited. The secondary woodland on the hill-slope that considered with A" moderate ecological value" will not be affected by the project.

Regarding the indirect impact to the wildlife fauna, the impact is also considered to be limited due to the typicalness and limited potential to provide important habitat to wildlife of those area that going to be affected by the project. For the unknown species of amphibian, the impact should also be limited given the transient nature and commonness of the seasonal wetland in rural area, and the disturbed surrounding area is not expected to support any important species of amphibian.

However, the increased human activities in the Study Area during construction may increase the risk of hill-fires and threaten the surrounding habitats, as most of the hill-fires in Hong Kong are anthropogenic in origin. However the impacts can be controlled by good construction practice as recommended in *Section 5.6*.

5.5.2 *Operational Phase*

Since no wildlife of recognised ecological importance is expected to be present in the immediate vicinity of the surrounding environment, the potential impacts arising from the operation of roads are considered negligible and no mitigation measures are considered necessary.

5.6 MITIGATION MEASURES

In order to mitigate the potential adverse impact identified in the previous Sections, as well as avoiding any adverse ecological impact to the surrounding environment due to uncontrolled construction activities, the following mitigation measures are recommended:

- to minimise the tree to be cut along the proposed work alignment;
- the woodland area to be lost to the roadwork should be well-defined and minimized as far as possible, and a tree survey should be undertaken for the Project when details of layout are available prior to the construction phase;
- on-site opportunities for advance replanting or compensatory planting should be considered wherever possible, species to be selected should be of native to Hong Kong or the South China region which bear fruits preferred by wintering birds and/or which are larval or adult butterfly food plants;
- any damage that may occur to individual major trees in the adjacent area should be treated with surgery;
- any slope-cutting on the woodland habitat should be minimised to maintain the integrity of the habitat whenever possible;
- if there is any loss of surrounding woodland because of the temporary landtake, the area should be return to original status after completion of the project by on-site tree replanting;
- the exact location of haul routes, storage and works areas etc. should be selected to minimize/avoid disturbance of ecological sensitive areas, such as the woodland, as far as possible;
- fences should be erected along the boundary of construction sites before the commencement of works to prevent tipping, vehicle movements, and encroachment of personnel into adjacent wooded areas;
- regular checks should be made to ensure that the work site boundaries are not exceeded and that no damage is being caused to the surrounding areas;
- the use of burning during construction should be avoided, or such use if unavoidable should be carried out under close supervision; and
- wild and uncontrolled open fires should be strictly prohibited within the work site boundary, and sufficient fire fighting equipment should be provided in the works area.

5.7 CONCLUSION

The existing ecological resources along the Project Area and key ecological issues have been identified and examined. No major impacts have been identified as the only area of value is outside the works area.

Mitigation measures have been recommended to minimise any potential impacts on the terrestrial ecosystem, such as minimising the woodland lost to the works.

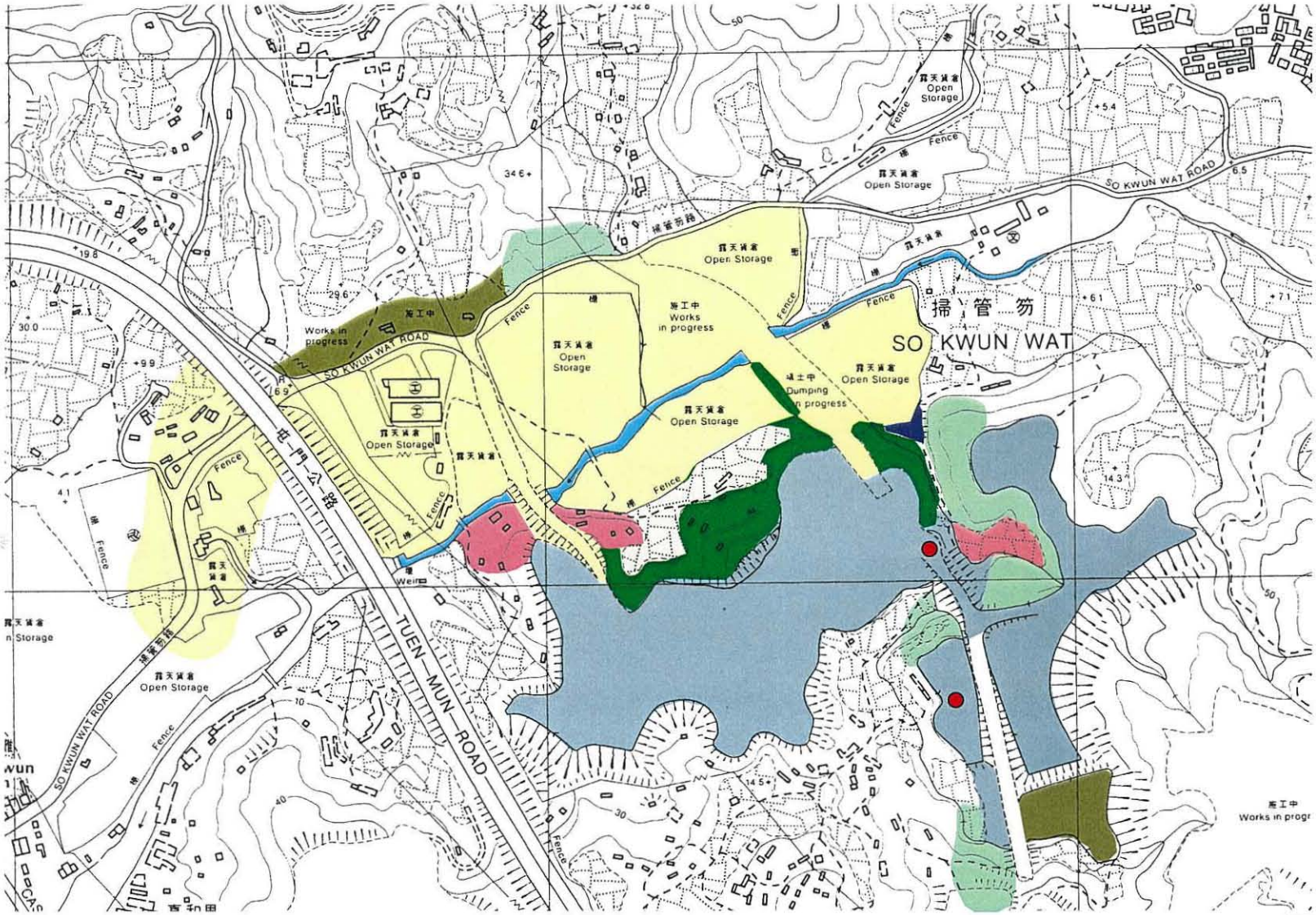

FIGURE 5.1a - HABITAT MAP OF THE STUDY AREA

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ERM

6 LANDSCAPE AND VISUAL IMPACT

6.1 INTRODUCTION

This section identifies the existing and future landscape conditions of the So Kwun Wat area and assesses the potential impacts of the Project, based on the preliminary engineering design. Broad design measures are recommended, where appropriate, to minimise any potential impacts and to enhance the present landscape conditions where possible.

In this assessment landscape impacts refer to the specific physical impacts that the proposed works would have, whereas visual impacts relate to changes that the works would have on existing and future views of the landscape.

6.2 ENVIRONMENTAL LEGISLATION AND GUIDELINES

There is no legislation in Hong Kong that relates directly to the assessment of landscape or visual impacts. However, a degree of control is achieved through the requirement to address such issues as part of an environmental review and assessment process, as contained in the *Technical Memorandum on Environmental Impact Assessment Process, April 1997* (TMEIA) under the *Environmental Impact Assessment Ordinance. Annex 18* of the TMEIA provides guidelines for landscape and visual impact assessment and *Annex 10* presents impact assessment criteria. This assessment has taken reference from these Annexes where appropriate. In addition, *Hong Kong Planning Standards and Guidelines* (HKPSG) *Chapter 10: Landscape and Conservation* outlines those criteria that should be considered in planning. Government requirements on the preservation and felling of trees are detailed in *Government General Regulation 740.*

6.3 ASSESSMENT METHODOLOGY

The prediction and assessment of landscape and visual impacts will be undertaken through adoption of the following methodology.

The visual impact assessment is achieved by the following actions:

- investigate the landscape context of the works area in terms of the surrounding topography, vegetation, land use and landscape character;
- identify the visual envelop of the proposed works;
- identify the key visual receivers who may be affected by the works;
- establish the sources of landscape and visual impacts;
- synthesis of the above information leading to an evaluation of the potential impacts;
- recommend landscaping and visual design measures where necessary to mitigate potential impacts;

- evaluate residual impacts following implementation of mitigation measures.

6.4 BASELINE CONDITIONS

6.4.1 *Existing Landscape Context*

The So Kwun Wat area is situated on a large flat valley floor enclosed on three sides by the hills of the Tai Lam Country Park, to the southwest valley it opens towards the sea. The hills have a rugged appearance with a number of rocky outcrops and are predominantly covered with grass/low scrub with some areas of high scrub/trees, particularly on the lower slopes.

The Alignment is located on the lower part of the So Kwun Wat area which can be divided into two parts, to either side of Tuen Mun Road.

The existing landscape of the area to the north-east of Tuen Mun Road is generally very disrupted rural landscape with large terraces of derelict land and open container storage areas along the main access road, at approximately +4, +6, +20 and +30mPD levels, as illustrated in *Figures 6.4a, 6.4c&d*. The containers, often stacked up to 7 high, form a predominant feature of the area with a variety of grey, blue and red colours, in contrast with the green backdrop of the Tai Lam Country Park and the few scattered low-rise rural settlements. In addition there are the tower cranes for handling of containers as well as container truck movements throughout the area. Near the Tuen Mun Road underpass there are a few small factories and open storage areas for heavy vehicles.

The other main landscape feature is the vegetated areas on the slopes in between platforms at different levels or around settlements. The vegetation varies from scrub to common ornamental and fruit trees. There are also a few grassed cut slopes. *Figures 6.4b-d* shows the existing areas of trees and their locations.

There are a few settlements in the vicinity of the Alignment. The main one is Lo Tsing Shan Tsuen on the foothills to the north with the others scattered around the area (see *Figure 6.4b*). Based on field observations and discussions with the District Office and Planning Department, there are no known significant cultural landmarks such as Fung Shui woodland in the So Kwun Wat area. There are a few urns on a hill slope to the north as indicated in *Figure 6.5a*, which will not be affected by the proposed works. There is also a local shrine, the location of which is shown in *Figure 6.5a*.

The existing main access road forms a predominantly linear landscape feature through the study area, with the upper section not paved. There is also the elevated Tuen Mun Road to the west running south-east/north-west. A concrete-lined water channel runs roughly north-east/south-west but is not highly visible due to its depressed position.

Compared to the lower So Kwun Wat area to the south-east of Tuen Mun Road, the area between Tuen Mun Road and Castle Peak Road is even more disrupted with factories, container storage areas and derelict land. There is a large construction site for the Comprehensive Development Area (CDA) near Castle Peak Road.

Based on the above discussion, the present landscape and visual quality is considered low.

6.4.2 *Future Landscape Context*

According to the Tuen Mun Outline Zoning Plan (S/TM/9, 1997) shown in *Figure 2.2a*, the planning intention of the lower So Kwun Wat area is generally for residential use, with a mixture of Village Type, Residential (A), Residential (B) and CDA developments ranging from low to high rise. There are also two areas of open space next to the So Kwun Wat Road section between Tuen Mun Road and Castle Peak Road. There is also an area of Undetermined use to the immediate east of Tuen Mun Road, subject to future planning studies. It is expected that in the future, the area will have a more urbanised residential character.

6.5 *SOURCES OF IMPACT*

The proposed road works generally follow the alignment of existing roads, except for the eastern section of Road L56B which will be new, as shown in *Figure 6.5a*. The visible component of the completed works will mainly be high quality paved roads with roadside landscaping planting, rising gently up the slope from west to east. There will be a new vehicular underpass crossing Tuen Mun Road, with an open stormwater channel nearby.

The construction activities of the proposed works will be typical of the works of such nature. The main activities that may have landscape and visual impacts will be cut and fill operations along most lengths of the roads to the northeast of Tuen Mun Road as shown in *Figure 6.5a*. There will also be excavation works for the new underpass crossing Tuen Mun Road. Other relatively minor scale activities include site clearance, storm drain and box culvert construction, road pavement and finishes.

6.6 *SENSITIVE RECEIVERS*

The visual envelope of the lower So Kwun Wat area, within which the Project may be visible, is delineated in *Figure 6.6a* based mainly on topographic considerations.

Potential visual receiver groups within the visual envelop that are sensitive to Alignment include:

- residential receivers, typically sensitive to visual impact because of the permanent impact on their daily outlook; and
- recreational users including walkers using the extensive network of footpaths in the Tai Lam Country Park also may be regarded as having a high level of sensitivity to visual intrusion having sought out a natural setting for recreation.

For the purpose of this assessment, transient viewers such as travellers and workers in the area, who are considered less sensitive than permanent residents or recreational users, are not included.

Representative receiver groups for this assessment are identified within the visual envelope as shown in *Figure 6.6a*, based on site investigation and desk top analysis of local topographic and land use plans. It should be noted that as it is

likely that the container storage areas would still be in place during the construction work period, the containers would substantially limit the visibility of the works. In addition due to the flat topography of the valley floor and the generally low-rise nature of residential blocks, as well as screening by vegetation around properties, visibility of the works from the low-rise residential houses will largely be restricted to the immediate vicinity. However the works will be visible from high up locations such as the Country Park or high-rise blocks along the coastal area.

6.7 *LANDSCAPE IMPACTS*

As discussed in *Section 6.4* above, the overall landscape quality of the study area is considered low. However there are localised areas with substantial tree cover that have high landscape value. Therefore, based on the current preliminary layout plan, significant landscape impacts are expected from the loss of the tree covered areas as shown in *Figures 6.4b - d*, particularly for the eastern section of the Road L56B. However, the species which will be lost are common ornamental and fruit trees and there are no rare species identified.

6.8 *VISUAL IMPACTS*

The visual impacts of the proposed works will be mainly during the construction phase, particularly during the cut and fill operations. The overall impacts are not considered to be high based on the following reasons:

- the proposed works will be in a generally disrupted area with low visual quality as described in Section 6.4.;
- the scale of the works as described in *Section 6.5* is not considered large; and
- the impacts on most sensitive receiver groups will be localised due to the generally flat terrain and nature of the works, with substantial screening by the container storage areas and local vegetation, although the users of the Country Park hills will have views of the works, but at a distance.

The main impacts would be on the few properties that are very close to the works, but the impacts would be temporary.

There should be no negative visual impacts during the operational phase. The existing road, part of which unpaved, will be replaced by a high quality serviced road with appropriate landscaping (as recommended in *Section 6.9*) in line with the planning intention of the area; this will be an improvement to the existing visual condition of the road.

6.9 *MITIGATION MEASURES*

Based on the above discussion it is important that appropriate landscape planting be planned and implemented to enhance the future streetscape of the residential areas, retaining existing trees where possible. Mitigation measures are recommended below.

- Hoardings where construction works are located near to properties to

minimise the visual impacts.

- There are significant functional values of trees for shade and visual relief. As natural features of the site, the existing trees also contribute to the character of the locality and soften the urbanised landscape. It is therefore recommended as a principle that the loss of the existing trees should be minimised as far as practicable. For the proposed eastern section of Road L56B, considerations should be given to adjustment of the road alignment further to the north and minimisation of required works area.

- Close to the junction of Castle Peak and So Kwun Wat Road, street side tree planting is recommended. Tall evergreen species should be selected to mark this major junction as a focal point from Castle Peak Road. This will contribute towards building an identity and image for the lower So Kwun Wat areas.

- The section of the existing So Kwun Wat Road to be re-aligned between Tuen Mun Highway and Castle Peak Road has been entrusted to the developer of the CDA site. Therefore, the tree species to be planted by these works should be in line with the proposals of this EIA.

- To the north of the CDA site, the section of So Kwun Wat Road in the vicinity of the G/IC and Open Space areas should be lined with medium size trees with wide canopy spread to provide shade as this area is zoned for public use.

- For the underpass of Tuen Mun Road, landscaping of the median strip is recommended to signify entry to Area 56 development. Low ground cover of interesting colourful species and columnar trees such as palms should be selected; this will allow sight lines for road traffic. On the nearside verges of roads B11 and B12 medium sized screening type tree species are proposed. Efforts should be made to group trees where land permits. In addition, it is also recommended that planters above the underpass are considered as part of the design for the structure. Hanging plants such as bougainvillea could be planted to add colour and to make it a more pleasant space.

- The character of the Roads B1 and Road L56A as the major access roads are defined as an urban street and medium size shading trees are proposed to line the route to the subsequent development areas. A number of tree species should be introduced to create variety in the streetscape. However, ornamental trees are proposed at the junction leading to the different development areas and therefore the mix of species should not compete with the identity of the junctions.

- The street tree planting opposite where the urns are located should not restrict the existing open aspects of the urns as they are at least approximately 5 m above the street level.

- At the junctions ornamental trees with coloured flowers or interesting foliage are proposed. It is also recommended that these junctions are treated with a mix of hard landscaping and low ground cover to allow adequate sight lines for traffic, both for drivers and pedestrians.

- As these are major access roads traffic will be source of visual impact to the future development areas. Therefore, the fill slopes behind the proposed trees along roads B1 and L56A should be planted with screening shrubs within

available land.

- The road works involve limited cut slopes within Area 56, and the majority of the works will require fill material. The cut areas are restricted to the vicinity of junction L56A and L56B and are formed in soil. These are not considered to be large, and as a principle, planting of seedling trees and shrubs should be carried out after an initial hydroseeding or turfing.

- Road L56B is a local distributor road which is narrow in width and limited in the volume of traffic that it will accommodate. It is not yet clear what will be the future use of the undetermined zoned sizes. However, the suggested character of the proposed road is local and it is therefore recommended that the landscaping of the road is more open to allow views and pedestrian access. It is recommended that medium size species with ever green or interesting foliage are planted on both sides of the road. However, on the southern side, planting should be augmented with shrubs to link the existing vegetation on the upper parts of the retained slope.

- For the 0.8m high roadside barriers in the form of planters required for sections of Roads B1 and 56B (see *Figures 3.5 g&h*), ornamental plant, low shrubs or trees that allow sightlines for road traffic are recommended.

- It is recommended that the Landscape Master Plan to be developed at the next stage of the Project should take into account the recommendations of this EIA study.

- A Tree Survey should be undertaken at the following stage of the Project when details of layout are available, to identify existing trees that will be inevitably loss and to provide a basis for the Master Landscape Plan for the proposed works for the necessary compensation planting. However it is expected at this stage that the street planting proposed would provide adequate compensation for the loss of the existing trees.

- The current road layout impinges on the local shrine. Should this be unavoidable, re-location of the shrine would need to be considered, in liaison with local residents.

Figures 6.9a-6.9d illustrate the above landscaping proposals. Further selection should be made after identifying soil type, root character in relation to the location and life span required. *Table 6.9a* shows a list of typical plant species that could be used for this project.

Table 6.9a *Typical Plant Species for Landscaping*

Plant Groups	Species
Tall, Evergreen Trees	*Cinnamomum camphora**
	*Ficus microcarpa**
	*Hibuscus tiliaceus**
	*Schima superba**
	Aacacia confusa
	Acacia mangium
	Araucaria cunninghamii
	Cassia siamea
	Casuarina equisetifolia
	Eucalypyus speciosa
	Ecualypyus citriodora
	Eucalypyus torreliana
	Eucalypyus
Medium, Wide Canopy Trees	*Hibuscus tiliaceus**
	*Litsea monopetala**
	Erythrina arborescens
	Lagerstroemia speciosa
	Mangifera indica
	Salix babylonica
Medium Trees with Colourful Flowers	*Bauhinia blakeana**
	*Castonapsis fissa**
	Cassia fistula
	Callistemon viminalis
	Cassia nodosa
	Cassia spectabilis
	Jacaranda acutifolia
	Lagerstroemia speciosa
	Spathodea campanulata
Small Trees with Interesting Foliage	*Cinnamomum burmanaii**

* Native Species

6.10 RESIDUAL IMPACTS

With the implementation of the recommended mitigation measures, the residual landscape and visual impacts are considered to be acceptable. Positive visual impacts would be generated by the additional landscape mitigation measures described in *Section 6.9* resulting in a widespread improvement in the visual quality of the landscape. They would also mitigate any negative impacts generated by the noise barriers.

6.11 CONCLUSION

The existing landscape of the lower So Kwun Wat area is generally very disrupted with large platforms of derelict land, container storage areas and a few properties. The scale and nature of the proposed works in the present landscape and visual context is not expected to have significant impacts. There will however be inevitable localised loss of tree areas that are significant in the local landscape.

The loss of existing trees should be minimised where possible. Landscape plantings are proposed for the works to compensate for the loss of existing trees and to enhance the future streetscape of the lower So Kwun Wat area for

residential developments. With the implementation of the proposed landscape mitigation measures, the residual impact of the works are considered to be acceptable.

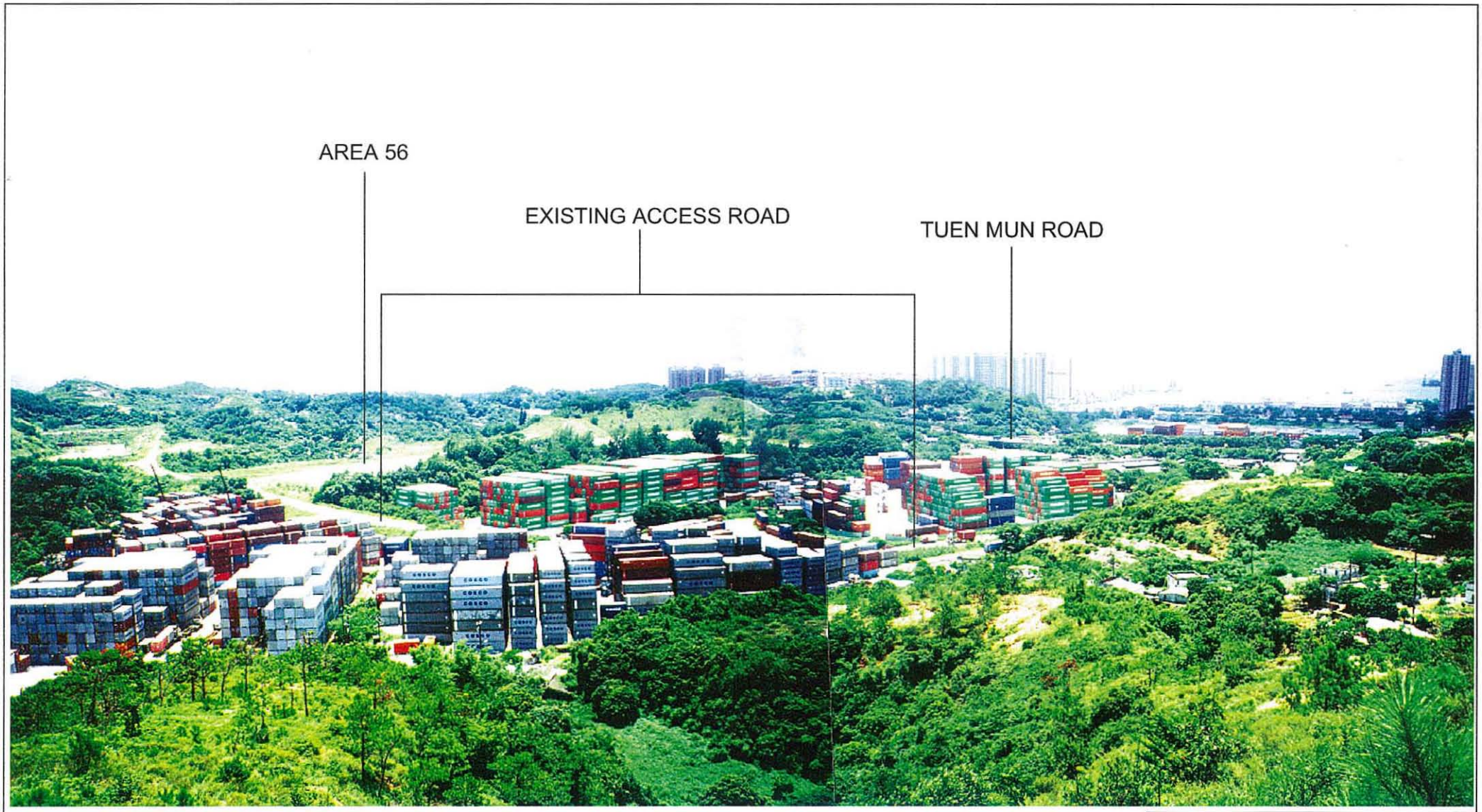

FIGURE 6.4a - A VIEW OF LOWER SO KWUN WAT AREA

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Hong Kong

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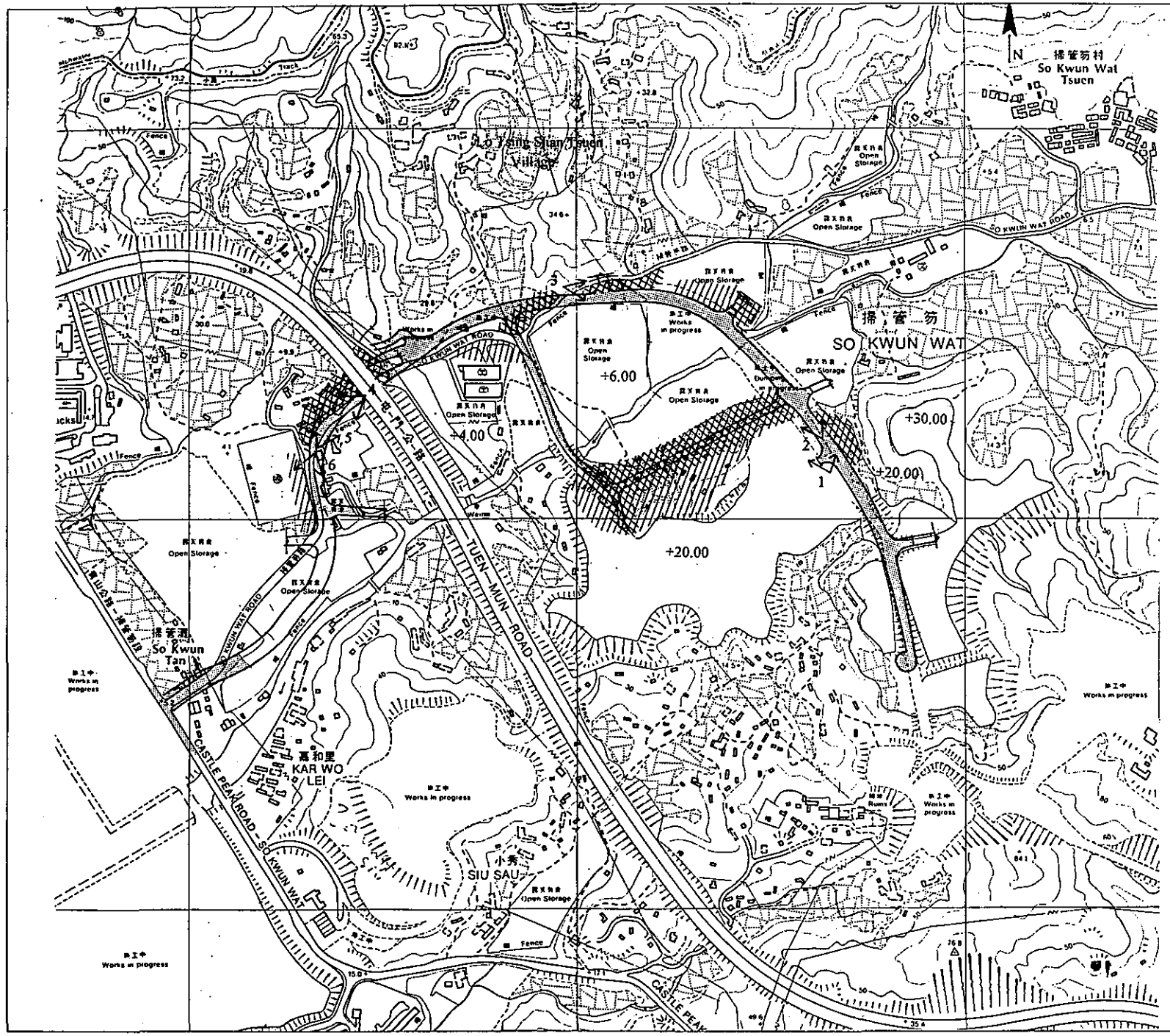

FIGURE 6.4B

EXISTING TREES ALONG THE PROPOSED ROAD

Proposed Road

Existing trees not affected

Existing trees affected

Photo. Location

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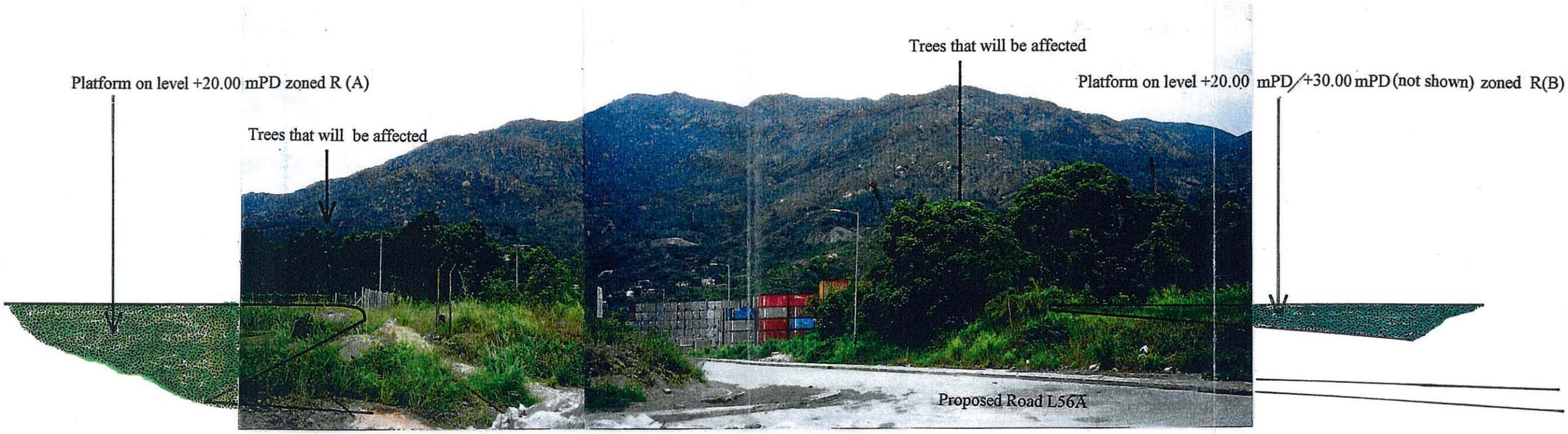
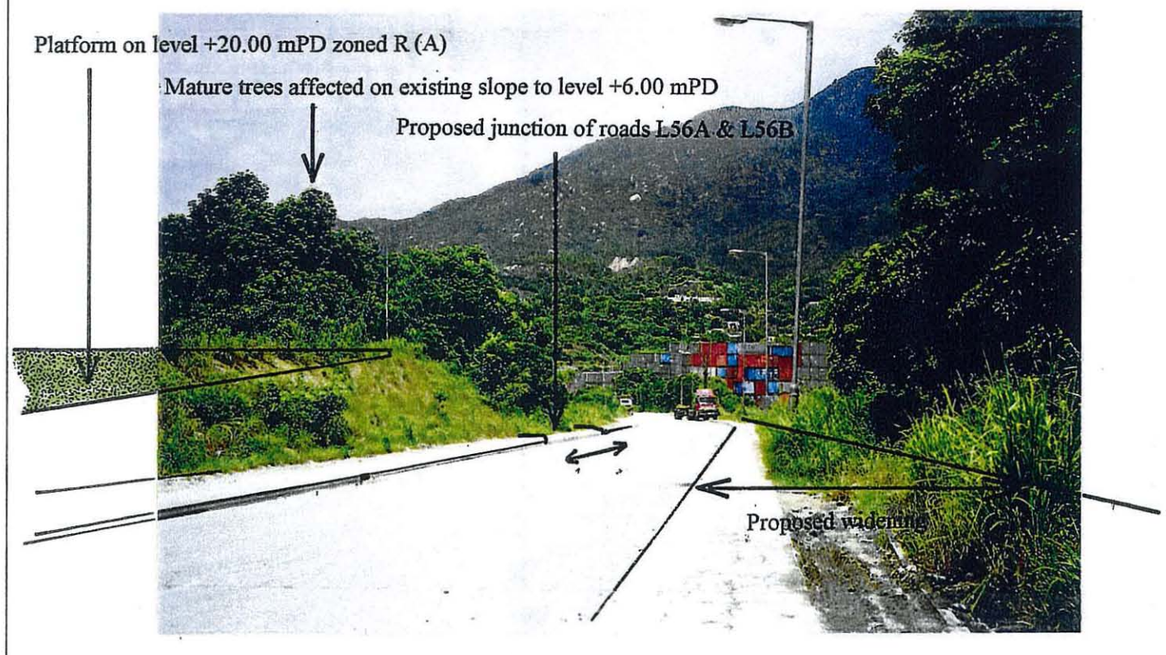
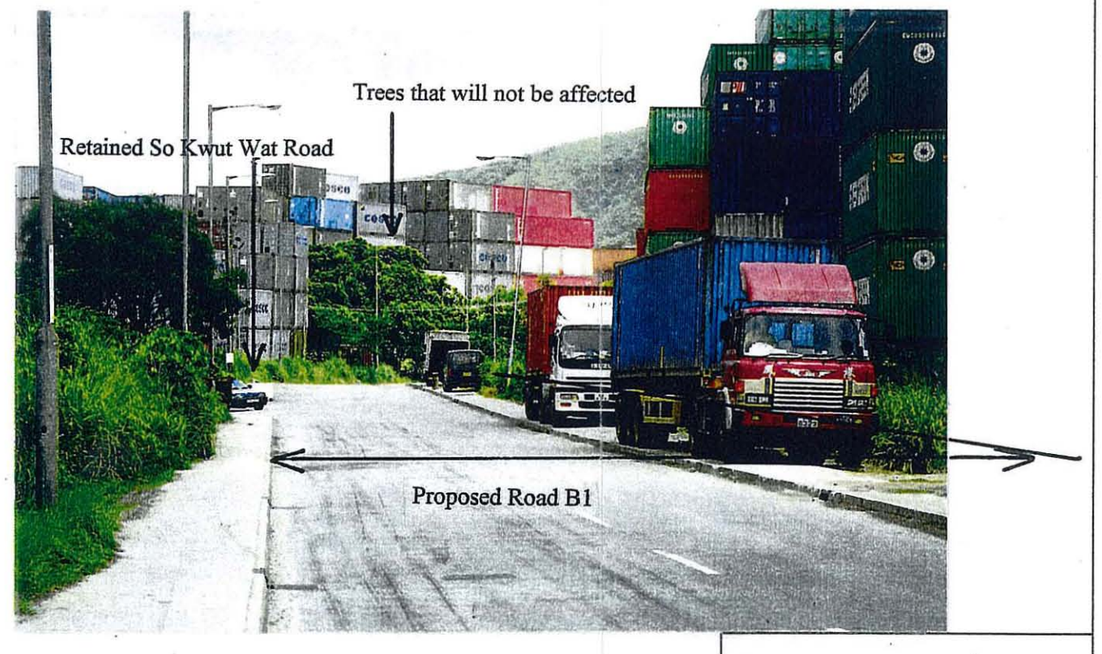


P.1 –View From The Existing Entry Point To The Platform on Level +20.00 Zoned R(A)



P.2–View Along Proposed Road L56A



P.3–View Along Proposed Road B1 Towards Junction With Retained So Kwut Wat Road

FIGURE 6.4C

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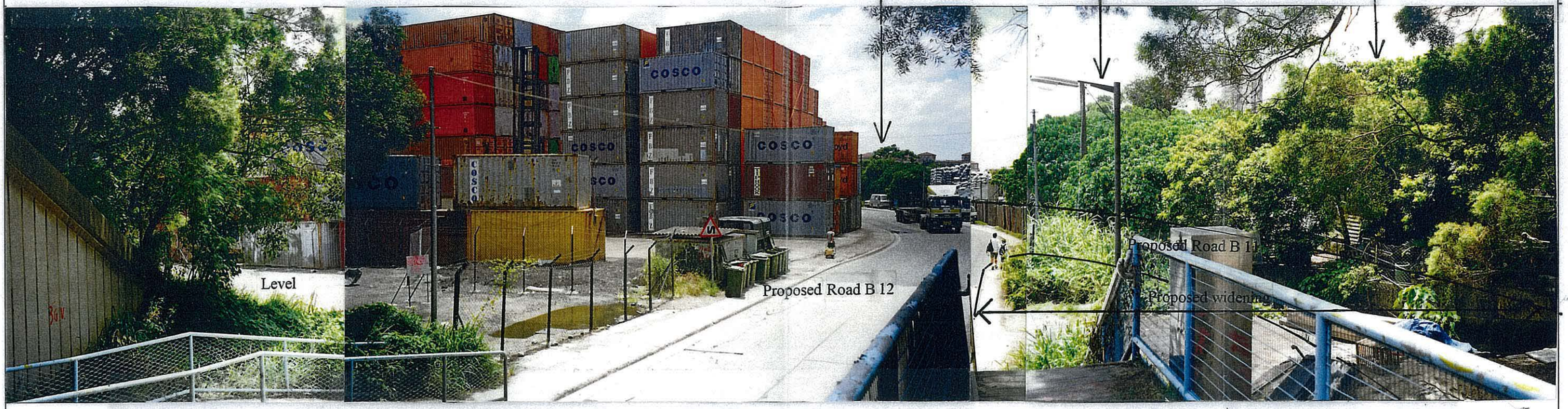
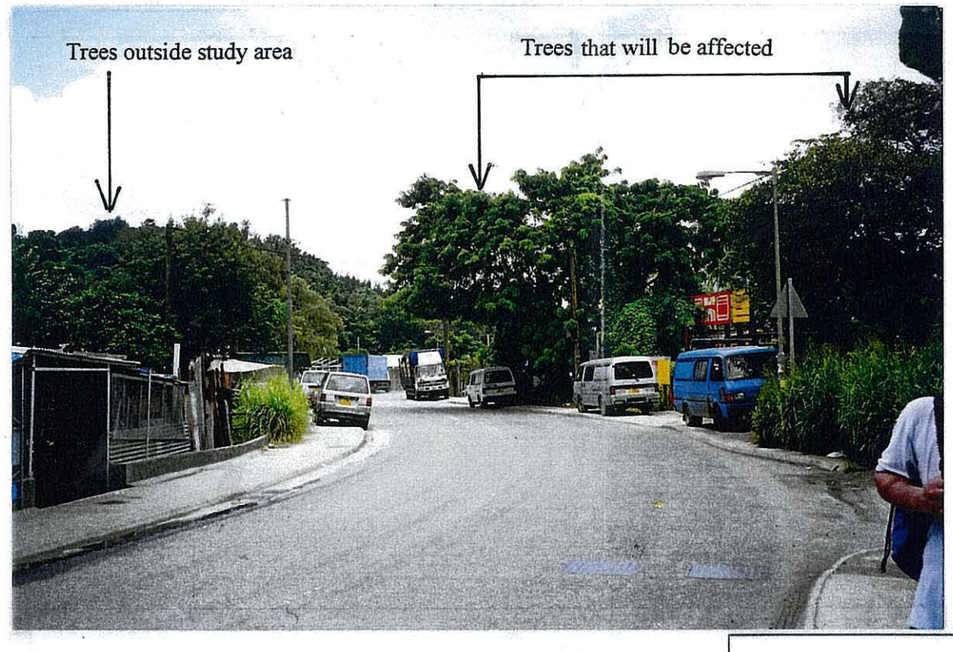


P.4 — View From The Raised Pedestrian Walkway At Tuen Mun Underpass

P.5 — View Along Proposed Road B2 Towards Tuen Mun Underpass



P.6 — View Along Proposed Road B2 Towards Area 55

FIGURE 6.4D

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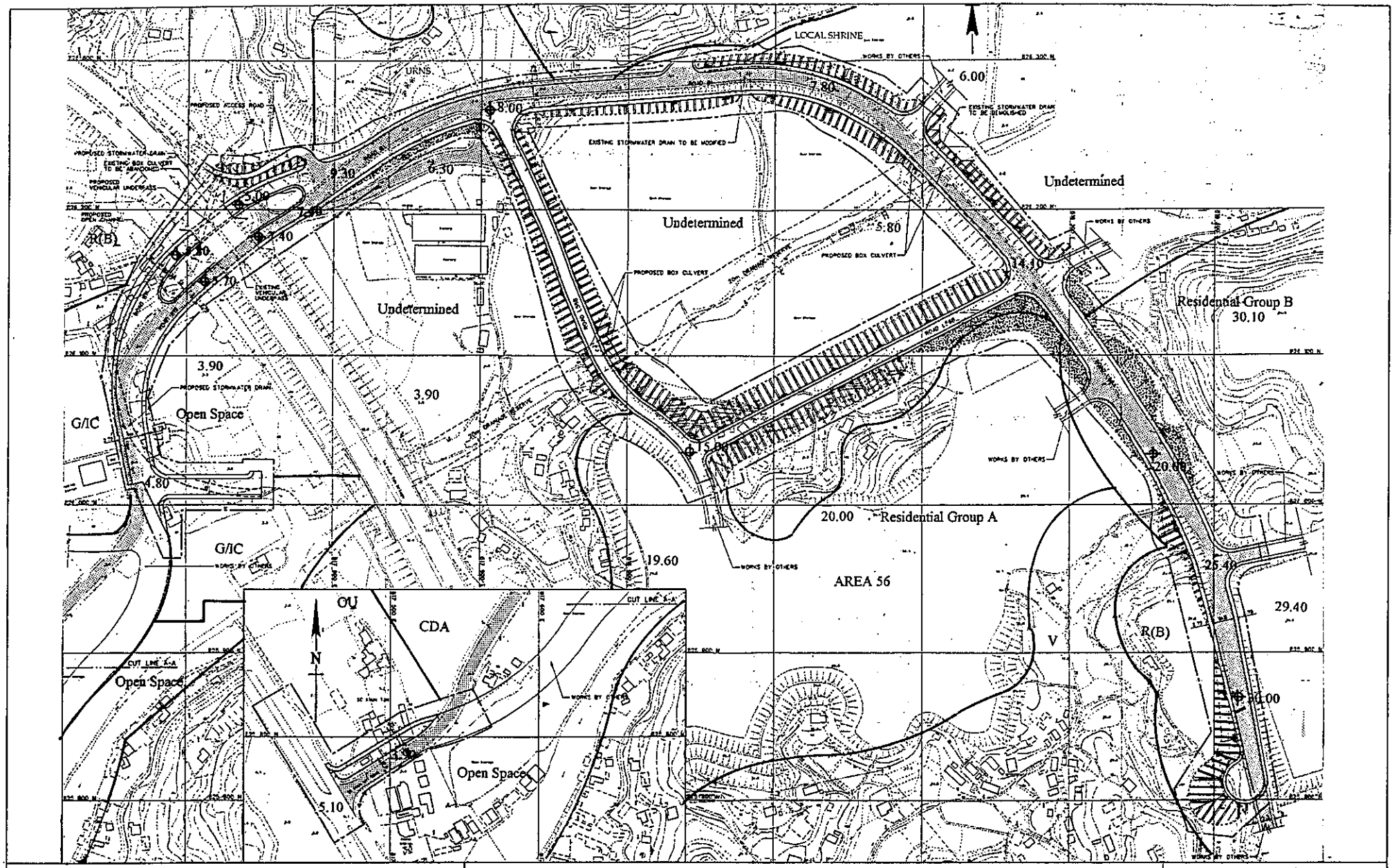

FIGURE 6.5A PROPOSED WORKS

LEGEND:

- Existing road
- Proposed works limit
- Proposed fill slope
- Proposed cut slope
- +6.00 Existing spot level
- +6.00 Proposed road level

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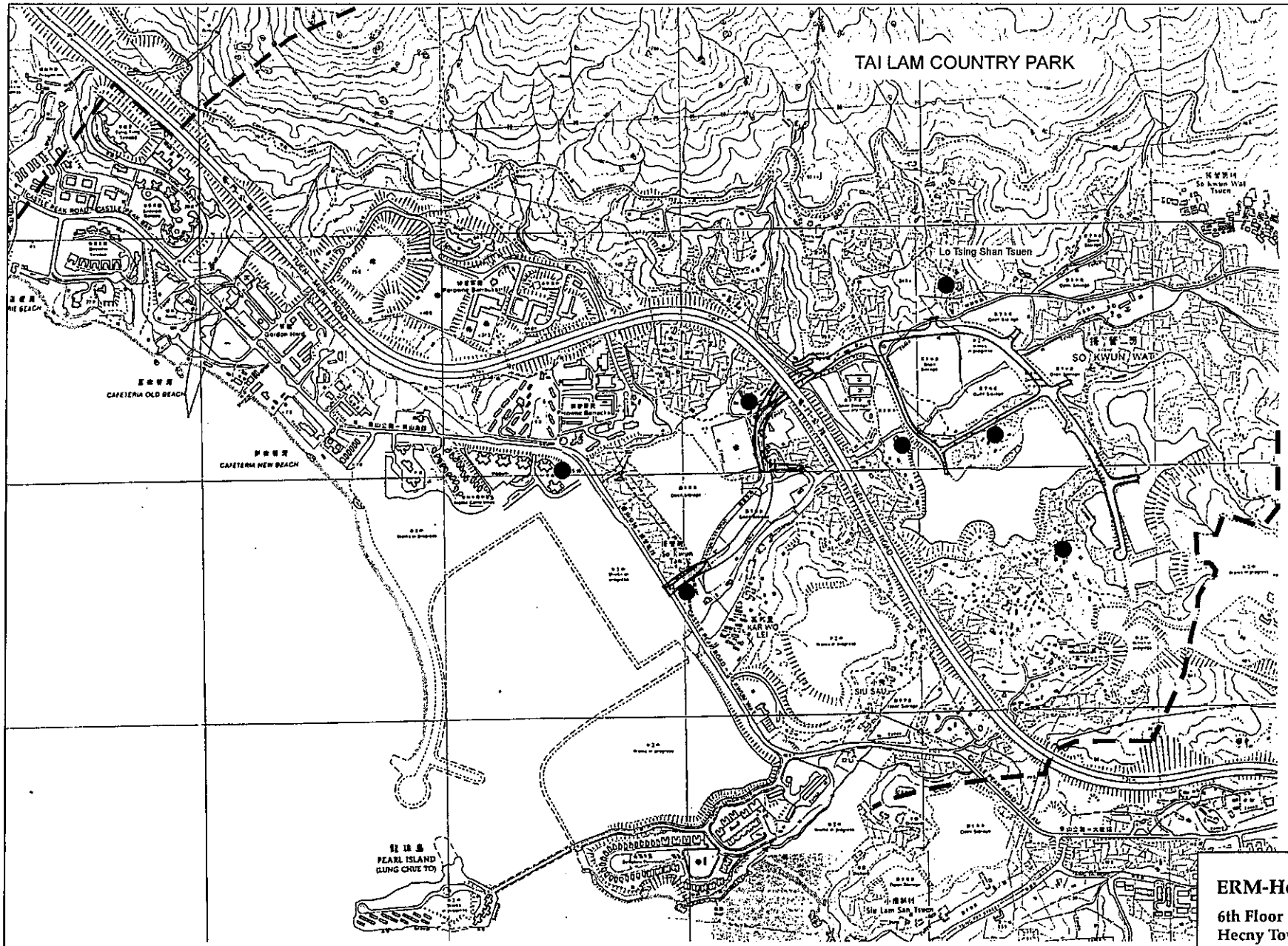

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FIGURE 6.6a - VISUAL ENVELOP AND RECEIVER GROUPS

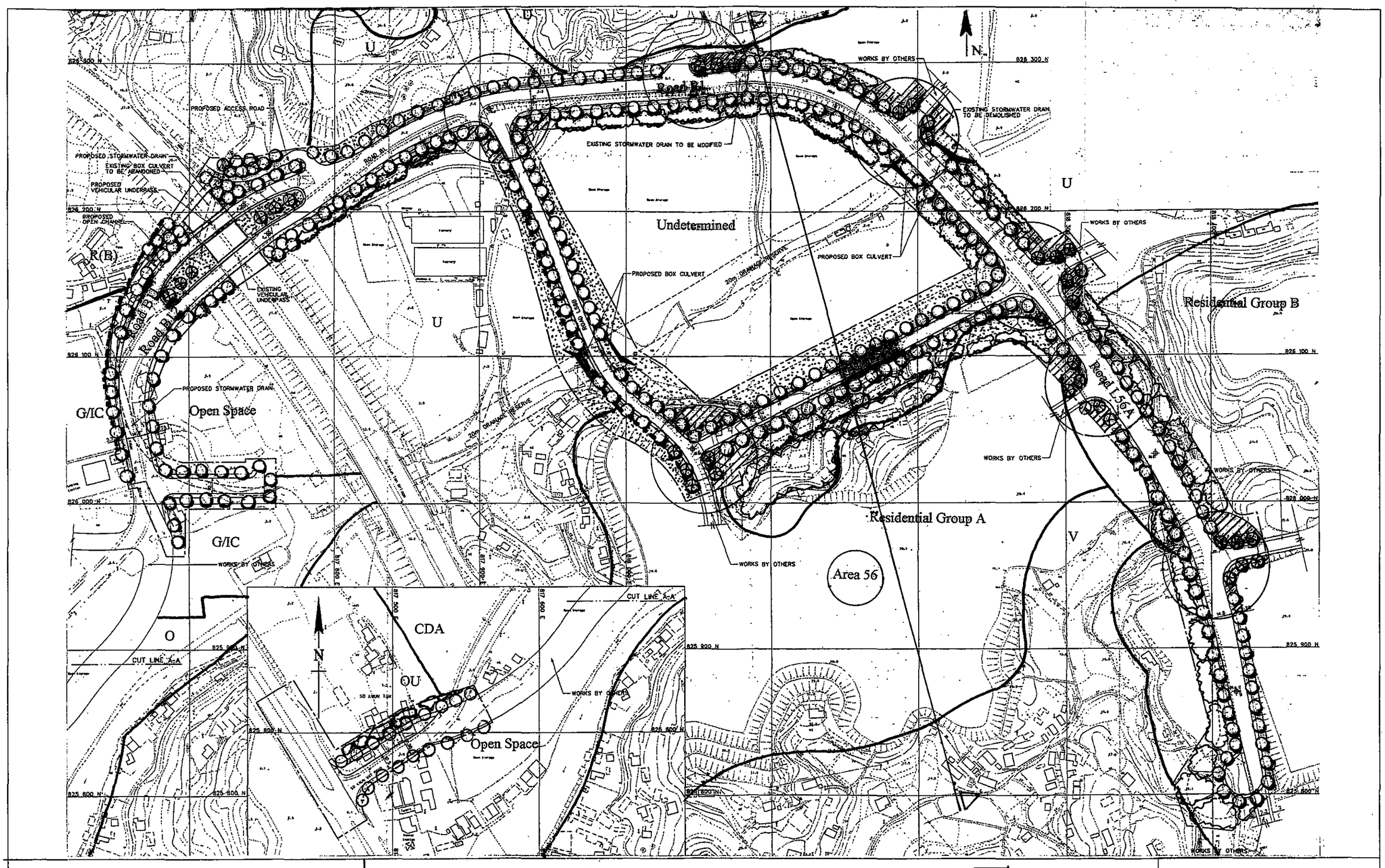

FIGURE 6.9A
LANDSCAPING CONCEPT PROPOSAL

LEGEND: U Urns; Noise Barriers; Proposed Scrub; Existing Scrub; Proposed Trees; Proposed Ornamental Trees; Low Ground Cover; Hard Landscaping

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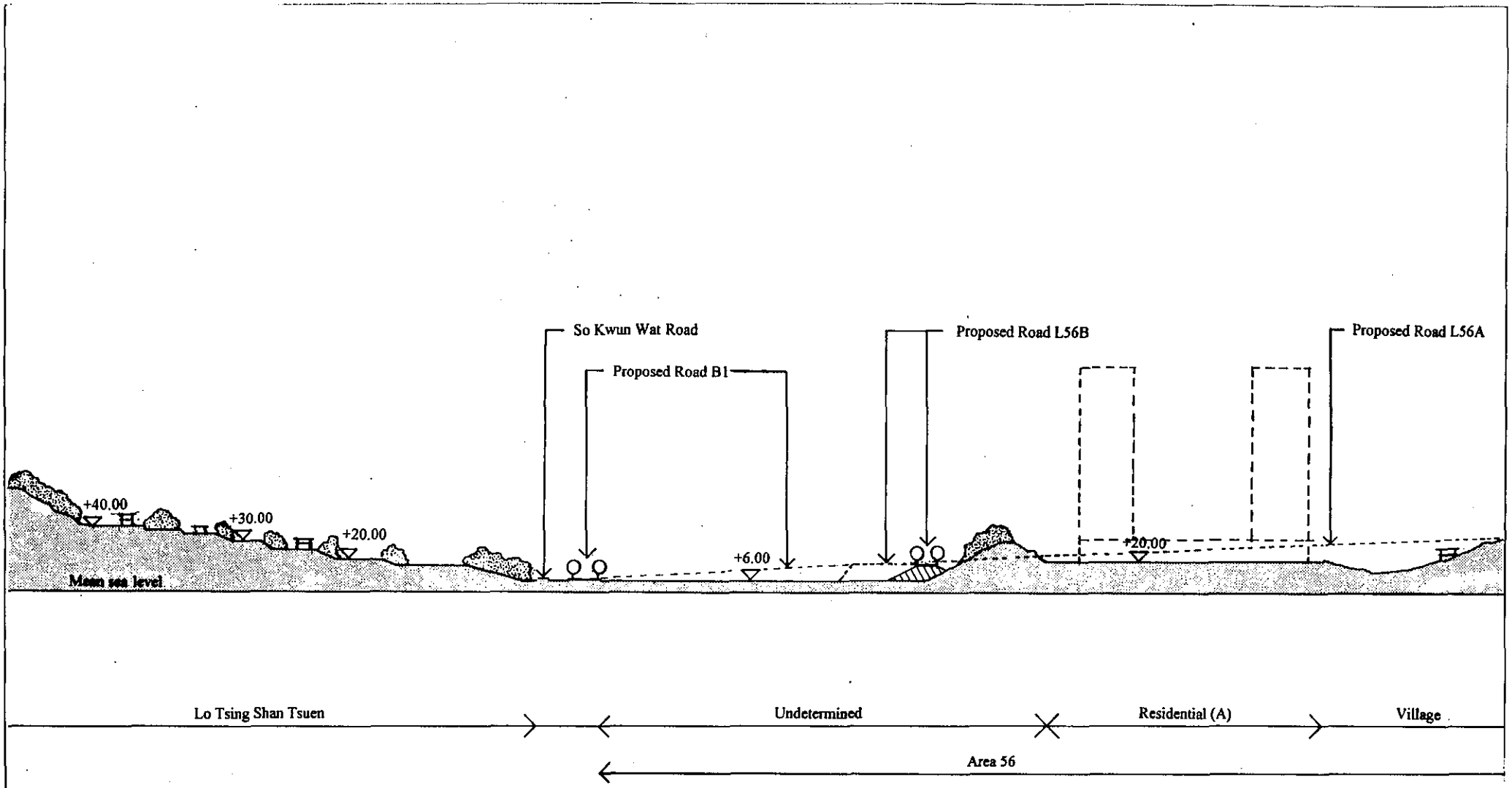

FIGURE 6.9B SECTION THROUGH LO TSING SHAN TSUEN AND AREA 56

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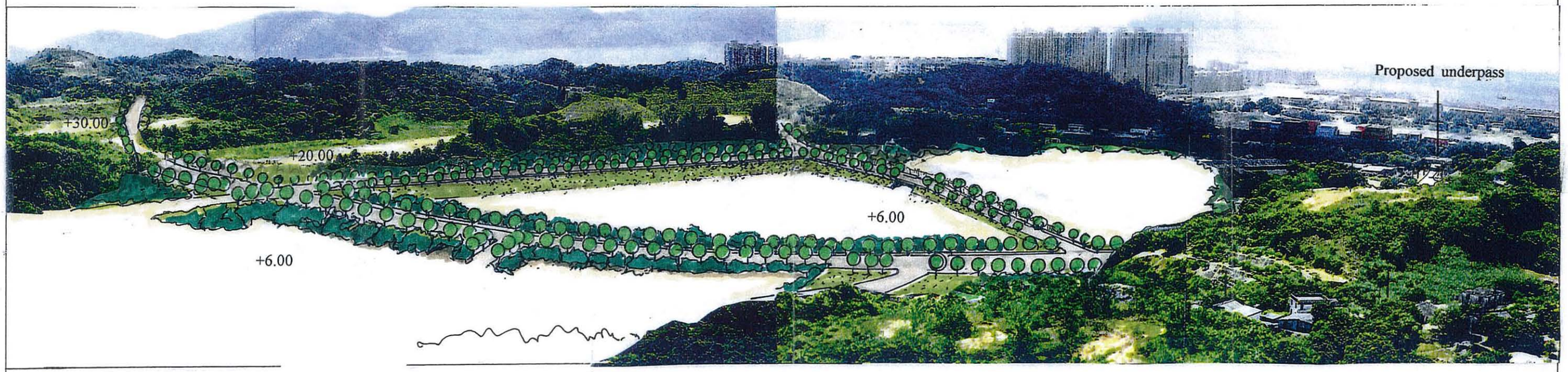
VIEW SHOWING THE EXISTING LANDSCAPING



PHOTOMONTAGE SHOWING THE PROPOSED LANDSCAPING FOR THE WORKS

FIGURE 6.9C

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EXISTING VIEW FROM AREA 56 TOWARDS TUEN MUN ROAD UNDERPASS

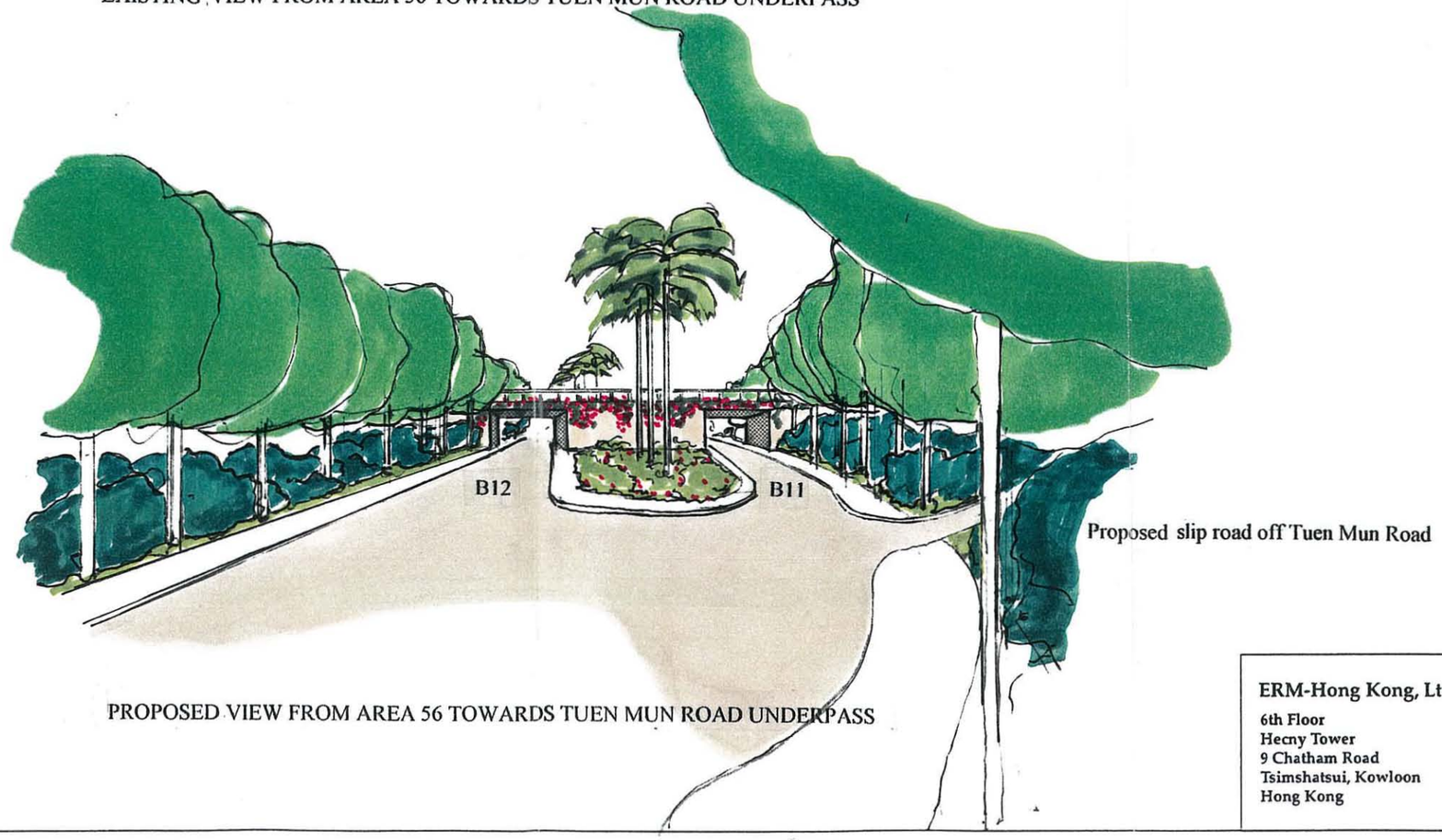

FIGURE 6.9D

PROPOSED VIEW FROM AREA 56 TOWARDS TUEN MUN ROAD UNDERPASS

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7 ENVIRONMENTAL MONITORING & AUDIT

7.1 INTRODUCTION

This Section presents the Environmental Monitoring and Audit (EM&A) requirements that have been included into the EM&A Manual for the Project. This Section describes the necessary EM&A requirements based on the findings of the assessment in the previous sections of this report. As discussed in *Sections 3 and 4*, construction noise and dust will lead to exceedance of environmental criteria and therefore EM&A at the affected sensitive receivers are recommended.

7.2 OBJECTIVES OF ENVIRONMENTAL MONITORING & 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.

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

7.3 CONSTRUCTION NOISE

Noise produced during the construction phase will impact upon nearby noise sensitive receivers (NSRs) as assessed in *Section 3*. The primary noise sources include excavators, dump trucks, loaders and rollers. The construction noise criteria of 75 dB(A) will be exceeded at some of the representative NSRs if construction noise is unmitigated.

7.3.1 *Mitigation Measures*

Noise mitigation measures have been recommended in the EIA report to reduce the noise impact to within the noise criteria and are presented in *Section 3.5.3*.

It is anticipated that if the mitigation measures described in *Section 3.5* can be successfully applied, the noise levels experienced by the affected receivers will be reduced to within the noise criteria.

7.3.2 *Monitoring Locations*

Noise monitoring requirements have been recommended in the EM&A Manual in order to ensure compliance with the criteria. Noise monitoring should be carried out at the NSRs N1, N9, N12, N14, N18, N20 (See *Figure 3.3b)* and additional locations considered necessary, in agreement with the Environmental Protection Department (EPD).

7.4 *Construction Dust*

The construction work will inevitably lead to dust (total suspended particulates (TSP)) emissions, mainly from excavation, truck haulage and material handling. It is predicted that the dust generated will exceed the hourly criteria of 500 $\mu g\ m^{-3}$ at the ASR A9 - A12, A14, A16 and A17 (See *Figure 4.4a*).

7.4.1 *Mitigation Measures*

Mitigation measures are presented in *Section 4.5.4* and recommended to limit the dust emission and dispersion. With proper dust control measures as part of good construction site practice, the TSP levels at the affected air sensitive receivers will comply with the dust criteria.

7.4.2 *Monitoring Locations*

Dust monitoring requirements have been recommended in the EM&A Manual to ensure the efficacy of the control measures. Monitoring stations should be set up at the village houses, A11 and A12.

8 CONCLUSIONS

This EIA Report has provided an assessment of the potential environmental impacts associated with the construction and operation of the proposed road and drain works. It can be concluded that the works will comply with environmental standards and legislation, provided that the recommended environmental control measures are implemented. The principal findings of the EIA are summarised below.

Noise

The Project is expected to result in exceedances of the daytime construction noise criteria of 75 dB at some NSRs. A set of broad mitigation measures have been recommended to reduce the impacts to the acceptable level, checked by the EM&A procedures set out in the EM&A Programme in *Section 7*. Further mitigation measures may be required for works during restrictive hours to achieve the evening and nighttime noise criteria, if work during these periods are required.

The potential traffic noise impacts associated with the operation of the Alignment have been assessed for the worst case traffic flows for the year 2016. The use of high noise barriers are limited by road design and sightline constraints, and the series of discontinuous 3m & 5m high noise barriers along the Alignment was found to be ineffective. The use of 0.8m roadside noise barrier will not be constrained by sightline requirement and is recommended in the form of planters located along the junction of Castle Peak Road/So Kwun Wat Road, Road B1 and Road L56B. Residual impacts are expected at approximately 17 existing dwellings and they are eligible for consideration for indirect technical remedies, as a last resort, in the form of window insulation and air-conditioning, subject to ExCo approval. Residual impacts at the planned NSRs have been assessed. However, it is considered that the noise exceedances could be mitigated by careful building layout and design such as increasing setback distance and use of noise tolerant building structures for screening.

Air Quality

Dust levels would be high in some construction period due to the proximity of the ASRs. Infrastructure construction will be the major dust generating activities. Dust suppression measures such as watering have been recommended to reduce these impacts to acceptable levels. The AQO criteria will be met with the incorporation of the mitigation measures, checked by the EM&A procedures set out in the EM&A Programme. During operational phase, vehicular exhaust emissions will be the major pollutant sources and it is assessed that the AQO will be satisfied at all ASRs.

Ecology

No major ecological impacts are expected as the habitats affected are all with low ecological value. Mitigation measures have been recommended to minimise the potential impacts.

Landscape and Visual

The existing landscape of the lower So Kwun Wat area is generally very disrupted with large platforms of derelict land, container storage areas and a few properties. The overall landscape and visual impacts of the Project is considered to be low. However, a loss of significant tree areas is expected in the local landscape.

A Tree Survey to identify the loss of existing tree is proposed prior to the construction of the Project. Landscape plantings have been proposed to compensate for the loss of existing trees and to enhance the future streetscape of the lower So Kwun Wat area for residential developments to be incorporated into the Landscape Master Plan at the following Project stage. The residual impact of the Project is considered to be acceptable, with the incorporation of the proposed landscape mitigation measures.

Annex A

Traffic Forecasts

TRAFFIC FORECASTS

Introduction

Traffic forecasts for the environmental assessment were derived in the first instance from traffic flows developed during the So Kwun Wat PSPS Tuen Mun Area 56 Traffic and Environmental Impact Assessment Study (Wilbur Smith Associates, December 1996). Traffic data from this source was then advanced to the year 2016 using growth rates implicit in the Enhanced CTS-2 transportation model (ECTS-2). Initial 2016 flows were then adjusted using more detailed local data pertaining to development levels and traffic patterns at individual sites.

Existing Forecasts

The Final Report of the So Kwun Wat PSPS Tuen Mun Area 56 Traffic and Environmental Impact Assessment Study was prepared on behalf of the Hong Kong Housing Authority in December 1996. The report presents detailed AM and PM peak traffic flows for the year 2001 and 2011. These flows were derived using the following principals:

- manual classified traffic counts were taken for all significant turning movements in the study area to give a picture of present patterns;
- background through traffic for the forecast year was derived from the ECTS-2 model;
- background local traffic for the forecast year was derived by applying ECTS-2 growth factors to the 1996 traffic counts;
- traffic from additional developments due to be in place by the forecast year was added by applying trip rates to agreed development schedules.

In order to advance these traffic forecasts to the 2016 scenario required for the EIA, the following procedures were carried out:

- growth factors to the year 2016 were developed from the ECTS-2 model and applied to the existing 2011 peak hour forecasts to derive initial 2016 forecasts;
- adjustments were made to local traffic patterns to account for revised development schedules in the area.

Initial 2016 Forecasts

The ECTS-2 model was used to determine traffic growth rates between the years 2001 and 2011 in the study area. This exercise determined an annual compound growth rate which was then applied to the 2011 peak hour forecasts applicable to the background traffic forecasts.

For background through traffic, growth rates were determined from ECTS-2 flows on the relevant links of Castle Peak Road and Tuen Mun Road. In some cases, especially Tuen Mun Road, negative growth was observed. This is due to the introduction of new competing infrastructure such as the Sham Tseng Link and West Rail which would reduce flows on Tuen Mun Road between the years

2001 and 2011. However, for the sake of this exercise it was considered unlikely that traffic would continue to fall beyond 2011 after the introduction of such schemes. In these cases therefore, negative growth was not applied and the original 2011 forecast was retained in order to maintain a conservatively high traffic forecast.

For the local area background traffic the growth rate was derived from the ECTS-2 forecast traffic growth in the zone that represents the study area (Zone 157). The growth rates so derived are shown in *Table A1*.

Table A1 ***Local Area Background Traffic Growth Rates***

Direction	Annual Compound Growth Rate	
	AM	PM
To Castle Peak Road	5.2%	5.6%
From Castle Peak Road	4.8%	5.0%

Revised Development

The study area is zoned to contain numerous new developments. In general these developments have been included in the 2011 traffic forecasts presented in the original study. However a review of these developments was carried out to determine recent revisions and additional post 2016 proposals. Consultation with Planning Department revealed that the schedules for a number in the vicinity had been revised since the earlier forecasts were produced. The sites reviewed are shown in *Figure A1* and the changes identified are shown in *Table A2*.

Table A2 Planned Future Developments

SITE	DESCRIPTION	DEVELOPMENT SCHEDULE (NO. OF UNITS)			COMPLETION YEAR
		Original (I)	*Revised (where relevant) (II)*	*Difference (II) - (I)*	
1 & 3	Hong Kong Gold Coast multiple land use	1,334	-	-	Largely completed
2	Redevelopment of container storage / repair sites for private residential	1,520 plus 1,447 sq.m GFA retail space	1,248 plus 1,447 sq.m GFA retail space	-272	1999
4	Redevelopment of military site for private residential	207	96	-111	2000
5	Private residential	443	-	-	2001
6	Comprehensive Development Area – R(B) Private residential	760	-	-	1999
7	Private residential	1,680	860	-820	1999
8	Private residential	12	-	-	2001
9	R(B) Private residential	0	2,000	+2,000	2001
10	Private residential	0	38	+38	1999
11	Private residential	0	80	+80	1998
12	Private residential	0	42	+42	1999
13	Private residential - Tai Lam Chung (Phase 1)	0	547	+547	2000
14	Private residential	0	182	+182	1999
15	Redevelopment of existing open storage area for R(B) private residential	0	165	+165	2000
16	Harbour Centre Development – CDA on reclamation	3,000 plus 9,700 m^2 retail GFA	-	-	2003
17	Redevelopment of military sites for R(B) type private residential	2,970	1,900	-1,070	2002
18	R(B) private residential	466	-	-	2005

SITE	DESCRIPTION	DEVELOPMENT SCHEDULE (NO. OF UNITS) Orginal (I)	Revised (where relevant) (II)	Difference (II) - (I)	COMPLETION YEAR
19	CDA (redevelopment of existing CSR site for R(B) type private residential	263	-	-	2005
20	CDA – redevelopment of site for R(B) private residential	1,500	-	-	2005
21	R(B) private residential	120	-	-	2005
22	Village type housing	34	102	+68	2005
23	R(B) private residential	120	-	-	2002
24	So Kwun Wat Village Extension	410	960	+550	2006 - 11
25	R(B) private residential	72	-	-	2002
26	R(B) private residential	128	-	-	2005
27	Tai Lam Chung Village expansion	0	1,050	+1,050	2006 - 11
28	Private residential -Tai Lam Chung (Phase 2)	0	432	+432	2002

Sources: Tuen Mun and Yuen Long District Planning Office, Planning Department, August 1997.
For Hong Kong Gold Coast development – Sino Properties, January 1995.

It can be seen from the *Table A2* that all sites with revised schedules are residential in nature. Revised traffic forecasts for these sites were determined by applying trip rates to the revised level of development. The trip rates applied are shown in *Table A3*, and were derived from the following sources:

R(B) - Surveys at Bayview Gardens, Tuen Mun East (December 1994, WSA);

R(3) - DR431;

In selecting trip rates the new DR 439 was reviewed, which represents the latest data pertaining to trip rates in Hong Kong. It was noted that trip rates for the two relevant land uses were lower in DR439 than those detailed above. In this case it was considered desirable to include the highest possible traffic generation from new developments in order to create a conservative traffic case for environmental assessment. Use of these trip rates also allowed for consistency with the previous study.

Table A3 *Assumed Trip Rates*

Land Use	Trip Rate (pcu/flat)			
	AM Peak		PM Peak	
	In	Out	In	Out
R(B) Residential	0.084	0.269	0.251	0.188
R(3) Residential	0.182	0.393	0.316	0.342

Trip rates were applied to both old and new development schedules to determine the net change in traffic generation that could be expected. The resultant changes in traffic flows were included in the background traffic forecasts using manual assignment techniques and a distribution consistent with that applied to the original forecasts.

The resultant traffic flows are summarised in *Figure A2*. It should be noted that the figure shows only a summary of forecast flows. For the actual environmental assessment a more detailed breakdown of vehicle type was determined based on traffic mix data available from ECTS-2.

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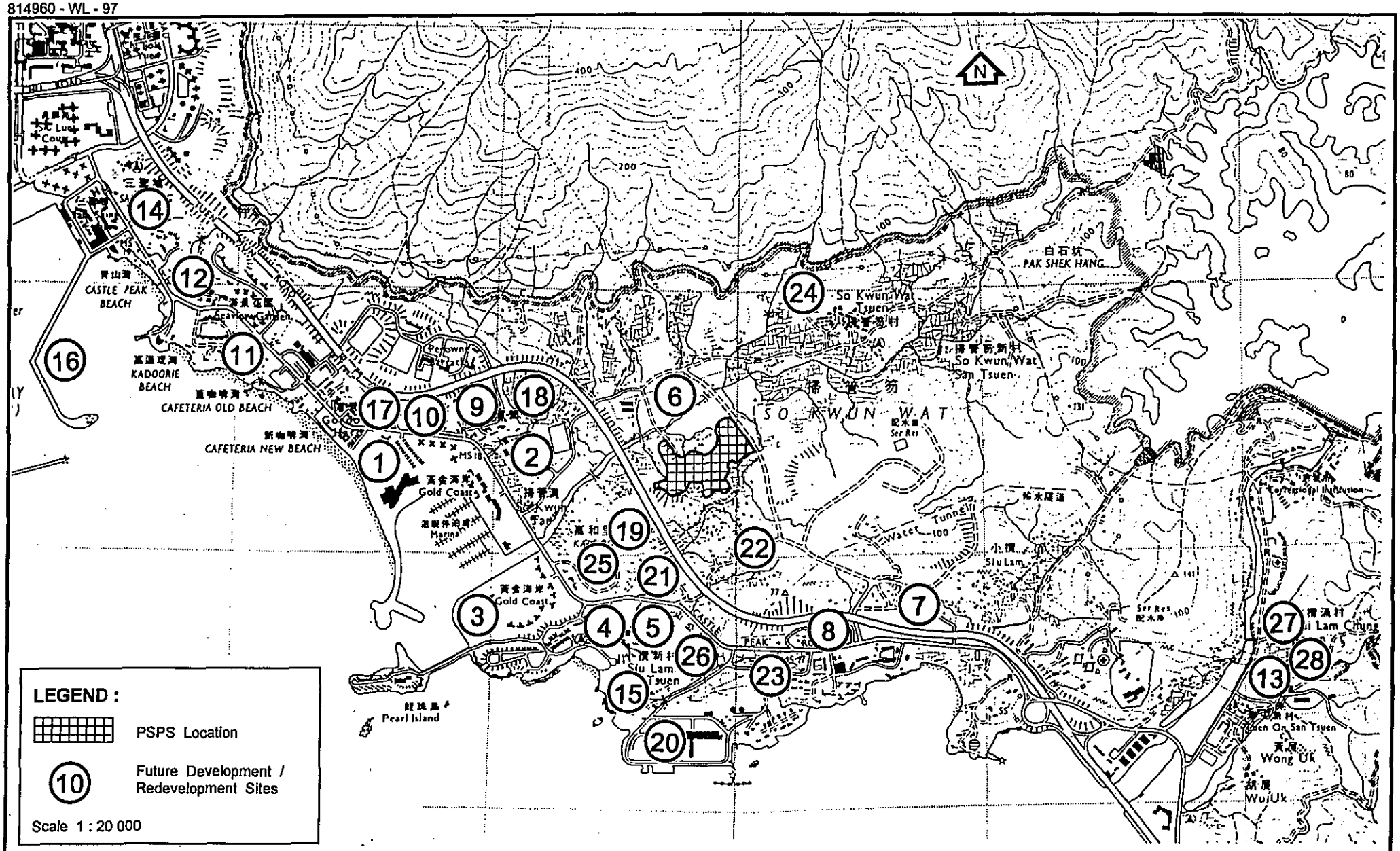

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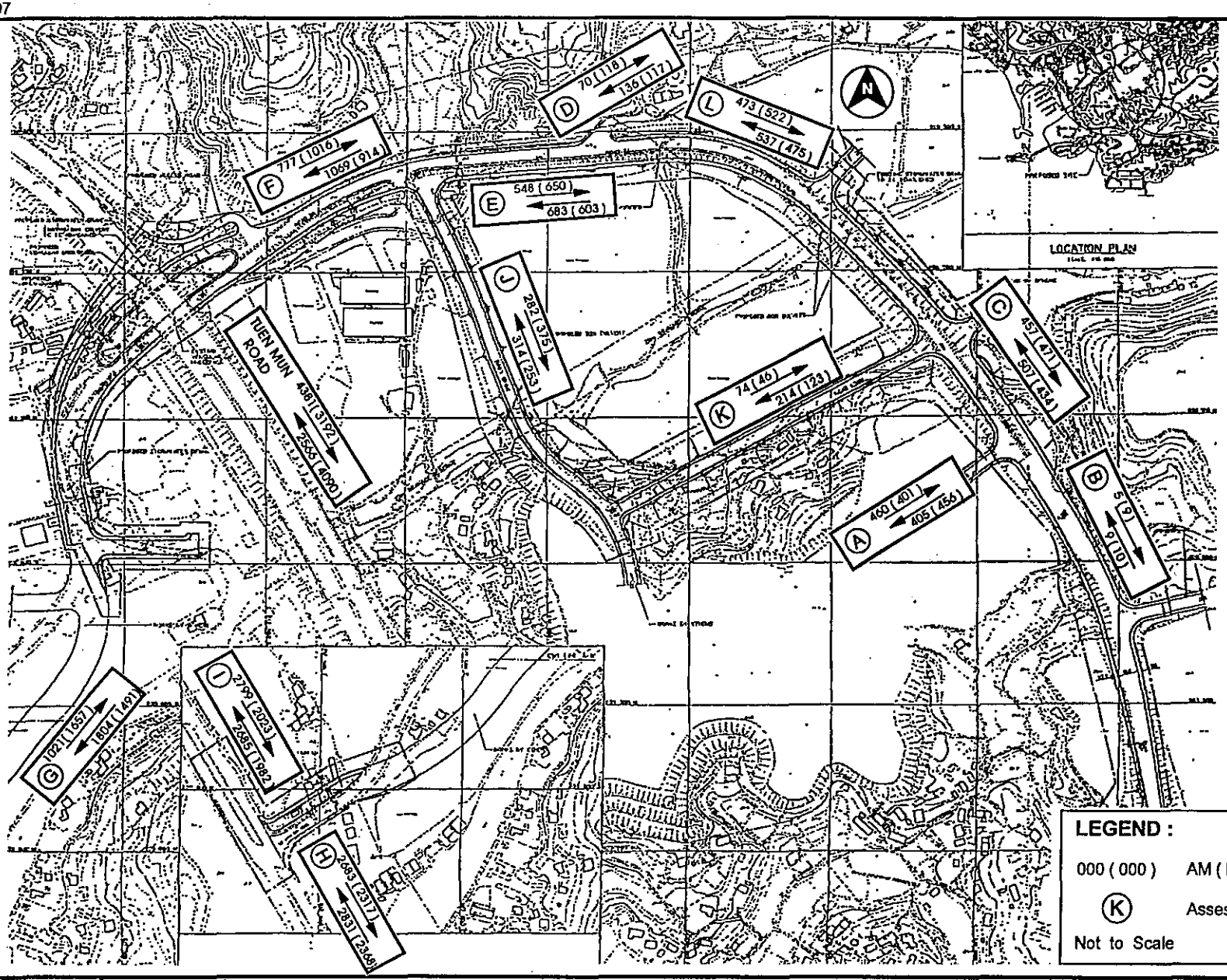
Construction of Roads and Drians to Serve
The Housing Development in Area 56, Tuen Mun
Environmental Impact Assessment Study

PLANNED / PROPOSED FUTURE DEVELOPMENTS

Figure : A1

814960 - WL - 97



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Agreement No. CE 5/97
Construction of Roads and Drians to Serve
The Housing Development in Area 56, Tuen Mun
Environmental Impact Assessment Study

2016 PEAK HOUR TRAFFIC FORECASTS

Figure : A2

Annex B

Plant Inventory

Table B1 - No mitigation measures

For NSR 1 - 6

Sitework					
Site clearance	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator	CNP081	1	112	112
	Generator	CNP101	1	108	108
	Compressor	CNP003	1	104	104
	Beaker, hand held	CNP027	1	122	122
	Lorry	CNP141	1	112	112
				Area Total SWL	123
At grade road widening	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Lorry	CNP141	1	112	112
	Grader	CNP104	1	113	113
	Roller	CNP185	1	108	108
	Loader	CNP081	1	112	112
				Area Total SWL	118
Storm drains construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	1	108	108
	Air compressor	CNP003	1	104	104
	Mobile crane	CNP048	1	112	112
	Excavator	CNP081	1	112	112
	Lorry	CNP141	1	112	112
				Area Total SWL	118
Box culvert construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	1	108	108
	Air Compressor	CNP003	1	104	104
	Mobile Crane	CNP048	1	112	112
	Excavator	CNP081	1	112	112
	Lorry	CNP141	2	112	115
				Area Total SWL	119
	Sheet piling	-	1	129	129
Retaining Wall	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator	CNP081	1	112	112
	Lorry	CNP141	1	112	112
	Concrete Truck	CNP044	1	109	109
				Area Total SWL	116
Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(opening Tuen Mun Road)	Excavator	CNP081	2	112	115
	Lorry	CNP141	2	112	115
	Concrete mixer	CNP046	1	96	96
	Concrete pump	CNP047	1	109	109
	Crane	CNP049	1	95	95
	Generator	CNP101	1	108	108
	Vibrator	CNP170	1	113	113
	Piling(diaphrahm w	CNP162	1	105	105
				Area Total SWL	120
Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(tunnelling)	Rock drill, crawler	CNP182	1	123	123
	Excavator	CNP081	2	112	115
	Lorry	CNP141	2	112	115
	Breaker, excavator	CNP027	1	122	122
				Area Total SWL	126
Road pavement and finishes	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry	CNP141	1	112	112
				Area Total SWL	115

For NSR 7 - 22

Sitework

Site clearance	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer	CNP030	2	115	118
	Excavator	CNP081	2	112	115
	Generator	CNP101	1	108	108
	Compressor	CNP003	1	104	104
	Loader	CNP081	1	112	112
	Beaker, hand held	CNP027	1	122	122
	Lorry	CNP141	2	112	115
				Area Total SWL	125

At grade road widening	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Lorry	CNP141	2	112	115
	Dump truck	CNP067	1	117	117
	Excavator	CNP081	1	112	112
	Grader	CNP104	1	113	113
	Roller	CNP185	1	108	108
	Loader	CNP081	1	112	112
				Area Total SWL	121

Storm drains construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	1	108	108
	Air compressor	CNP003	1	104	104
	Mobile crane	CNP048	1	112	112
	Excavator	CNP081	1	112	112
	Lorry	CNP141	2	112	115
				Area Total SWL	119

Box culvert construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	1	108	108
	Air Compressor	CNP003	1	104	104
	Mobile Crane	CNP048	1	112	112
	Excavator	CNP081	1	112	112
	Lorry	CNP141	2	112	115
				Area Total SWL	119
	Sheet piling	-	1	129	129

Retaining Wall	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator	CNP081	1	112	112
	Lorry	CNP141	1	112	112
	Concrete Truck	CNP044	1	109	109
				Area Total SWL	116

Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(opening Tuen Mun Road)	Excavator	CNP081	2	112	115
	Lorry	CNP141	2	112	115
	Concrete mixer	CNP046	1	96	96
	Concrete pump	CNP047	1	109	109
	Crane	CNP049	1	95	95
	Generator	CNP101	1	108	108
	Vibrator	CNP170	1	113	113
	Piling(diaphrahm wall)	CNP162	1	105	105
				Area Total SWL	120

Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(tunnelling)	Rock drill, crawler mounted	CNP182	1	123	123
	Excavator	CNP081	2	112	115
	Lorry	CNP141	2	112	115
	Breaker, excavator mounted	CNP027	1	122	122
				Area Total SWL	126

Road pavement and finishes	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry	CNP141	2	112	115
				Area Total SWL	117

Table B2 - Mitigation measures using Quiet Plant

For NSR 1 - 6

Sitework					
Site clearance	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator(QP)	CNP081	1	105	105
	Generator(QP)	CNP101	1	100	100
	Compressor(QP)	CNP003	1	100	100
	Beaker, hand held(QP)	CNP027	1	110	110
	Lorry(QP)	CNP141	1	105	105
				Area Total SWL	113
At grade road widening	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Lorry(QP)	CNP141	1	105	105
	Grader	CNP104	1	113	113
	Roller	CNP185	1	108	108
	Loader(QP)	CNP081	1	105	105
				Area Total SWL	115
Storm drains construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	1	100	100
	Mobile crane	CNP048	1	112	112
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	1	105	105
				Area Total SWL	114
Box culvert construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator	CNP101	1	108	108
	Air Compressor	CNP003	1	104	104
	Mobile Crane	CNP048	1	112	112
	Excavator	CNP081	1	112	112
	Lorry	CNP141	2	112	115
				Area Total SWL	119
	Sheet piling	-	1	129	129
Retaining Wall	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator	CNP081	1	112	112
	Lorry	CNP141	1	112	112
	Concrete Truck	CNP044	1	109	109
				Area Total SWL	116
Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(opening Tuen Mun Road)	Excavator	CNP081	2	112	115
	Lorry	CNP141	2	112	115
	Concrete mixer	CNP046	1	96	96
	Concrete pump	CNP047	1	109	109
	Crane	CNP049	1	95	95
	Generator	CNP101	1	108	108
	Vibrator	CNP170	1	113	113
	Piling(diaphrahm wall)	CNP162	1	105	105
				Area Total SWL	120
Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(tunnelling)	Rock drill, crawler moun	CNP182	1	123	123
	Excavator	CNP081	2	112	115
	Lorry	CNP141	2	112	115
	Breaker, excavator mou	CNP027	1	122	122
				Area Total SWL	126
Road pavement and finishes	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry	CNP141	1	105	105
				Area Total SWL	112

For NSR 7 - 22

Sitework

Site clearance	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer(QP)	CNP030	2	100	103
	Excavator(QP)	CNP081	2	105	108
	Generator(QP)	CNP101	1	100	100
	Compressor(QP)	CNP003	1	100	100
	Loader(QP)	CNP081	1	105	105
	Beaker, hand held(QP)	CNP027	1	110	110
	Lorry(QP)	CNP141	2	105	108
				Area Total SWL	115

At grade road widening	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Lorry(QP)	CNP141	2	105	108
	Dump truck(QP)	CNP067	1	110	110
	Excavator(QP)	CNP081	1	105	105
	Grader	CNP104	1	113	113
	Roller	CNP185	1	108	108
	Loader(QP)	CNP081	1	105	105
				Area Total SWL	117

Storm drains construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	1	100	100
	Mobile crane	CNP048	1	112	112
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	2	105	108
				Area Total SWL	114

Box culvert construction	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	1	100	100
	Mobile crane	CNP048	1	112	112
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	2	105	108
				Area Total SWL	114
	Sheet piling	-	1	129	129

Retaining Wall	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	1	105	105
	Concrete Truck	CNP044	1	109	109
				Area Total SWL	112

Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(opening Tuen Mun Road)	Excavator(QP)	CNP081	2	105	108
	Lorry(QP)	CNP141	2	105	108
	Concrete mixer	CNP046	1	96	96
	Concrete pump(QP)	CNP047	1	105	105
	Crane	CNP049	1	95	95
	Generator(QP)	CNP101	1	100	100
	Vibrator(QP)	CNP170	1	110	110
	Piling(diaphrahm wall)	CNP162	1	105	105
				Area Total SWL	115

Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(tunnelling)	Rock drill, crawler mounted	CNP182	1	123	123
	Excavator(QP)	CNP081	2	105	108
	Lorry(QP)	CNP141	2	105	108
	Breaker, excavator mounted	CNP027	1	105	105
				Area Total SWL	123

Road pavement and finishes	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry(QP)	CNP141	2	105	108
				Area Total SWL	113

Table B3 - Mitigation measures using Quiet Plant & limited no. of plant

For NSR 7 - 22

Sitework					
Site clearance	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Bulldozer(QP)	CNP030	1	100	100
	Excavator(QP)	CNP081	1	105	105
	Generator(QP)	CNP101	1	100	100
	Compressor(QP)	CNP003	1	100	100
	Loader(QP)	CNP081	1	105	105
	Beaker, hand held(QP)	CNP027	1	110	110
	Lorry(QP)	CNP141	1	105	105
				Area Total SWL	114
At grade road widening	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Lorry(QP)	CNP141	1	105	105
	Excavator(QP)	CNP081	1	105	105
	Grader	CNP104	1	113	113
	Roller	CNP185	1	108	108
	Loader(QP)	CNP081	1	105	105
				Area Total SWL	116
Storm drains construct	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	1	100	100
	Mobile crane	CNP048	1	112	112
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	1	105	105
				Area Total SWL	114
Box culvert constructio	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Generator(QP)	CNP101	1	100	100
	Air compressor(QP)	CNP003	1	100	100
	Mobile crane	CNP048	1	112	112
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	1	105	105
				Area Total SWL	114
	Sheet piling	-	1	129	129
Retaining Wall	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	1	105	105
	Concrete Truck	CNP044	1	109	109
				Area Total SWL	112
Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(opening Tuen Mun Road	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	1	105	105
	Concrete mixer	CNP046	1	96	96
	Concrete pump(QP)	CNP047	1	105	105
	Crane	CNP049	1	95	95
	Generator(QP)	CNP101	1	100	100
	Vibrator(QP)	CNP170	1	110	110
	Piling(diaphrahm wall)	CNP162	1	105	105
				Area Total SWL	114
Vehicular underpass	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
(tunnelling)	Rock drill, crawler mounted	CNP182	1	123	123
	Excavator(QP)	CNP081	1	105	105
	Lorry(QP)	CNP141	1	105	105
	Breaker, excavator mounted(QP)	CNP027	1	105	105
				Area Total SWL	123
Road pavement and fin	**Noise Source**	**Ref. No.**	**No.**	**SWL/unit**	**sub-SWL**
	Road roller	CNP185	1	108	108
	Asphalt paver	CNP004	1	109	109
	Lorry(QP)	CNP141	1	105	105
				Area Total SWL	112

Table B4 - Mitigation measures using Quiet Plant, limited no. of plant & Movable Barrier

For NSR 7 - 22

Sitework

Site clearance	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
	Bulldozer(QP)	CNP030	1	100	5	95
	Excavator(QP)	CNP081	1	105	5	100
	Generator(QP)	CNP101	1	100	10	90
	Compressor(QP)	CNP003	1	100	10	90
	Loader(QP)	CNP081	1	105	5	100
	Beaker, hand held(QP)	CNP027	1	110	5	105
	Lorry(QP)	CNP141	1	105	0	105
					Area Total SWL	109
At grade road widening	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
	Lorry(QP)	CNP141	1	105	0	105
	Dump truck(QP)	CNP067	1	110	0	110
	Excavator(QP)	CNP081	1	105	5	100
	Grader	CNP104	1	113	5	108
	Roller	CNP185	1	108	5	103
	Loader(QP)	CNP081	1	105	5	100
					Area Total SWL	114
Storm drains construction	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP003	1	100	10	90
	Mobile crane	CNP048	1	112	5	107
	Excavator(QP)	CNP081	1	105	5	100
	Lorry(QP)	CNP141	1	105	0	105
					Area Total SWL	110
Box culvert construction	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
	Generator(QP)	CNP101	1	100	10	90
	Air compressor(QP)	CNP003	1	100	10	90
	Mobile crane	CNP048	1	112	5	107
	Excavator(QP)	CNP081	1	105	5	100
	Lorry(QP)	CNP141	1	105	0	105
					Area Total SWL	110
	Sheet piling	-	1	129	0	129
Retaining Wall	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
	Excavator(QP)	CNP081	1	105	5	100
	Lorry(QP)	CNP141	1	105	0	105
	Concrete Truck	CNP044	1	109	0	109
					Area Total SWL	111
Vehicular underpass	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
(opening Tuen Mun Road)	Excavator(QP)	CNP081	1	105	5	100
	Lorry(QP)	CNP141	1	105	0	105
	Concrete mixer	CNP046	1	96	5	91
	Concrete pump(QP)	CNP047	1	105	10	95
	Crane	CNP049	1	95	5	90
	Generator(QP)	CNP101	1	100	10	90
	Vibrator(QP)	CNP170	1	110	10	100
	Piling(diaphrahm wall)	CNP162	1	105	0	105
					Area Total SWL	110
Vehicular underpass	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
(tunnelling)	Rock drill, crawler mounte	CNP182	1	123	5	118
	Excavator(QP)	CNP081	1	105	5	100
	Lorry(QP)	CNP141	1	105	0	105
	Breaker, excavator mount	CNP027	1	105	5	100
					Area Total SWL	118
Road pavement and finishes	Noise Source	Ref. No.	No.	SWL/unit	Barrier Atten	sub-SWL
	Road roller	CNP185	1	108	5	103
	Asphalt paver	CNP004	1	109	5	104
	Lorry(QP)	CNP141	1	105	0	105
					Area Total SWL	109

Annex C

Detailed Calculations of Construction Noise

Table C1 - Unmitigated Predicted Noise Levels (PNL)

Stage	SWL	N1	N6	Distance (m) N1	Distance (m) N6
No Mitigation measure					
Site clearance	123	92	86	20	40
At grade road widening	118	87	81	20	40
Storm drains construction	118	86	80	20	40
Box culvert construction	119	N/A	N/A	-	-
Retaining wall	116	N/A	N/A	-	-
Vehicular underpass(opening Tuen Mun Road)	120	N/A	N/A	-	-
Vehicular underpass(tunnelling)	126	N/A	N/A	-	-
Road pavement and finishes	115	84	78	20	40
Box culvert construction(sheet piling)	129	N/A	N/A	-	-

Stage	SWL	N9	N12	N14	N18	N20	N22	Distance (m) N9	Distance (m) N12	Distance (m) N14	Distance (m) N18	Distance (m) N20	Distance (m) N22
No Mitigation measure													
Site clearance	125	86	N/A	N/A	84	86	N/A	50	-	-	60	50	-
At grade road widening	121	93	77	88	88	91	83	15	95	26	25	18	45
Storm drains construction	119	90	74	85	86	88	81	15	95	26	25	18	45
Box culvert construction	119	80	75	71	84	70	N/A	50	85	135	30	160	-
Retaining wall	116	65	71	64	65	69	77	200	104	212	191	130	52
Vehicular underpass(opening Tuen Mun Road)	120	79	73	N/A	67	N/A	N/A	62	120	-	240	-	-
Vehicular underpass(tunnelling)	126	85	80	N/A	74	N/A	N/A	62	120	-	240	-	-
Road pavement and finishes	117	88	72	83	84	87	79	15	95	26	25	18	45
Box culvert construction(sheet piling)	129	71	80	67	70	N/A	N/A	183	77	270	210	-	-

N/A denotes: NSRs that do not have a direct line of sight to the specific construction area or with separation distance greater than 300m

Table C2 - Mitigated Predicted Noise Levels (with the use of quiet plant)

Stage	SWL	Distance (m) N1	Distance (m) N6	N1	N6
Mitigation measure 1 (Using Quiet Plant)					
Site clearance	113	82	76	20	40
At grade road widening	115	84	78	20	40
Storm drains construction	114	83	77	20	40
Box culvert construction	119	N/A	N/A	-	-
Retaining wall	116	N/A	N/A	-	-
Vehicular underpass(opening Tuen Mun Road)	120	N/A	N/A	-	-
Vehicular underpass(tunnelling)	126	N/A	N/A	-	-
Road pavement and finishes	112	81	75	20	40
Box culvert construction(sheet piling)	129	N/A	N/A	-	-

Stage	SWL	N9	N12	N14	N18	N20	N22	Distance (m) N9	N12	N14	N18	N20	N22
Mitigation measure 1 (Using Quiet Plant)													
Site clearance	115	76	N/A	N/A	74	76	N/A	50	-	-	60	50	-
At grade road widening	117	88	72	84	84	87	79	15	95	26	25	18	45
Storm drains construction	114	86	70	81	81	84	76	15	95	26	25	18	45
Box culvert construction	114	75	71	67	80	65	N/A	50	85	135	30	160	-
Retaining wall	112	61	66	60	61	64	72	200	104	212	191	130	52
Vehicular underpass(opening Tuen Mun Road)	115	74	68	N/A	62	N/A	N/A	62	120	-	240	-	-
Vehicular underpass(tunnelling)	123	82	77	N/A	71	N/A	N/A	62	120	-	240	-	-
Road pavement and finishes	113	85	69	80	80	83	75	15	95	26	25	18	45
Box culvert construction(sheet piling)	129	71	80	67	70	N/A	N/A	183	77	270	210	-	-

N/A denotes: NSRs that do not have a direct line of sight to the specific construction area or with separation distance greater than 300m

Table C3 - Mitigated Predicted Noise Levels (with the use of quiet plant & limited no of plant)													
								Distance (m)					
		N9	N12	N14	N18	N20	N22	N9	N12	N14	N18	N20	N22
Stage	**SWL**												
Mitigation measure 2 (Using Quiet Plant & limited no of plant)													
Site clearance	114	75	N/A	N/A	73	75	N/A	50	-	-	60	50	-
At grade road widening	116	87	71	82	83	85	77	15	95	26	25	18	45
Storm drains construction	114	85	69	81	81	84	76	15	95	26	25	18	45
Box culvert construction	114	75	70	66	79	65	N/A	50	85	135	30	160	-
Retaining wall	112	61	66	60	61	64	72	200	104	212	191	130	52
Vehicular underpass(opening T	114	73	67	N/A	61	N/A	N/A	62	120	-	240	-	-
Vehicular underpass(tunnelling	123	82	77	N/A	71	N/A	N/A	62	120	-	240	-	-
Road pavement and finishes	112	84	68	79	79	82	74	15	95	26	25	18	45
Box culvert construction(sheet	129	71	80	67	70	N/A	N/A	183	77	270	210	-	-

N/A denotes: NSRs that do not have a direct line of sight to the specific construction area or with separation distance greater than 300m

Table C4 - Mitigated Predicted Noise Levels (with the use of quiet plant, limited no of plant & barriers)

Stage	SWL	N1	N6	Distance (m) N1	N6
Mitigation measure 3 (Using Quiet Plant + 5m hoarding along site boundary)					
Site clearance*	108	77	71	20	40
At grade road widening*	110	79	73	20	40
Storm drains construction*	109	78	72	20	40
Box culvert construction	119	N/A	N/A	-	-
Retaining wall	116	N/A	N/A	-	-
Vehicular underpass(opening Tuen Mun Road)	120	N/A	N/A	-	-
Vehicular underpass(tunnelling)	126	N/A	N/A	-	-
Road pavement and finishes*	107	76	70	20	40
Box culvert construction(sheet piling)	129	N/A	N/A	-	-

Stage	SWL	N9	N12	N14	N18	N20	N22	Distance (m) N9	N12	N14	N18	N20	N22
Mitigation measure 3 (Using Quiet Plant, limited no. of plant & movable barriers)													
Site clearance	109	70	N/A	N/A	69	70	N/A	50	-	-	60	50	-
At grade road widening	114	85	69	80	81	84	76	15	95	26	25	18	45
Storm drains construction	110	81	65	76	77	80	72	15	95	26	25	18	45
Box culvert construction	110	71	66	62	75	61	N/A	50	85	135	30	160	-
Retaining wall	111	60	65	59	60	64	72	200	104	212	191	130	52
Vehicular underpass(opening Tuen Mun Road)	110	69	63	N/A	57	N/A	N/A	62	120	-	240	-	-
Vehicular underpass(tunnelling)	118	77	72	N/A	66	N/A	N/A	62	120	-	240	-	-
Road pavement and finishes	109	80	64	76	76	79	71	15	95	26	25	18	45
Box culvert construction(sheet piling)	129	71	80	67	70	N/A	N/A	183	77	270	210	-	-

N/A denotes: NSRs that do not have a direct line of sight to the specific construction area or with separation distance greater than 300m

Table C5 - Mitigated Predicted Noise Levels (Maximum allowable SWL for each construction activities)

Stage	SWL for each stage	Further reduction in noise levels	Maximum SWL from construction activities	Distance (m) N1	N6	N1	N6								
Maximum allowable SWL															
Site clearance*	108	2	106	75	69	20	40								
At grade road widening*	110	4	106	75	69	20	40								
Storm drains construction*	109	3	106	75	69	20	40								
Box culvert construction	119		119	N/A	N/A	-	-								
Retaining wall	116		116	N/A	N/A	-	-								
Vehicular underpass(opening Tuen Mun Road)	120		120	N/A	N/A	-	-								
Vehicular underpass(tunnelling)	126		126	N/A	N/A	-	-								
Road pavement and finishes*	107	1	106	75	69	20	40								
Box culvert construction(sheet piling)	129		129	N/A	N/A	-	-								

Stage	SWL for each stage	Further reduction in noise levels	Maximum SWL from construction activities	N9	N12	N14	N18	N20	N22	Distance (m) N9	N12	N14	N18	N20	N22
Maximum allowable SWL															
Site clearance	109	0	109	70	N/A	N/A	69	70	N/A	50	-	-	60	50	-
At grade road widening	114	10	104	75	59	70	71	74	66	15	95	26	25	18	45
Storm drains construction	110	6	104	75	59	70	71	74	66	15	95	26	25	18	45
Box culvert construction	110	0	110	71	66	62	75	61	N/A	50	85	135	30	160	-
Retaining wall	111	0	111	60	65	59	60	64	72	200	104	212	191	130	52
Vehicular underpass(opening Tuen Mun Road)	110	0	110	69	63	N/A	57	N/A	N/A	62	120	-	240	-	-
Vehicular underpass(tunnelling)	118	2	116	75	70	N/A	64	N/A	N/A	62	120	-	240	-	-
Road pavement and finishes	109	5	104	75	59	71	71	74	66	15	95	26	25	18	45
Box culvert construction(sheet piling)	129		129	71	80	67	70	N/A	N/A	183	77	270	210	-	-

N/A denotes: NSRs that do not have a direct line of sight to the specific construction area or with separation distance greater than 300m

Annex D

Road Traffic Noise Modelling Results

Table D1 - Predicted Noise Levels - No Mitigation Measures ($L_{10, peak\ hour}$ dB(A))

NSRs	Floor	1997 Prevailing Traffic Noise	HKPSG criteria Noise Levels	2016 Predicted Noise Levels Existing Roads	2016 Predicted Noise Levels New Road	2016 Predicted TOTAL
1	1/F	76	70	78	84	**85**
	2/F	76	70	78	84	**85**
	3/F	76	70	78	83	**84**
2	1/F	71	70	77	70	**78**
	2/F	72	70	77	70	**78**
	3/F	72	70	78	70	**78**
3	1/F	71	70	78	70	**79**
	2/F	71	70	78	70	**79**
	3/F	71	70	78	70	**79**
4	1/F	71	70	78	70	**79**
	2/F	72	70	78	70	**79**
5	1/F	73	70	79	68	**79**
	2/F	73	70	79	68	**79**
6	1/F	71	70	76	75	**79**
	2/F	72	70	76	76	**79**
	3/F	72	70	77	75	**79**
7	1/F	72	70	77	74	**79**
	2/F	72	70	76	76	**79**
	3/F	72	70	77	74	**79**
9	1/F	76	70	75	78	**80**
	2/F	76	70	76	78	**80**
10	1/F	77	70	76	72	**78**
	2/F	78	70	77	72	**78**
11	1/F	80	70	81	66	**81**
	2/F	81	70	81	67	**82**
12	1/F	75	70	76	66	**77**
	2/F	76	70	77	67	**78**
13	1/F	71	70	72	69	**74**
	2/F	72	70	72	71	**75**
14	1/F	74	70	65	75	**76**
	2/F	74	70	66	75	**76**
15	1/F	69	70	65	71	**72**
	2/F	69	70	66	71	**72**
16	1/F	62	70	57	70	70
	2/F	63	70	57	70	70
	3/F	65	70	60	71	**71**
17	1/F	68	70	64	69	70
	2/F	68	70	64	69	70
	3/F	69	70	64	69	**71**

Table D1 - Predicted Noise Levels - No Mitigation Measures ($L_{10, peak\ hour}$ dB(A))

NSRs	Floor	1997 Prevailing Traffic Noise	HKPSG criteria Noise Levels	2016 Predicted Noise Levels Existing Roads	2016 Predicted Noise Levels New Road	2016 Predicted TOTAL
18	1/F	75	70	54	72	**72**
	2/F	75	70	57	72	**72**
19	1/F	75	70	56	66	66
	2/F	75	70	58	66	67
20	1/F	66	70	65	68	70
	2/F	66	70	67	68	70
21	1/F	66	70	65	68	69
	2/F	66	70	67	68	70
22	1/F	59	70	52	55	57
	2/F	61	70	59	57	61
23	1/F	52	70	47	52	53
	2/F	53	70	49	54	55
24	1/F	54	70	47	50	52
	2/F	55	70	49	51	53
25	1/F	63	70	69	63	70
	2/F	64	70	70	64	**71**
26	1/F	62	70	66	67	70
	2/F	65	70	69	67	**71**
27	1/F	68	70	65	71	**72**
	2/F	69	70	66	71	**72**
28	1/F	74	70	77	80	**82**
	2/F	75	70	77	80	**82**
	3/F	75	70	77	80	**82**

Exceedances of the HKPSG criteria are highlighted in **BOLD**

Table D2 - Mitigated Predicted Noise Levels - with 5m high noise barrier ($L_{10, peak\ hour}$ dB(A))

		No barrier			5m high noise barrier			Difference
NSR	Floor	Unmitigated Existing Road	Unmitigated New Road	**Unmitigated TOTAL**	Mitigated Existing Road	Mitigated New Road	**Mitigated TOTAL**	Unmitigated Total - Mitigated Total
13	1/F	72	69	**74**	72	68	**73**	0.3
	2/F	72	71	**75**	72	70	**74**	0.4

Exceedances of the HKPSG criteria are highlighted in **BOLD**

Table D3 - Mitigated Predicted Noise Levels For Planned NSRs - with 0.8m high noise barrier ($L_{10,\ peak\ hour}$ dB(A))

		No barrier			barrier located at 0.5m from roadkerb			Difference
NSR	Floor	Unmitigated Existing Road	Unmitigated New Road	**Unmitigated TOTAL**	Mitigated Existing Road	Mitigated New Road	**Mitigated TOTAL**	Unmitigated Total - Mitigated Total
A	1/F	80	63	**80**	80	61	**80**	0.0
	2/F	80	64	**80**	80	63	**80**	0.0
	3/F	81	65	**81**	81	64	**81**	0.0
	4/F	81	66	**81**	81	65	**81**	0.0
	5/F	81	67	**81**	81	66	**81**	0.1
	6/F	81	67	**82**	81	67	**82**	0.0
	7/F	81	68	**82**	81	67	**82**	0.0
	8/F	81	68	**82**	81	67	**82**	0.0
	9/F	81	68	**82**	81	68	**82**	0.0
	10/F	81	68	**82**	81	68	**82**	0.0
B	1/F	77	71	**78**	77	67	**77**	0.6
	2/F	77	72	**78**	77	69	**78**	0.5
	3/F	78	72	**79**	78	70	**78**	0.3
	4/F	78	72	**79**	78	71	**79**	0.2
	5/F	78	72	**80**	78	71	**79**	0.2
	6/F	79	72	**80**	79	72	**80**	0.1
	7/F	79	73	**80**	79	72	**80**	0.1
	8/F	79	73	**80**	79	72	**80**	0.1
	9/F	79	73	**80**	79	72	**80**	0.1
	10/F	79	73	**80**	79	72	**80**	0.1
C	1/F	72	77	**78**	72	74	**76**	1.8
	2/F	73	77	**78**	73	76	**77**	0.9
	3/F	74	77	**79**	74	76	**78**	0.5
	4/F	74	77	**79**	74	76	**78**	0.2
	5/F	74	77	**79**	74	77	**79**	0.1
	6/F	75	77	**79**	75	76	**79**	0.1
	7/F	75	76	**79**	75	76	**79**	0.0
	8/F	75	76	**79**	75	76	**79**	0.0
	9/F	75	76	**79**	75	76	**79**	0.0
	10/F	75	76	**79**	75	76	**79**	0.0
D	1/F	0	76	**76**	0	74	**74**	1.9
	2/F	0	75	**75**	0	74	**74**	1.0
	3/F	0	75	**75**	0	75	**75**	0.7
	4/F	0	75	**75**	0	74	**74**	0.5
	5/F	0	75	**75**	0	74	**74**	0.5
	6/F	0	74	**74**	0	74	**74**	0.5
	7/F	0	74	**74**	0	74	**74**	0.4
	8/F	0	74	**74**	0	74	**74**	0.4
	9/F	0	74	**74**	0	73	**73**	0.4
	10/F	0	73	**74**	0	73	**73**	0.3
E	1/F	74	67	**75**	74	63	**74**	0.6
	2/F	74	67	**75**	74	64	**74**	0.5
	3/F	74	67	**75**	74	65	**75**	0.3
	4/F	74	67	**75**	74	66	**75**	0.2

Table D3 - Mitigated Predicted Noise Levels For Planned NSRs - with 0.8m high noise barrier ($L_{10,\ peak\ hour}$ dB(A))

NSR	Floor	Unmitigated Existing Road	Unmitigated New Road	**Unmitigated TOTAL**	Mitigated Existing Road	Mitigated New Road	**Mitigated TOTAL**	Unmitigated Total - Mitigated Total
	5/F	75	67	**75**	75	66	**75**	0.1
	6/F	75	67	**75**	75	66	**75**	0.1
	7/F	75	67	**76**	75	66	**76**	0.0
	8/F	75	67	**76**	75	66	**76**	0.1
	9/F	75	67	**76**	75	66	**76**	0.0
	10/F	75	67	**76**	75	66	**76**	0.1
F	1/F	73	74	**77**	73	72	**75**	1.2
	2/F	73	74	**77**	73	73	**76**	0.6
	3/F	74	74	**77**	74	73	**77**	0.4
	4/F	74	74	**77**	74	73	**77**	0.3
	5/F	74	74	**77**	74	73	**77**	0.3
	6/F	74	74	**77**	74	73	**77**	0.2
	7/F	75	74	**77**	75	73	**77**	0.1
	8/F	75	73	**77**	75	73	**77**	0.2
	9/F	75	73	**77**	75	73	**77**	0.2
	10/F	75	73	**77**	75	73	**77**	0.1
G	1/F	58	76	**76**	58	74	**74**	2.3
	2/F	59	76	**76**	59	75	**75**	1.1
	3/F	61	76	**76**	61	75	**75**	0.6
	4/F	62	76	**76**	62	75	**75**	0.4
	5/F	63	75	**76**	63	75	**75**	0.3
	6/F	65	75	**76**	65	75	**75**	0.1
	7/F	65	75	**75**	65	75	**75**	0.1
	8/F	66	75	**75**	66	75	**75**	0.1
	9/F	66	75	**75**	66	75	**75**	0.1
	10/F	66	74	**75**	66	74	**75**	0.0
H	1/F	0	73	**73**	0	68	**68**	4.8
	2/F	0	73	**73**	0	69	**69**	3.7
	3/F	0	73	**73**	0	70	**70**	2.7
	4/F	0	73	**73**	0	71	**71**	1.9
	5/F	0	73	**73**	0	71	**71**	1.4
	6/F	0	73	**73**	0	72	**72**	1.1
	7/F	0	73	**73**	0	72	**72**	0.8
	8/F	0	72	**72**	0	72	**72**	0.5
	9/F	0	72	**72**	0	72	**72**	0.5
	10/F	0	72	**72**	0	72	**72**	0.2
I	1/F	55	69	**69**	55	68	**69**	0.2
	2/F	56	69	**69**	56	68	**69**	0.2
	3/F	57	69	**69**	57	68	**69**	0.3
	4/F	58	69	**69**	58	68	**69**	0.2
	5/F	59	68	**69**	59	68	**69**	0.2
	6/F	60	68	**69**	60	68	**68**	0.3
	7/F	61	68	**69**	61	67	**68**	0.2
	8/F	61	67	**68**	61	67	**68**	0.2
	9/F	62	67	**68**	62	67	**68**	0.2

Table D3 - Mitigated Predicted Noise Levels For Planned NSRs - with 0.8m high noise barrier ($L_{10,\ peak\ hour}$ dB(A))

NSR	Floor	Unmitigated Existing Road	Unmitigated New Road	**Unmitigated TOTAL**	Mitigated Existing Road	Mitigated New Road	**Mitigated TOTAL**	Unmitigated Total - Mitigated Total
	10/F	62	67	**68**	62	67	**68**	0.2
J	1/F	66	74	**74**	66	74	**74**	0.0
	2/F	66	74	**75**	66	74	**75**	0.0
	3/F	66	74	**75**	66	74	**75**	0.0
	4/F	66	74	**75**	66	74	**75**	0.0
	5/F	66	74	**75**	66	74	**75**	0.0
	6/F	67	74	**75**	67	74	**75**	0.0
	7/F	67	74	**75**	67	74	**75**	0.0
	8/F	67	74	**74**	67	74	**74**	0.0
	9/F	67	73	**74**	67	73	**74**	0.0
	10/F	67	73	**74**	67	73	**74**	0.0
K	1/F	66	66	**69**	66	64	**68**	0.8
	2/F	67	67	**70**	67	65	**69**	0.7
	3/F	67	67	**70**	67	66	**69**	0.7
	4/F	67	68	**71**	67	67	**70**	0.6
	5/F	67	68	**71**	67	67	**70**	0.6
	6/F	68	69	**71**	68	68	**71**	0.5
	7/F	68	69	**71**	68	68	**71**	0.5
	8/F	68	69	**72**	68	68	**71**	0.4
	9/F	68	69	**72**	68	69	**71**	0.4
	10/F	69	69	**72**	69	69	**72**	0.4
L	1/F	67	67	**70**	67	65	**69**	0.8
	2/F	67	67	**70**	67	65	**69**	1.1
	3/F	68	67	**71**	68	65	**70**	0.5
	4/F	69	67	**71**	69	65	**71**	0.4
	5/F	70	67	**72**	70	66	**72**	0.4
	6/F	71	67	**72**	71	66	**72**	0.3
	7/F	71	67	**73**	71	66	**72**	0.4
	8/F	71	67	**73**	71	66	**72**	0.3
	9/F	71	67	**73**	71	66	**73**	0.3
	10/F	72	67	**73**	72	66	**73**	0.2
M	1/F	61	66	**67**	61	64	**66**	1.3
	2/F	67	67	**70**	67	66	**70**	0.6
	3/F	68	68	**71**	68	68	**71**	0.4
	4/F	68	69	**72**	68	68	**71**	0.4
	5/F	68	69	**72**	68	68	**71**	0.4
	6/F	68	69	**72**	68	68	**71**	0.4
	7/F	68	69	**72**	68	68	**71**	0.4
	8/F	68	69	**72**	68	68	**71**	0.3
	9/F	68	69	**72**	68	68	**71**	0.3
	10/F	68	69	**72**	68	68	**71**	0.3
N	1/F	63	51	**63**	63	51	**63**	0.0
	2/F	65	53	**65**	65	53	**65**	0.0
	3/F	67	55	**67**	67	55	**67**	0.0

Table D3 - Mitigated Predicted Noise Levels For Planned NSRs - with 0.8m high noise barrier ($L_{10,\ peak\ hour}$ dB(A))

NSR	Floor	Unmitigated Existing Road	Unmitigated New Road	**Unmitigated TOTAL**	Mitigated Existing Road	Mitigated New Road	**Mitigated TOTAL**	Unmitigated Total - Mitigated Total
	4/F	68	58	**69**	68	58	**69**	0.0
	5/F	69	59	**70**	69	59	**70**	0.0
	6/F	71	59	**71**	71	59	**71**	0.0
	7/F	72	60	**72**	72	60	**72**	0.0
	8/F	73	60	**73**	73	60	**73**	0.0
	9/F	74	60	**74**	74	60	**74**	0.0
	10/F	74	60	**75**	74	60	**75**	0.0
O	1/F	63	37	**63**	63	37	**63**	0.0
	2/F	65	38	**65**	65	38	**65**	0.0
	3/F	66	40	**66**	66	40	**66**	0.0
	4/F	66	41	**66**	66	41	**66**	0.0
	5/F	67	43	**67**	67	43	**67**	0.0
	6/F	67	45	**67**	67	45	**67**	0.0
	7/F	68	46	**68**	68	46	**68**	0.0
	8/F	68	48	**68**	68	48	**68**	0.0
	9/F	68	49	**68**	68	49	**68**	0.0
	10/F	69	50	**69**	69	50	**69**	0.0
P	1/F	37	64	**64**	37	63	**63**	0.9
	2/F	37	65	**65**	37	64	**64**	0.5
	3/F	37	65	**65**	37	65	**65**	0.3
	4/F	37	65	**66**	37	65	**65**	0.4
	5/F	38	66	**66**	38	65	**65**	0.3
	6/F	38	65	**65**	38	65	**65**	0.2
	7/F	38	65	**65**	38	65	**65**	0.3
	8/F	38	65	**65**	38	65	**65**	0.2
	9/F	38	65	**65**	38	65	**65**	0.2
	10/F	38	65	**65**	38	65	**65**	0.2

Table D4 - Mitigated Predicted Noise Levels for Existing NSRs - with 0.8m high noise barrier ($L_{10, peak\ hour}$ dB(A))

		No barrier			barrier located at 0.5m from roadkerb			Difference
NSR	Floor	Unmitigated Existing Road	Unmitigated New Road	**Unmitigated TOTAL**	Mitigated Existing Road	Mitigated New Road	**Mitigated TOTAL**	Unmitigated Total - Mitigated Total
N1	1/F	78	84	**85**	78	78	**81**	3.7
	2/F	78	84	**85**	78	83	**84**	0.4
	3/F	78	83	**84**	78	83	**84**	0.0
N2	1/F	77	70	**78**	77	64	**78**	0.5
	2/F	77	70	**78**	77	66	**78**	0.4
	3/F	78	70	**78**	78	67	**78**	0.4
N3	1/F	78	70	**79**	78	65	**78**	0.6
	2/F	78	70	**79**	78	66	**78**	0.3
	3/F	78	70	**79**	78	68	**78**	0.3
N4	1/F	78	70	**79**	78	65	**79**	0.2
	2/F	78	70	**79**	78	67	**79**	0.0
N5	1/F	79	68	**79**	79	67	**79**	0.1
	2/F	79	68	**79**	79	67	**79**	0.0
N6	1/F	76	75	**79**	76	69	**77**	1.9
	2/F	76	76	**79**	77	70	**78**	1.4
	3/F	77	75	**79**	77	71	**78**	0.9
N7	1/F	77	74	**79**	76	68	**77**	1.6
	2/F	76	76	**79**	77	70	**78**	1.2
	3/F	77	74	**79**	77	71	**78**	0.9
N9	1/F	75	78	**80**	75	76	**78**	1.6
	2/F	76	78	**80**	76	77	**79**	0.8
N10	1/F	76	72	**78**	76	68	**77**	0.9
	2/F	77	72	**78**	77	69	**78**	0.5
N11	1/F	81	66	**81**	81	62	**81**	0.1
	2/F	81	67	**82**	81	64	**82**	0.1
N12	1/F	76	66	**77**	76	65	**77**	0.1
	2/F	77	67	**78**	77	66	**78**	0.0
N13	1/F	72	69	**74**	71	69	**73**	0.5
	2/F	72	71	**75**	72	71	**74**	0.4
N14	1/F	65	75	**76**	64	69	**70**	5.4
	2/F	66	75	**76**	66	71	**72**	3.5
N15	1/F	65	71	**72**	64	65	**68**	4.6
	2/F	66	71	**72**	65	67	**69**	3.4

Table D4 - Mitigated Predicted Noise Levels for Existing NSRs - with 0.8m high noise barrier ($L_{10, peak\ hour}$ dB(A))

		No barrier			barrier located at 0.5m from roadkerb			Difference
NSR	Floor	Unmitigated Existing Road	Unmitigated New Road	**Unmitigated TOTAL**	Mitigated Existing Road	Mitigated New Road	**Mitigated TOTAL**	Unmitigated Total - Mitigated Total
N16	1/F	57	70	**70**	57	62	**63**	6.9
	2/F	57	70	**70**	57	64	**65**	5.7
	3/F	60	71	**71**	60	65	**66**	4.5
N17	1/F	64	69	**70**	65	61	**67**	3.2
	2/F	64	69	**70**	65	63	**67**	2.9
	3/F	64	69	**71**	66	64	**68**	2.7
N18	1/F	54	72	**72**	54	65	**66**	6.6
	2/F	57	72	**72**	57	67	**67**	5.1
N19	1/F	56	66	**66**	56	63	**64**	2.7
	2/F	58	66	**67**	58	64	**65**	2.2
N20	1/F	65	68	**70**	65	67	**69**	0.7
	2/F	67	68	**70**	67	67	**70**	0.4
N21	1/F	65	68	**69**	64	67	**69**	0.7
	2/F	67	68	**70**	66	67	**70**	0.7
N22	1/F	52	55	**57**	52	54	**57**	0.2
	2/F	59	57	**61**	59	56	**61**	0.1
N23	1/F	47	52	**53**	47	52	**53**	0.3
	2/F	49	54	**55**	49	53	**54**	0.6
N24	1/F	47	50	**52**	47	50	**52**	0.0
	2/F	49	51	**53**	49	51	**53**	0.1
N25	1/F	69	63	**70**	63	62	**66**	4.0
	2/F	70	64	**71**	64	63	**67**	4.3
N26	1/F	66	67	**70**	60	64	**65**	4.4
	2/F	69	67	**71**	64	64	**67**	4.4
N27	1/F	65	71	**72**	64	67	**69**	2.7
	2/F	66	71	**72**	65	68	**70**	2.3
N28	1/F	77	80	**82**	76	75	**78**	3.4
	2/F	77	80	**82**	77	78	**80**	1.5
	3/F	77	80	**82**	77	79	**81**	0.6

Table D5 - Existing Dwellings Eligible for Indirect Technical Remedies

NSR	Prevailing	2016 'TOTAL'	2016 "Existing"	2016 "New"	> Noise Criterion, 70 dB(A)	Total noise levels ≥ prevailing+1.0	Contribution to overall levels from new road is at least 1.0	Eligible for insulation
1	76	**81**	78	78	yes	yes	yes	**yes**
	76	**84**	78	83	yes	yes	yes	**yes**
	76	**84**	78	83	yes	yes	yes	**yes**
2	71	**78**	77	64	yes	yes	no	no
	72	**78**	77	66	yes	yes	no	no
	72	**78**	78	67	yes	yes	no	no
3	71	**78**	78	65	yes	yes	no	no
	71	**78**	78	66	yes	yes	no	no
	71	**78**	78	68	yes	yes	no	no
4	71	**79**	78	65	yes	yes	no	no
	72	**79**	78	67	yes	yes	no	no
5	73	**79**	79	67	yes	yes	no	no
	73	**79**	79	67	yes	yes	no	no
6	71	**77**	76	69	yes	yes	no	no
	72	**78**	77	70	yes	yes	no	no
	72	**78**	77	71	yes	yes	no	no
7	72	**77**	76	68	yes	yes	no	no
	72	**78**	77	70	yes	yes	no	no
	72	**78**	77	71	yes	yes	no	no
9	76	**78**	75	76	yes	yes	yes	**yes**
	76	**79**	76	77	yes	yes	yes	**yes**
10	77	**77**	76	68	yes	no	no	no
	78	**78**	77	69	yes	no	no	no
11	80	**81**	81	62	yes	no	no	no
	81	**82**	81	64	yes	no	no	no
12	75	**77**	76	65	yes	yes	no	no
	76	**78**	77	66	yes	yes	no	no
13	71	**73**	71	69	yes	yes	yes	**yes**
	72	**74**	72	71	yes	yes	yes	**yes**
14	74	**70**	64	69	no	no	yes	no
	74	**72**	66	71	yes	no	yes	no
15	69	**68**	64	65	no	no	yes	no
	69	**69**	65	67	no	no	yes	no
16	62	**63**	57	62	no	yes	yes	no
	63	**65**	57	64	no	yes	yes	no
	65	**66**	60	65	no	yes	yes	no

Table D5 - Existing Dwellings Eligible for Indirect Technical Remedies

NSR	Prevailing	2016 'TOTAL'	2016 "Existing"	2016 "New"	> Noise Criterion, 70 dB(A)	Total noise levels ≥ prevailing+1.0	Contribution to overall levels from new road is at least 1.0	Eligible for insulation
17	68	**67**	65	61	no	no	yes	no
	68	**67**	65	63	no	no	yes	no
	69	**68**	66	64	no	no	yes	no
18	75	**66**	54	65	no	no	yes	no
	75	**67**	57	67	no	no	yes	no
19	75	**64**	56	63	no	no	yes	no
	75	**65**	58	64	no	no	yes	no
20	66	**69**	65	67	no	yes	yes	no
	66	**70**	67	67	no	yes	yes	no
21	66	**69**	64	67	no	yes	yes	no
	66	**70**	66	67	no	yes	yes	no
22	59	**57**	52	54	no	no	yes	no
	61	**61**	59	56	no	no	yes	no
23	52	**53**	47	52	no	no	yes	no
	53	**54**	49	53	no	yes	yes	no
24	54	**52**	47	50	no	no	yes	no
	55	**53**	49	51	no	no	yes	no
25	63	**66**	63	62	no	yes	yes	no
	64	**67**	64	63	no	yes	yes	no
26	62	**65**	60	64	no	yes	yes	no
	65	**67**	64	64	no	yes	yes	no
27	68	**69**	64	67	no	yes	yes	no
	69	**70**	65	68	no	no	yes	no
28	74	**78**	76	75	yes	yes	yes	**yes**
	75	**80**	77	78	yes	yes	yes	**yes**
	75	**81**	77	79	yes	yes	yes	**yes**

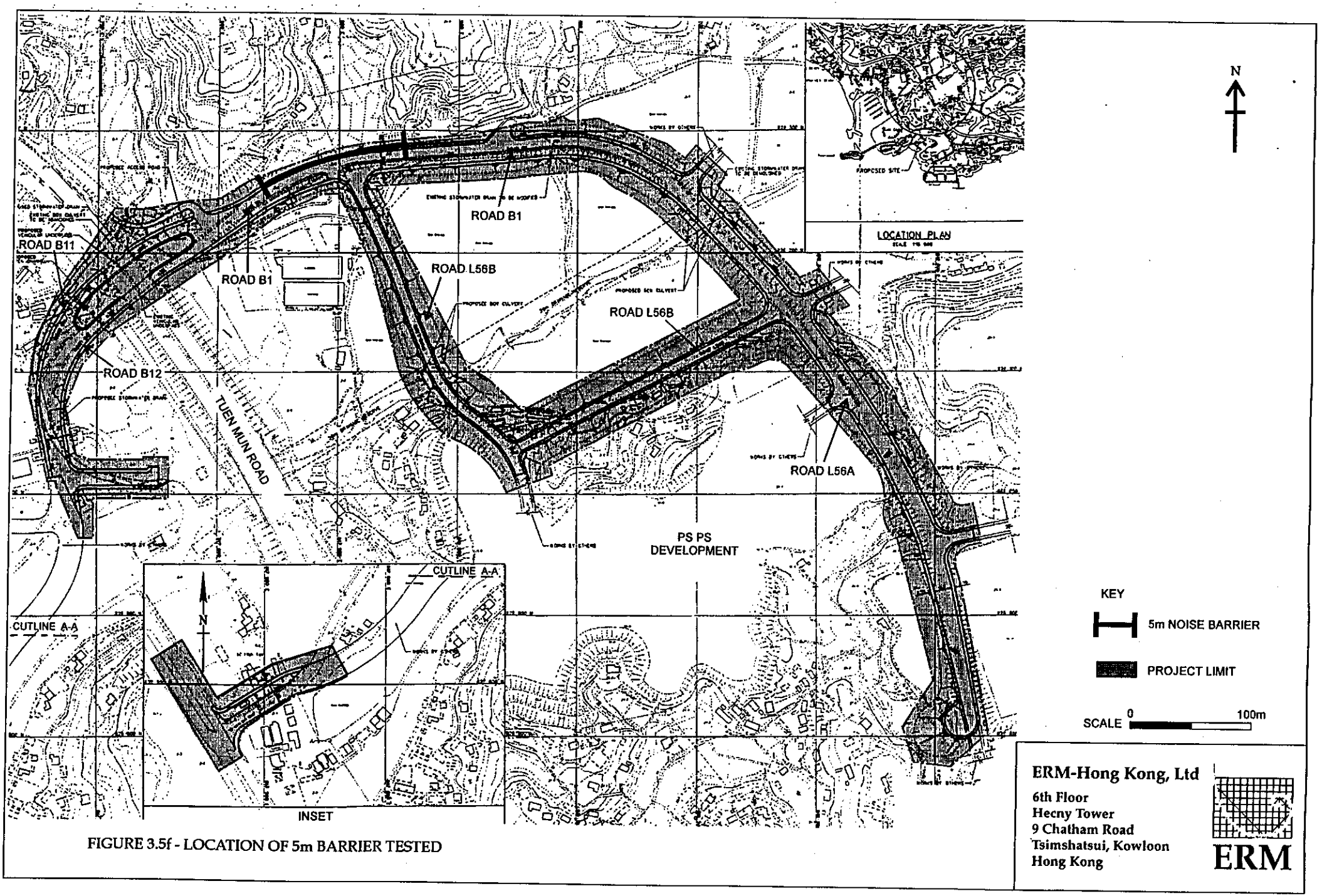

FIGURE 3.5f - LOCATION OF 5m BARRIER TESTED

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Hong Kong
ERM

Annex E

Terrestrial Ecology - Plant List

Table E1 *Plantation Woodland*

Growth Form	Species	Relative Abundance	
		Acacia Plantation	Tristania Plantation
Tree	*Acacia confusa*	*****	*
	Bischofia javanica		*
	Bridelia tomentosa	*	***
	Casuarina equisetifolia		**
	Celtis sinensis		**
	Cratoxylum ligustrinum		*
	Dalbergia balansae		**
	Desmos cochinchinensis		*
	Dimocarpus longan		**
	Ficus hispida		**
	Ficus microcarpa		*
	Ficus superba		*
	Leucanea leucocephala		*
	Litsea glutinosa		*
	Macaranga tanarius	*	***
	Mallotus paniculatus		****
	Psidium guajava		*
	Rhus succedanea		**
	Sapium discolor		*
	Tristania conferta		*****
	Zanthoxylum alianthoide		**
Shrub	*Alchornea trewiodies*	**	*
	Breynia fructicosa		*
	Ilex asprella		*
	Innula cappa		*
	Lantana camara	**	*
	Litsea rotundifolia		*
	Melastoma sanguineum		*
	Phyllanthus cochinchinensis		**
	Sageretia theezans		**
	Urena lobata	**	*
Herb	*Ageratum conyzoides*	***	
	Alocasia macrorrhiza	**	****
	Emilia sonchifolia	**	*
	Erigeron floribundus	**	
	Gynura bicolor	**	
	Sonchus arvensis	**	
Climber	*Morinda umbellata*	*	**
	Ipomoea carica	***	*
	Mikania micrantha	***	*
	Paederia scandens	**	***
	Pueriera lobata	*	*

Table E2 *Secondary Woodland*

Growth Form	Species	Relative Abundance	
		Disturbed	Hill-slope
Tree	*Acacia confusa*	*	*
	Aporusa dioica	*	**
	Aquilaria sinensis		*
	Bischofia javanica		*
	Bridelia tomentosa	*	***
	Casuarina equisetifolia	*	*
	Celtis sinensis	**	**
	Cratoxylum cochinchinense	*	**
	Dalbergia balansae	*	**
	Desmos cochinchinensis		**
	Dimocarpus longan	*	*
	Ficus hispida	****	**
	Ficus microcarpa	*	**
	Ficus superba	*	*
	Leucanea leucocephala	**	
	Litsea glutinosa	*	**
	Macaranga tanarius	***	**
	Mallotus paniculatus	****	***
	Microcos paniculata		***
	Phyllanthus reticulatus		*
	Rhus succedanea	**	***
	Sapium discolor	*	**
	Schefflera octophylla	*	***
	Sterculia lanceolata	*	***
	Zanthoxylum alianthoides	*	**
	Zanthoxylum avicennia	*	**
Shrub	*Alchornea trewioides*	*	*
	Alocasia macrorrhiza	**	***
	Ilex asprella	*	**
	Melastoma candidum	*	**
	Melastoma sanguineum	*	*
	Phyllanthus cochinchinensis	**	**
	Phyllanthus emblica	*	
	Psychotria rubra	*	***
	Rhodomyrtus tomentosa	**	**
	Sageretia theezans	**	**
	Tarenna attenuata		*
	Wikstromeia indica	**	*
Herb	*Ardisia crenata*		*
	Bidens pilosa	**	
	Dianella ensifolia	*	*
	Dicranopteris linearis	**	*
	Elephantopus tomentosa	*	*
	Innula cappa	*	
	Ischaemum spp.	**	*
	Liriope spicata	*	**
	Miscanthus floridulus	*	
Climber	*Asparagus cochinchinensis*	*	*
	Cansjera rheedii	*	**
	Gymnema sylvestre	**	**
	Hyserpa nitida	*	**
	Melodinus suaveolens		*
	Millettia nitida	*	**

Growth Form	Species	Relative Abundance	
		Disturbed	Hill-slope
	Morinda umbellata	**	*
	Mussendanea pubescens	*	*
	Strophanthus divariculatus	*	**
	Tetracera asiatica	**	**
	Tinospora sinensis		**

Table E3. *Shrub-Grass Mosaic*

Growth Form	Species	Relative Abundance
Tree/Shrub	*Altalantia buxifolia*	*
	Aporusa dioica	*
	Backea fructicosa	*
	Bredelia tomentosa	*
	Cratoxylum ligustrinum	*
	Helicteres angustifolia	**
	Ilex asprella	**
	Lantana camara	**
	Litsea glutinosa	**
	Litsea rotundifolia	**
	Mallotus paniculatus	*
	Melastoma sanguineum	**
	Phoenix hanceana	*
	Phyllanthus cochinchinensis	**
	Rhapiolepis indica	*
	Rhodomyrtus tomentosa	***
	Rhus succedanea	***
	Sageretia theezans	*
	Schefflera octophylla	*
	Wikstromeia indica	**
Herb	*Ageratum conyzoides*	*
	Aster baccroides	***
	Dianella ensifolia	**
	Dicranopteris linearis	****
	Elephantopus tomentosa	**
	Innula cappa	*
	Liriope spicata	*
	Pteroloma triquetrum	**
Grass/Sedge	*Arundinella setosa*	***
	Cymbopogon spp.	***
	Eragrotis pilosa	*
	Eremochloa ciliaris	*
	Fimbristylis spp.	*
	Ischaemum spp.	***
	Miscanthus floridulus	*
	Neyraudia reynaudiana	**
	Setaria pallide-fusca	*
Climber	*Asparagus cochinchinensis*	*
	Cassytha filiformis	**
	Embelia laeta	***
	Gymnema sylvestre	**
	Lygodium japonica	**
	Milletia nitida	**
	Morinda umbellata	***
	Paederia scandens	***
	Smilax glabra	**
	Strophanthus divariculatus	***
	Tylophora ovata	*

Table E4 *Wasteland Habitat*

Growth Form	Species	Relative Abundance
Shrub	*Desmodium gangeticum*	*
	Desmodium heterophyllum	***
	Lantana camara	***
	Synedrella nodiflora	**
	Triumfetta bartramia	**
Herb	*Ageratum conyzoides*	****
	Bidens pilosa	***
	Cassia mimosoides	*
	Cleome gynandra	**
	Emilia sonchifolia	*
	Erigeron floribundus	**
	Gynura bicolor	*
	Mimosa pudica	****
	Phyllodium pulchellum	**
	Sonchus arvensis	*
	Sesbania cochinchinensis	**
	Euphorbia hirta	*
	Youngia japonica	*
Grass	*Chloris barbata*	***
	Digitaria spp.	**
	Eleusine indica	***
	Imperata cylindrica	**
	Miscanthus floridulus	**
	Neyraudia reynaudiana	***
	Panicum maxima	****
	Paspalum spp.	**
	Pennisetum purpureum	**
	Rhynchelytrum repens	***
	Sporobolus fertilis	**
Climber	*Ipomoea carica*	***
	Mikania micrantha	****
	Paederia scandens	***
	Pueraria lobata	***