Highways Department
Major Works Project Management Office

KTB/200/Issue 4

Agreement No. CE 7/94
PWP Item No. 6246TH

Kam Tin Bypass
Design and Construction Consultancy

Environmental Impact Assessment
(Final)

Joint Consultants

Binnie Consultants Limited
Wilbur Smith Associates Limited
Harris & Sutherland (Far East) Limited

in association with

Peter Tan & Associates

March 1996

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Project Title : AGREEMENT NO. CE7/94 DESIGN AND CONSTRUCTION CONSULTANCY – KAM TIN BYPASS	**Job no.** 0957/B05	**Document No.** KTB/200
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Pages	Date	Issue No.	Description
ALL	26/9/95	1	DRAFT EIA REPORT
ALL	15/12/95	2	FINAL EIA REPORT (DRAFT - LIMITED ISSUE) (EPD - 3, HyD - 1)
ALL but Appendix A EM &A Manual NOW KTB/201	25/1/1996	3	FINAL EIA REPORT WITH CHANGES AS REQUESTED BY EPD IN JANUARY 1996. PRINCIPALLY RELATE TO PROTECTION OF NSR.18 (SCHOOL).
ALL	12/3/96	4	FINAL EIA REPORT WITH MINOR CHANGES REQUESTED BY EPD (FEB. 96)

Prepared by : AM Proctor **Signed :** **Date :** 25/1/96

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1 INTRODUCTION

Project Background

1.1 Kam Tin is located in the North West New Territories (NWNT), 3 km to the east of Yuen Long (see Figure 1.1).

1.2 At present, Kam Tin Road is a 2-lane single carriageway road with the provision of narrow footpaths at discrete locations. With the opening of the Tolo Highway and the New Territories Circular Road, and the rapid development of the NWNT areas, Kam Tin Road has been increasingly used as a main route for east-west traffic movements. The road is currently approaching its capacity and will experience serious traffic congestion and delay with the increase in traffic in the future. Additional traffic burden is expected when the Route 3 (Country Park Section) opens to traffic in 1998.

1.3 Kam Tin Bypass is a proposed new route, about 1.3 km long and constructed on an embankment, running to the north of Kam Tin and connecting onto Kam Tin Road to the east and west of the rural centre. The main objective of the Kam Tin Bypass Project is to improve the road connections between Tai Po, Shek Kong and Yuen Long, and to relieve the section of Kam Tin Road through the central area of Kam Tin of traffic so that a comprehensive environmental and traffic improvement scheme can be implemented there in future.

1.4 The need for improvement to Kam Tin Road was first identified by the North West New Territories Base Strategy Studies, which were completed in 1983. In 1984, the Land Development Policy Committee endorsed the need for a continuing programme of improvement to the highways infrastructure in the area, in which construction of the Bypass was a key element.

1.5 In 1993, it was proposed that a 2-lane single carriageway road be constructed under Public Works Programme (PWP) Item No. 246TH, with a target completion date of June 1999. Subsequent studies, eg. the traffic forecast from the Second Comprehensive Transport Study Report (CTS-2) Enhancement, and proposals for other road network improvements in the Kam Tin area, indicated a dual 2-lane standard road would be required from Au Tau to Route Twisk. Consequently, Government has decided to increase the scope of the Project works to provide a dual 2-lane carriageway road ('dual two carriageway') to bypass Kam Tin.

1.6 Binnie Wilbur Harris JV has been appointed by Highways Department to undertake the design, tender documentation and construction supervision of Kam Tin Bypass. The original designs for the Bypass were based on the 2-lane single carriageway road: modification and re-design of the road, subway and associated structures will be developed under this consultancy to incorporate both the changes in requirements and the latest highway standards.

1.7 This Environmental Impact Assessment (EIA) Study Report will consider the potential impacts and mitigation measures for the chosen design, which represents the best practicable environmental option.

EIA Study Approach

1.8 The general approach to the EIA Study has been to identify all significant environmental impacts and constraints so that the findings can be translated into environmentally acceptable designs, construction methods and operational procedures for the Bypass.

1.9 The EIA Study has been carried out in close and continuing liaison with the engineering design team. As each environmental issue has arisen during the study phase, its impact on the engineering of the scheme has been discussed and any feasible adjustments incorporated into the design. In a similar manner, the engineering team has been regularly advising the EIA Study team on the engineering constraints and design criteria to which the team has had to work. Working together in this integrated and iterative way has facilitated the development of the best practicable environmental option for the design, construction and operation of the project.

EIA Study Objectives

1.10 The objectives of the EIA Study have been as follows:

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

(ii) to identify and describe the elements of the community and environment likely to affect or be affected by the construction and future operation of the Project;

(iii) to identify and quantify emission 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 propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the Project;

(vi) to identify, predict and evaluate the residual and cumulative environmental impacts (specifying whether these are transient, long term and/or irreversible) expected to arise during the construction and operation phases of the project in relation to sensitive receivers and potential affected uses;

(vii) to identify, assess and specify practicable, effective and enforceable 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 acceptable levels;

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

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

(x) to identify any additional studies necessary to fulfil the requirements of the EIA; and

(xi) to design and specify the environmental monitoring and audit (EM&A) requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted.

Purpose of Report

1.11 The purpose of this Final EIA Report is to:

(i) provide an assessment and evaluation of the environmental impacts and cumulative effects arising from the proposed Project in sufficient detail to identify those issues of key concern during the construction, operation and decommissioning of the proposed Project which are likely to influence decisions on the proposed Project;

(ii) define measurable environmental parameters and environmental features likely to be affected by the proposed Project and identify the environmental monitoring programmes which are required both to provide a baseline profile of existing environmental conditions and to monitor impacts and compliance during construction, commissioning, operation (and decommissioning) of the Project;

(iii) define the environmental audit requirements for compliance and post-project audit, which would include a review of the monitoring data both to identify compliance with regulatory requirements, policies and standards, and to define any remedial works required to redress unanticipated or unacceptable consequential environmental impacts.

Structure of Report

1.12 The structure of this Final EIA Report is as follows:

Section 1: provides a general introduction to the EIA Study

Section 2: describes the main features of the project, provides an outline description of the Study Area, and briefly describes other major road and drainage infrastructure developments within the vicinity of Kam Tin

Section 3: describes the applicable environmental legislation

Section 4: identifies visual sensitive receivers and presents the results of the visual impact assessment

Section 5: identifies noise sensitive receivers and presents the results of the noise impact assessment

Section 6: identifies air sensitive receivers and presents the results of the air quality impact assessment

Section 7: presents the results of the ecological impact assessment

Section 8: identifies water quality sensitive receivers and presents the results of the water quality impact assessment

Section 9: presents the results of the construction waste and spoil management studies

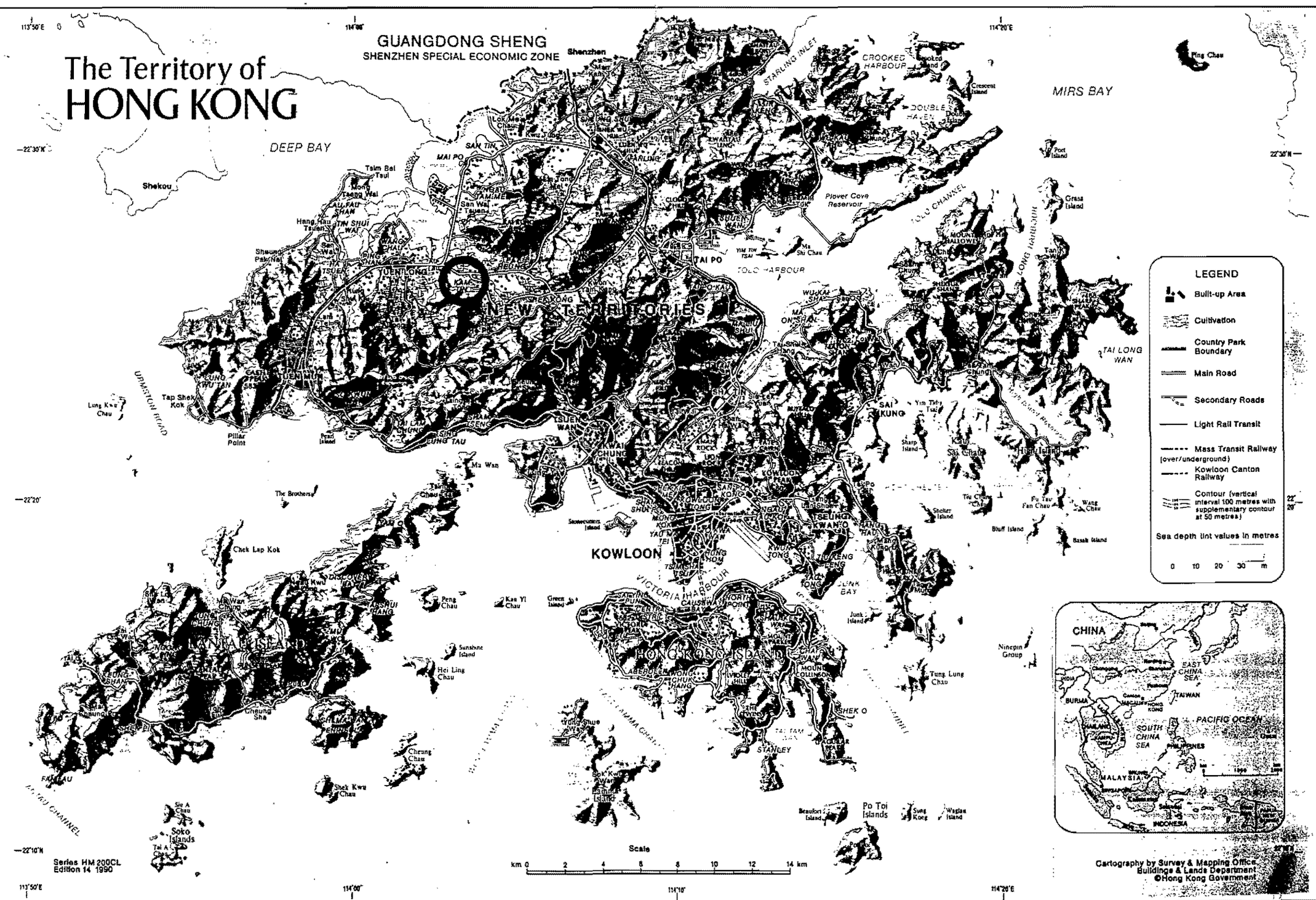
Section 10: provides a summary of environmental impacts identified in Sections 4-9

Detailed noise calculations are presented in Appendix A.

Responses to comments on the Draft EIA Report are presented in Appendix B.

The Environmental Monitoring and Audit manual for the scheme, which is designed to ensure the implementation and effectiveness of the recommended environmental protection and pollution control measures, is presented as a separate document.

The Territory of HONG KONG



Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale N.T.S.
Title : EIA - LOCATION OF THE KAM TIN BYPASS PROJECT	Joint Consultants :	Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)		Figure No. 1.1

2 KAM TIN BYPASS & ASSOCIATED PROJECTS

Introduction

2.1 The Kam Tin Bypass Project is one of several interrelated infrastructure developments and improvements planned or currently under implementation in the NWNT. This section presents an overview of the physical environment and development plans for the Study Area, as well as outlining details of the Route 3, Main Drainage Channels and Western Corridor Railways projects which may impact on the Kam Tin area during the construction and post-commissioning phases of the Bypass project. The locations of the road and drainage projects relative to Kam Tin are shown in Figure 2.1. The railway alignment is still under discussion and thus has not been included in the figure.

Kam Tin Bypass

2.2 The proposed Kam Tin Bypass will be a dual two carriageway, approximately 1.3 km long, to be constructed to the north of Kam Tin. The road will be constructed on an embankment, and will connect to the existing Kam Tin Road by roundabouts to the west and east of the Kam Tin urban area.

2.3 As stated in the Brief, the Kam Tin Bypass Project ('the Project'), includes:

(i) construction of a dual two carriageway with associated road junctions;

(ii) provision of pedestrian and cyclist facilities, construction of two pedestrian subways and traffic signal controlled crossings;

(iii) environmental measures as recommended and agreed in the EIA;

(iv) construction of drainage works including the mitigation measures as recommended and agreed in the Drainage Impact Assessment (DIA);

(v) traffic management, reprovisioning and borrow area works;

(vi) all road works necessary for the connection of the Bypass to the existing road networks;

(vii) landscape works on and adjacent to the roads and associated pedestrian and cyclist facilities, including also the borrow area if required;

(viii) all other engineering works required for the completion and functioning of the works above, as well as the continued operation and functioning of adjacent roads, access tracks, drains, services and facilities that are affected by or interfaced with the Project.

2.4 The proposed construction programme is shown in Table 2.1.

Description of Study Area

2.5 The main EIA Study Area is defined in Figure 2.2, and covers the area within 300 m either side of the proposed centreline of Kam Tin Bypass. The study areas for the ecological impact assessment, and landscape and visual impact assessment, have extended beyond this boundary when necessary.

2.6 Kam Tin, with its five walled villages, is a place of historical and cultural importance. Kat Hing Wai, Kam Tin, is the original 10th Century settling place of the Tang clan, the first of the 'Five Great Clans' to migrate to the New Territories from further north in China. Kam Tin is designated as a Rural Centre in the NWNT Base Strategy study.

2.7 Kam Tin is located in the Yuen Long, Kam Tin and Ngau Tam Mei drainage basin, the largest drainage basin in the NWNT and the main agricultural area in Hong Kong. The basin is drained by two major water courses: the Kam Tin River draining the eastern half and the Yuen Long Creek (Shan Pui River) draining the western half of the plain respectively.[1] The basin is characterised by having a steep upland portion and an abrupt transition to a relatively flat lowland plain.

2.8 The flood plains in the area are susceptible to serious and frequent flooding. The area around Kam Tin is subject to frequent flooding, with a return period of 1-2 years. The severity of the flooding problems has been further exacerbated since rapid private sector development has taken place in the area. A number of structural improvements to the primary drainage systems and protection works to flood prone villages are already at various stages of planning, design and construction.

2.9 The Study Area is located in the topographically confined Deep Bay Airshed, which has a limited capability to disperse air pollutants, and is also within Deep Bay Water Control Zone. These factors have significant implications in terms of the potential impacts of the project on the environment and the environmental standards and guidelines which will be applicable.

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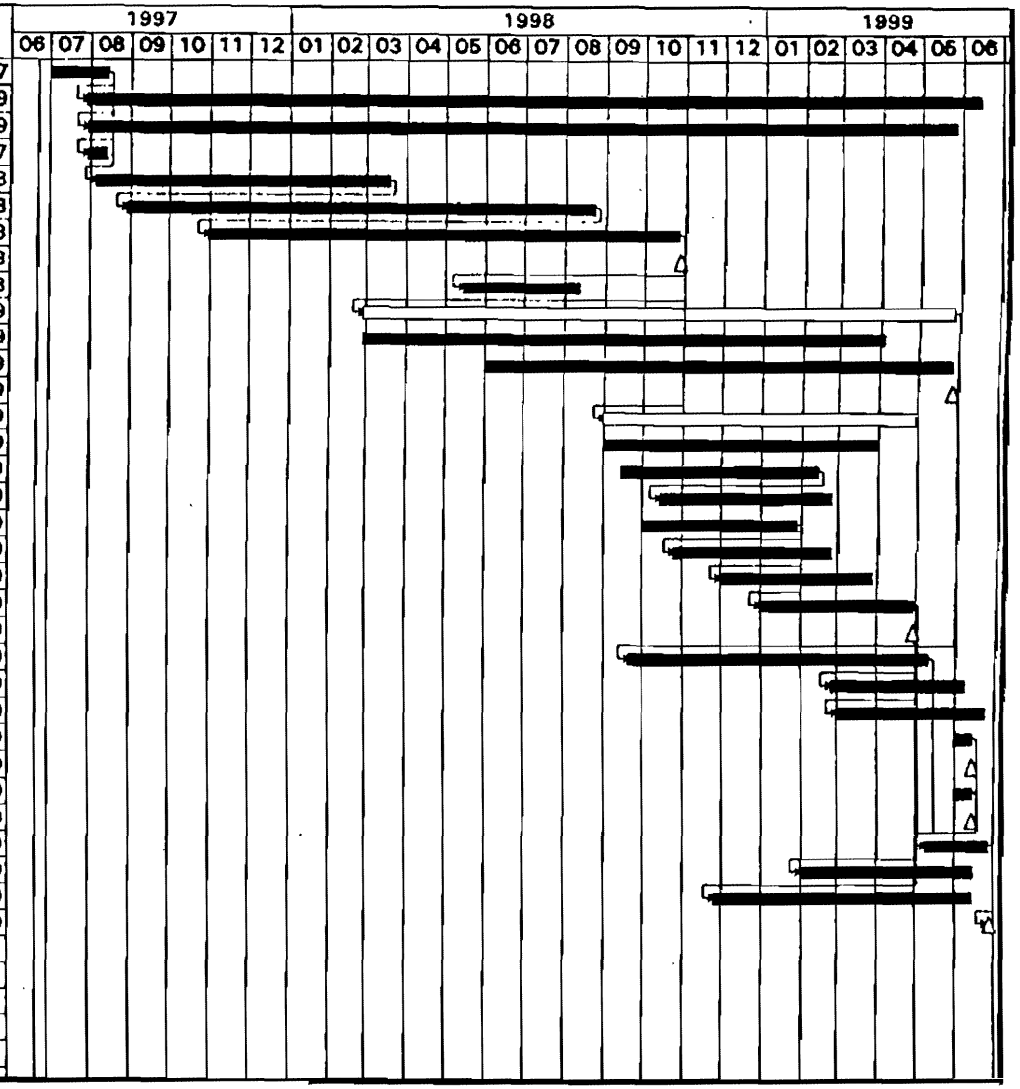
[1] *Main Drainage Channels for Ngau Tam Mei, Yuen Long and Kam Tin: EIA Study* (November 1994) ERM Hong Kong for Territory Development Department, NTN Development Office

Table 2.1
Proposed Kam Tin Bypass Construction Programme

Row #	Task Name	Start	End
1	Site Office, Plant Mobilization, Site Clearance	30/06/1997	14/08/1997
2	Traffic Diversion (continual task)	29/07/1997	15/06/1999
3	Existing Drainage Diversion (continual task)	30/07/1997	28/05/1999
4	Remove unsuitable material	30/07/1997	14/08/1997
5	Ground Treatment Work	05/08/1997	19/03/1998
6	Cross Road Drainage/Flood Mitigation Measure	29/08/1997	24/08/1998
7	Road Embankment	31/10/1997	28/10/1998
8	Embankment Completion	29/10/1998	29/10/1998
9	Subway	15/05/1998	13/08/1998
10	Slope Drainage	27/02/1998	28/05/1999
11	U - Channel	27/02/1998	05/04/1999
12	Trapezoidal Channel	01/06/1998	28/05/1999
13	Drainage Completion	28/05/1999	28/05/1999
14	Roadwork	01/09/1998	30/04/1999
15	Footpath Paving	01/09/1998	02/04/1999
16	Cycle Track Formation & Subbase	15/09/1998	15/02/1999
17	Cycle Track Paving	15/10/1998	25/02/1999
18	Carriageway Formation & Subbase	01/10/1998	29/01/1999
19	Profile Barrier/Road Kerb	26/10/1998	25/02/1999
20	Road drainage	01/12/1998	29/03/1999
21	Carriageway Paving	01/01/1999	30/04/1999
22	Roadwork Completion	30/04/1999	30/04/1999
23	Landscaping	21/09/1998	12/05/1999
24	RoadLighting	25/02/1999	09/06/1999
25	Traffic Signs	01/03/1999	25/06/1999
26	Merging Eastern Junction to Existing Road	01/06/1999	15/06/1999
27	Eastern road junction Completed	15/06/1999	15/06/1999
28	Merging Western Junction to Existing Road	01/06/1999	15/06/1999
29	Western road junction Completed	15/06/1999	15/06/1999
30	Road Marking	10/05/1999	28/06/1999
31	E & M Installation	01/02/1999	16/06/1999
32	Noise Barrier	26/11/1998	15/06/1999
33	Completion of work	29/06/1999	29/06/1999



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Page 1

Milestone △ Summary

2.10 Sensitive receivers and sensitive uses within 300 m of the centreline of the proposed Bypass include:

(i) a significant number of potentially affected residential areas (the villages of Kam Tin Shi, Tai Hong Wai, Kam Tin San Tsuen, Wing Lung Wai, Kiu Tau Tsuen and parts of Kat Hing Wai, Tai Hong Tsuen, Tsz Tong Tsuen, Ng Ka Tsuen, Ko Po Tsuen, Kam Hing Wat and Kong A Leng);

(ii) several schools; recreational facilities, including playgrounds and the Anthropological Survival Out-Reach Farm community facilities near Kong a Leng;

(iii) places of worship; a temple, shrines and grave sites;

(iv) sites of historical interest, including the Kat Hing Wai and Tai Hong Wai walled villages and the historical buildings at Tsz Tong Tsuen;

(v) several hectares of agricultural land and fishponds;

(vi) water courses to the north and south of Kam Tin, feeding into the Kam Tin River.

2.11 Representative noise sensitive receivers (NSRs) and air sensitive receivers (Air SRs), selected with the approval of the EPD, are identified in Section 5: Noise (see Figure 5.1) and Section 6: Air Quality (see Figure 6.1). Future sensitive receivers are defined according to the planning for the area as discussed below and shown in Figure 2.3.

Planning for the Kam Tin Area

2.12 Figure 2.3 shows the planning zones for Kam Tin, taken from the draft Outline Zoning Plans S/YL-KTS/1 and S/YL-KTN/1 dated 17 June 1994. Certain areas, already zoned as potential domestic residential developments, are of particular relevance to this project.

2.13 The purpose of the Outline Zoning Plan is to illustrate the broad principles of development and control only. It is a small scale plan and the road alignments and boundaries between the land use zones may be subject to minor alterations as detailed planning proceeds. Details of the residential designations, their abbreviations as they appear on Figure 2.3, and the maximum height and/or number of storeys to which they can be built are listed in Table 2.2.

Table 2.2
Summary of Outline Zoning Plan Schedule of Proposed Domestic Land Uses

Schedule of Uses	Abbreviation	Max. Storeys/Height
Residential (Group C)	R(C)	4/12m
Residential (Group C) 1	R(C)1	4/12m
Residential (Group C) 2	R(C)2	3/9m
Residential (Group D)	R(D)	2/6m
Village Type Development	V	3/8.23m

2.14 At the eastern end of the proposed Works Site Limit, immediately to the south of the roundabout, three plots of R(C)1, R(D) and Village Type Developments have been zoned.

2.15 The land to the northern side of the roundabout, has been zoned for Village Type Development, as has the area to west of the eastern roundabout.

2.16 To the south of the southern boundary of the proposed Works Site Limit (approximately 200-400m from the eastern roundabout), the adjoining land has been zoned for R(C)1 type Development. The majority of the remainder of the land to the north and the south of the Site's southern boundary is zoned for use as Village Type Development.

2.17 The land north and south of the Bypass adjacent to the remaining 100m of the road is to be preserved as agricultural land, according to the Outline Zoning Plan.

Improvement to Kam Tin Road, Stages 1 and 2

2.18 The existing Kam Tin Road is a single 2-lane carriageway with provision of narrow footpaths at discrete locations. However, the section between the Au Tau roundabout and Kam Tin Bypass (western roundabout) is due to be upgraded to a dual 2-lane carriageway standard, with provision of pedestrian and cyclist facilities, under PWP Item No. 560TH Improvement to Kam Tin Road Stage 1. These works are due to commence in early 1998 for completion in early 2000[2].

2.19 Stage 2 of the road improvements covers the section between the eastern roundabout of Kam Tin Bypass near Shek Kong Military Camp and Route Twisk. The tentative implementation plan for this Project is from early 2002 to early 2005.

2.20 There will be a junction, via slip roads, between the Au Tau to Kam Tin section of Kam Tin Road and the Route 3 (Country Park Section).

Route 3 (Country Park Section)

2.21 The Tai Lam Tunnel and Yuen Long Approach Road or Country Park Section of Route 3 is currently being implemented on a Build Operate Transfer (BOT) basis under the management of the Western Harbour Link & Route 3 (Country Park Section) Office of Highways Department.

2.22 Route 3 forms an integral part of the extensive transport infrastructure being developed to support Hong Kong's new airport at Chek Lap Kok on the north coast of Lantau Island and also the proposed container terminals on Lantau Island. The location of Route 3 relative to Kam Tin Bypass is shown in Figure 2.1, which is adapted from the location plan in the Route 3 (Country Park Section) Environmental Assessment[3].

2.23 In the south, Route 3 will be connected to the Ting Kau Bridge. In the north, the highway will connect to Kam Tin Road via slip roads that feed traffic to the eastern area of the New Territories and towards the Au Tau interchange and Yuen Long. The bulk of the traffic, however, will head north onto the New Territories Circular Road, which will provide a major crossing to the People's Republic of China. Route 3 will connect the New Territories Circular Road with Castle Peak Road at Yuen Long and the Yuen Long Southern Bypass.

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[2] Pre-Submission Meeting with Highways Department for Agreement CE 38/95 (18 September 1995)

[3] *Route 3 Country Park Section and Ting Kau Bridge: Preliminary Design Stage 2 - Country Park Section - Tai Lam Tunnel and Yuen Long Approach Road - Volume 3A: Environmental Assessment - Technical Report* (undated) Freeman Fox Maunsell for Highways Department, Western Link Office

2.24 The Route 3 (Country Park Section) is currently being constructed and is due to open to traffic in 1998.

Main Drainage Channels for Yuen Long and Kam Tin

2.25 Kam Tin currently experiences frequent and extensive flooding on a 1-2 year return period basis. Drainage Services Department is currently managing the implementation of major drainage works[4] designed to alleviate flooding in areas around Kam Tin, as listed in Table 2.3. The river training projects basically comprise bend straightening, channel deepening and widening although the treatment for the bank and bottom protection may vary.

2.26 The location of the river training works immediately adjacent to Kam Tin is indicated in Figure 2.1.

Table 2.3
Proposed Drainage Works for the Kam Tin Area

PWP No.	Title	Tentative Start/ Completion
60CD	Construction of Main Drainage Channels for Yuen Long and Kam Tin Stage I Phase 1: the construction of wide river channels entering Deep Bay	1993-1997
43CD	NWNT Development - Main Drainage Channels for Yuen Long and Kam Tin Stage I Phase 2: the construction of new river channel sections	1995-1998
22CD	NWNT Development - Main Drainage Channels for Yuen Long and Kam Tin - Remainder Phases 1-4: the remainder of main drainage channel construction and the artificial channelisation (widening, deepening and lining) of natural meandering rivers/streams	1998-2001[5]
30CD	Village Flood Protection for Yuen Long, Kam Tin and Ngau Tam Mei, NWNT Stage I - Sha Po Tsuen, Pok Wai, Chuk Yuen Tsuen/Ha San Wai, Mai Po Lo Wai/Mai Po San Tsuen Stage II - Yuen Long and Kam Tin Villages (Ma Tin Tsuen, Shui Pin Tsuen, Shui Pin Wai, Tai Kiu, Wang Chau Villages)	 1996-2000 1997-2003

[4] Adapted from Draft Brief for Agreement No. CE 57/95 (11 August 1995)

[5] See footnote 2

Western Corridor Railway

2.27 The Western Corridor Railway (WCR) is one of several strategic routes that have been identified under the Railway Development Study, which is being managed by the Railway Division of Highways Department. The detailed feasibility of the WCR is being undertaken by the Kowloon Canton Railway Corporation. The project, proposed for completion by 2001, would provide a new arterial transportation link to the border. It would provide three services: a long distance freight service (the Port Rail Line), a cross border passenger service and a sub-regional passenger link between the North West New Territories and the urban area. The whole alignment would run from the border via Yuen Long, Kam Tin, Tsuen Wan and Kwai Chung to West Kowloon[6].

2.28 The Kam Tin Layout Plan No. L/YL-KT/1E which was approved by Government on 11.7.95 indicates an alignment for the proposed rail link and location of the associated rail station and public transport interchange. Based on the administrative route protection plan recently circulated by Chief Engineer/Railways, HyD, the proposed alignment of the WCR and the associated rail station will fall outside the study area. For the purposes of the EIA Study, it has been assumed that the future alignment of the railway follows the administrative protection route of the WCR.

Cumulative Impacts

2.29 During our studies, we have liaised with all adjacent projects (eg. PWP Item 60CD - NWNT Development Main Drainage Channels for Yuen Long and Kam Tin Stage 1, Phase 1; BOT Project - Route 3 Country Park Section; PWP Item 560TH - NWNT Development Improvement to Kam Tin Road - Stage 1 - Section between Au Tau Roundabout and Kam Tin River; Proposed PWP Item - NWNT Development to Kam Tin Road - Stage 2 - Section between Shek Kong Military Camp and Route Twisk; Western Corridor Railway Railway Development Study) and obtained as much information as is readily available concerning the timing of construction and likely impacts of these projects.

[6] *Railway Development Strategy* (December 1994) Hong Kong Government Transport Branch

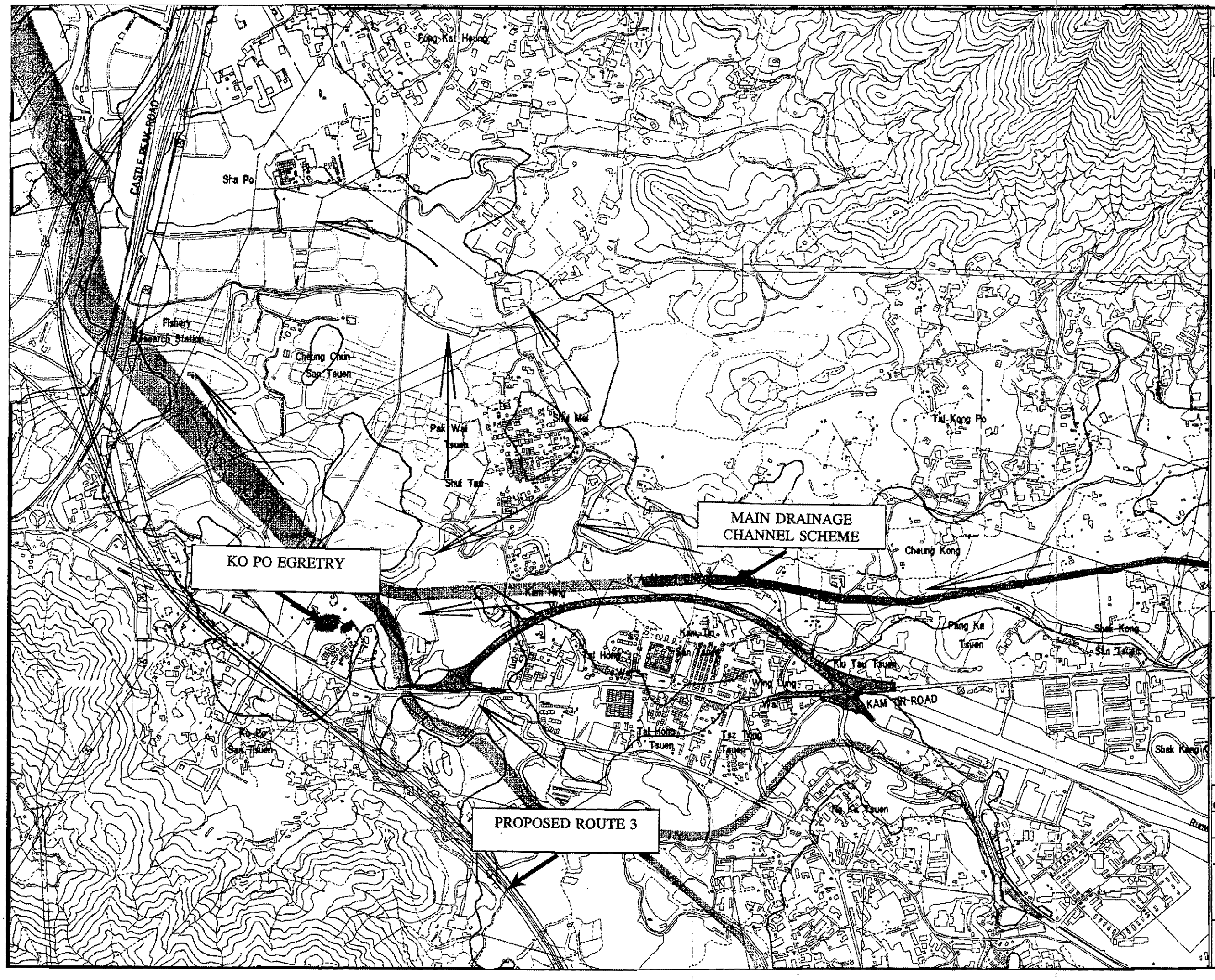
2.30 The section of the main river channel just to the north of Kam Tin Bypass will be substantially completed before the construction of Kam Tin Bypass commences on site. It has been assumed throughout these EIA studies that this water body must be protected from any contamination. The actual progress and programme of DSD's river training works contract and the Bypass contract will be closely monitored during the Detailed Design Phase.

2.31 The construction and operational phases of Route 3 will have major impacts on sensitive receivers in the vicinity of Route 3. The alignment of Route 3 is shown in Figure 2.1. There are few sensitive receivers lying between the western roundabout of Kam Tin Bypass and Route 3. The October 1995 Final Detailed Impact Assessment report written for Route 3 Contractors Consortium by CES has identified three sensitive receivers to the south and south west of Kam Tin. These are coded R2039, R2048 and R2066. R2039 and R2048 lie just within the south-western boundary of the Study Area for Kam Tin Bypass shown in Figure 2.2. R2066 is representative of a group of 3-storey houses which lie over half a kilometre to the south of Kam Tin Road and about 100 m south of the east-west section of Kam Sheung Road.

2.32 R2039 and R2048 are substantially screened from any noise impacts due to Kam Tin Bypass project by a hill. None of the dwellings were used to calculate construction noise in the Route 3 DEIA. R2066 was marked as not being currently impacted by traffic noise with R2039 having a current predicted noise level of 57 dB(A). No significant accumulative effect from Kam Tin Bypass and Route 3 is likely.

2.33 Air quality impacts are more accumulative. Construction dust TSP levels at R2066 were predicted in the Route 3 DEIA as a maximum daily average of 61 $\mu g/m^3$ and an annual average of 5 $\mu g/m^3$. NO_2 levels predicted at R2066 during the operational phase in 2002 by the DEIA were 21 $\mu g/m^3$ for the daily maximum and 4 $\mu g/m^3$ for the annual maximum. These numbers do not suggest any significant accumulative effect from the two projects.

2.34 Kam Tin Road to the west of the Bypass is the subject of feasibility studies for widening works. The Route 3 DEIA shows the positions of 1.0 m barriers that are to be constructed along the edges of Kam Tin Road near its junction with Route 3.



LEGEND :

- Flood Storage Area In 1992
- Proposed Kam Tin Bypass
- Floodway
- River Training By DSD

Project title

Agreement no. CE 7/94 Kam Tin By-pass

Drawing title

EIA - KAM TIN BYPASS & ADJACENT PROJECTS

Plan register no.

BCL1/home3/mapboss/BASIN11/ZF14/XTCOMP2

Figure No. 2.1

Scale N.T.S.

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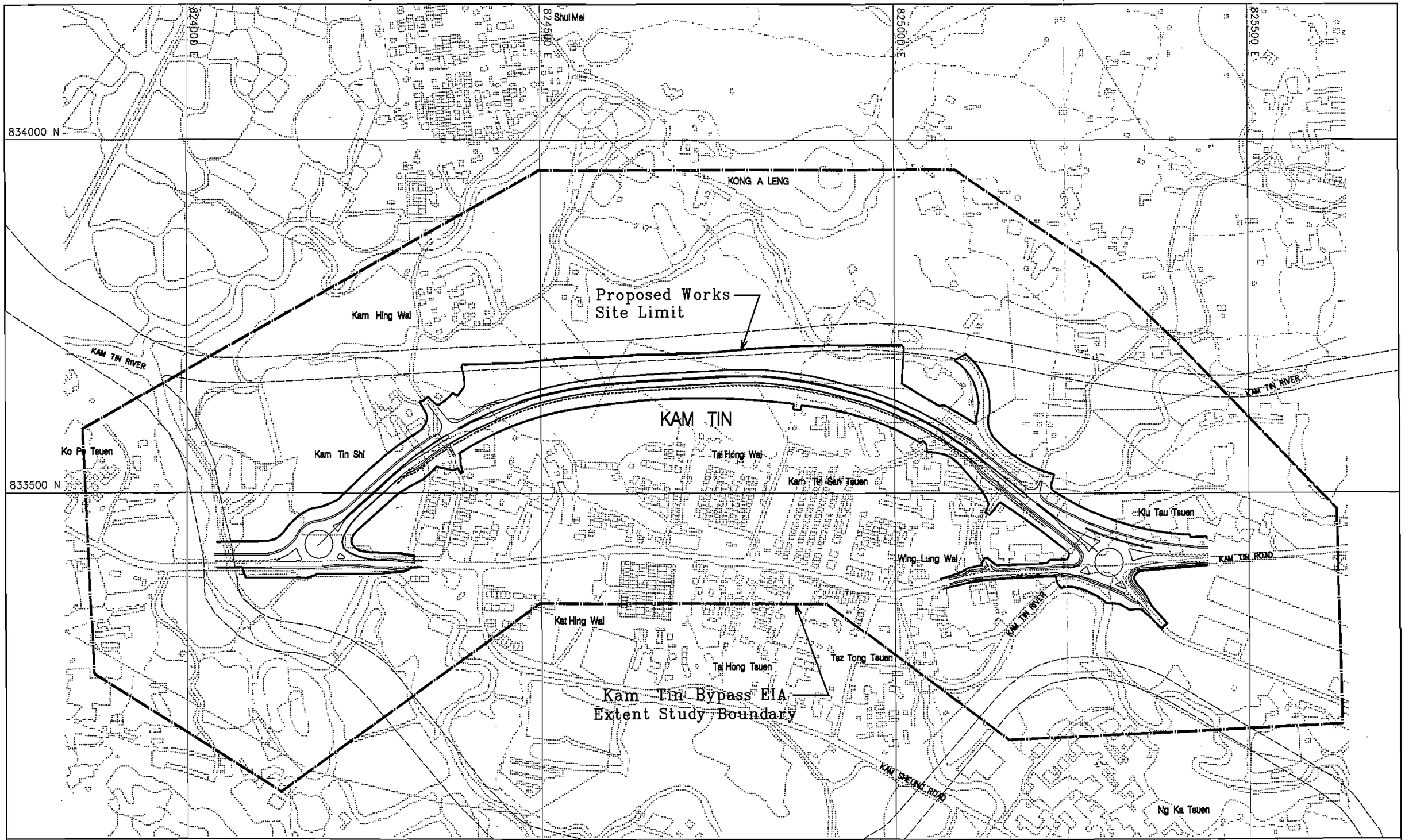

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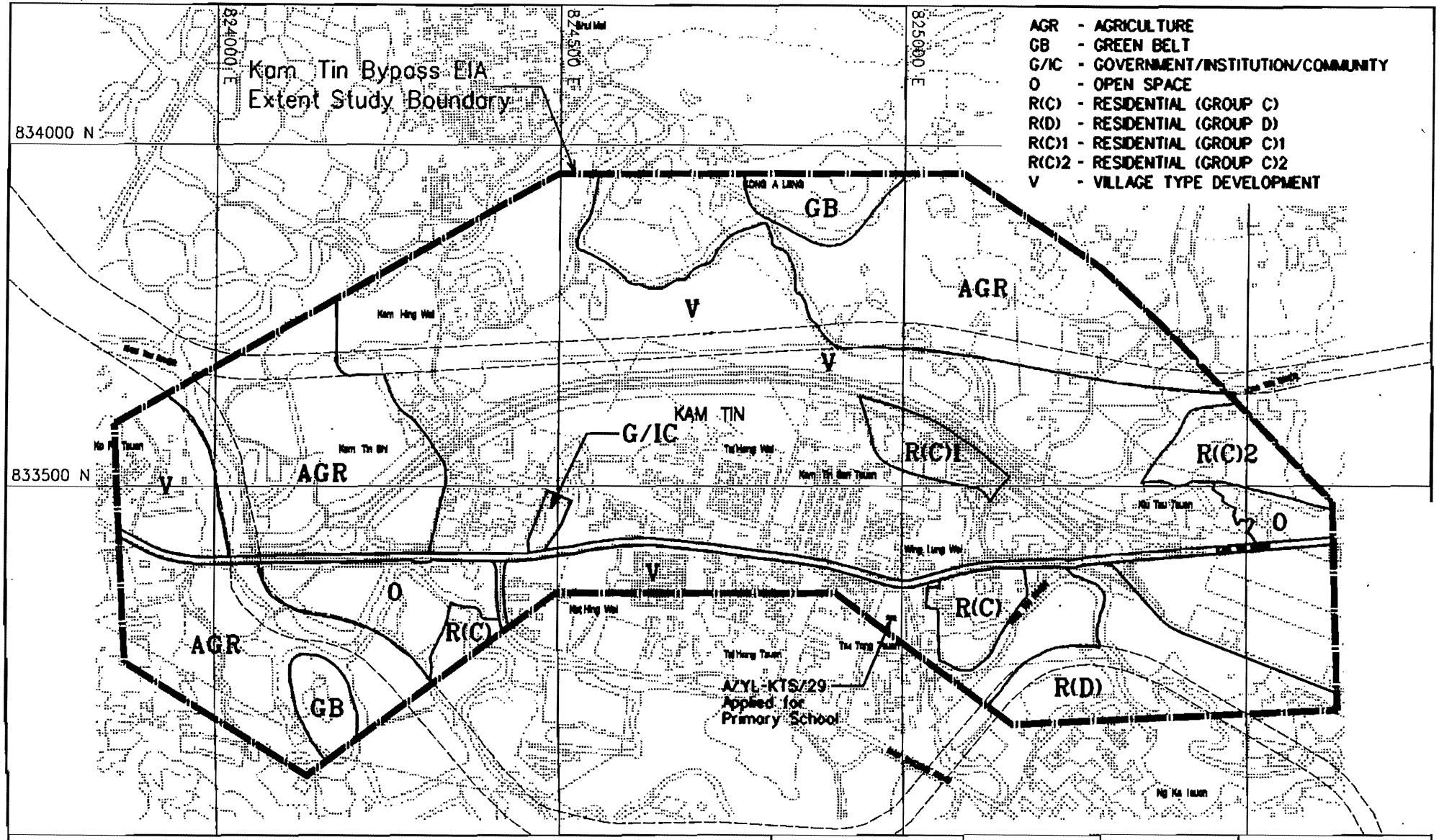
Title : KAM TIN BY-PASS GENERAL LAYOUT	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 2.2



Agreement No. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : NOV. 95	Scale : 1 : 8000
Title : EIA - KAM TIN BYPASS PLANNING ZONES FROM OZPS	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 2.3

3 ENVIRONMENTAL LEGISLATION AND PLANNING GUIDELINES

Introduction

3.1 One of the Hong Kong Government's overall policy objectives on environmental planning, as outlined in the 1989 *White Paper on Pollution in Hong Kong*, is "to avoid creating new environmental problems by ensuring the consequences for the environment are properly taken into account in site selection, planning and design of all new developments".

3.2 This section highlights the relevant environmental legislation and guidelines which are currently applicable to the proposed project.

Hong Kong Planning Standards and Guidelines

3.3 The *Hong Kong Planning Standards and Guidelines* (*HKPSG*) *Chapter 9: Environment* provides guidance for including environmental considerations in the planning of both public and private developments. The environmental suitability of a site for a certain land use is governed by such factors as:

(i) natural environmental characteristics including topography, climate, hydrological and hydrographical characteristics, vegetation, wildlife and habitat, and soil conditions;

(ii) the nature, distribution and consequences of the residuals including aerial emissions, wastes, sewage or noise generated by land uses in the development area;

(iii) the capacity of the environment to receive additional developments; and

(iv) existing land uses.

Rural Areas

3.4 *HKPSG Chapter 10: Landscape and Conservation* states that:

"The primary aim of environmental planning in rural areas is to achieve a balance between the need for development and the need to minimise disruption of primary industries and loss of rural resources and amenity.

Planning in rural areas should recognise that the natural resources and primary industries of rural areas have important non-economic as well as economic values, which can be of local, regional and territorial significance.

Planning should aim therefore to identify, conserve and enhance these values through:

(a) The conservation, protection and enhancement of the physical, cultural and social environment of rural areas;

(b) The avoidance of encroachment of urban development on, and the protection of, land having a high actual or potential value for agriculture, outdoor recreation or conservation; and

(c) The prevention of sporadic urban or other incompatible development in rural areas."

Green Belt, Country Parks and 'Special Areas'

3.5 The major land uses within rural areas under statutory control are Green Belt (under the *Town Planning Ordinance [Cap 131]* (1988) and the *Town Planning Amendment Ordinance* of 1991) and Country Park (under the *Country Parks Ordinance [Cap 208]* of 1976).

3.6 Green Belt zoning is intended to limit development on the fringes of existing and proposed urban areas in order to maintain, and where possible enhance, their landscape and amenity values. Only certain types of developments are permitted in Green Belt areas: others are subject to approval by the Town Planning Board.

3.7 Country Parks are areas designated for provision of informal outdoor recreation and conservation of landscape, wildlife and historical features. 'Special Areas' of Government land may be gazetted for "the safeguarding of botanical, zoological, landscape and/or historical significance" under the *Country Park Special Areas Regulations* (1989). No new developments can be carried out in Country Parks and Special Areas without the approval of the Director of Agriculture and Fisheries.

Site of Special Scientific Interest

3.8 Sites of Special Scientific Interest (SSSI) are terrestrial or aquatic sites which because of their flora, fauna, geographical, geological or physiographical features are of particular scientific interest. SSSI are registered by the Planning Department upon the advice of the Director of Agriculture and Fisheries. Unlike Country Parks or Special Areas, the status of SSSI does not confer any statutory power to the Government nor imply any legal restrictions on the activities of the land owner.

Visual Assessment and Landscaping

3.9 There is no current legislation which specifically relates to landscape and visual impacts of developments in Hong Kong. However, the *HKPSG Chapter 10: Landscape and Conservation* referred to above does contain recommendations about developments in agricultural areas, woodlands, water gathering grounds, areas of freshwater fish culture, scenic and potential recreation areas.

3.10 This chapter of the *HKPSG* also provides guidelines for reducing adverse environmental effects of development in rural areas. Recommendations cover:

(i) *Topography and site information:*

Developments on hill tops, scenic ridges and prominent positions should be avoided wherever possible. Site layout, road alignments, etc. should follow and relate to the natural contours. Overall, formation work and site disturbance should be minimised.

In scenic areas, opportunities should be taken to use local landform and any excavated material available to 'fit' the development into the ground form, soften the geometric outline of buildings, and screen ancillary features from view;

Developments should be sited and planned to minimise long term visual impact.

(ii) *Retention of existing vegetation:*

Developments should be sited so as to retain existing woodlands, groups of trees and feature trees wherever possible.

Retention of trees on development sites is made easier if non-building areas are specified to include all significant tree features and suitable conditions to ensure these areas are protected and included in development proposals.

Advice should be sought from Agriculture and Fisheries Department, Buildings Department, Territory Development Department, Urban Services Department or Regional Services Department on regulations governing the felling of trees, the suitability of trees for retention and the possible occurrence of important flora and fauna.

(iii) *Site layout, overhead services alignments, etc.:*

The appropriate siting and design of development is often crucial for the maintenance of the landscape in rural areas. Building layouts that avoid regular repetitive or geometric forms and that relate well to natural landforms are preferred.

Views from surrounding areas should be taken into account.

Overhead services should be aligned to minimise visual impact and below ground routes should be preferred in sensitive areas.

(iv) *Building design and landscape treatment:*

In areas of scenic importance, building design should be sympathetic with the surrounding landscape and the general rural environment.

The preparation and implementation of landscape plans should be a requirement on all major developments and, as a general rule, for developments in scenic areas. Landscape Plans should include all or most of the following:

(a) A framework of tree planting to separate, screen and complement buildings;

(b) Shrub and ground cover on the periphery of the site where this is open to public view;

(c) Re-vegetation of excavated areas and formed slopes not built upon, consistent with geotechnical requirements; and

(d) Proposals to ensure that the vegetation to be established is maintained or self-sustaining.

3.11 *HKPSG* also provides the following guidelines for roadside planting which are applicable in both the urban and rural context:

(i) Wherever possible, existing trees and woodlands are to be retained. Where this proves impractical, all possible efforts should be made to transplant suitable healthy trees either elsewhere on site or in the near vicinity.

(ii) Wherever possible, footways, median strips and road side areas should be designed to accommodate planting. Transport Department, Highways Department and Fire Services Department should be consulted. In areas where planting is intended, special consideration to the location of utility services may be required.

(iii) Roadside and median plantings can also temper the environment, reduce vehicle pollution to a degree and screen traffic and other uses.

(iv) Major planting belts (structure plantings) should be wide enough to be usable for recreation and be heavily planted. Where a buffer for polluting uses is intended a wide planting is needed (say 45 m).

(v) Intersections (especially grade separated) occupy large areas and present scope for heavy planting and contouring. Care must be taken with sight lines, and the Territory Development Department should be consulted.

(vi) Always consult with future maintenance authorities (Urban Services Department, Regional Services Department).

Noise

3.12 *HKPSG* states that "The basic role of planning against noise is to provide an environment whereby noise impacts on sensitive uses are maintained at acceptable levels."

3.13 Noise control legislation in Hong Kong comes under the *Noise Control Ordinance [Cap 400]* of 1988 regulations and associated Technical Memoranda (TM). The following TM have been issued on:

(i) *The Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places* (1988)

(ii) *Noise from Construction Works other than Percussive Piling* (1988)

(iii) *Noise from Percussive Piling* (1988)

3.14 New environmental legislation on noise control, the *Noise Control (Construction) Regulation* and the associated *TM on Noise from Work within a Designated Area*, is currently being drafted and due to be enacted in 1996. This legislation is designed to control noise from the use of specified powered mechanical equipment and the carrying out of prescribed construction work on construction sites within a designated area during restricted hours.

3.15 An amendment to the *TM on Noise from Percussive Piling*, phasing out the use of diesel hammers, is under consideration.

3.16 Noise Sensitive Receivers (NSRs) are defined by the *HKPSG* and *Noise Control Ordinance* as follows:

(i) all domestic premises, including temporary housing accommodation;

(ii) hotels and hostels

(iii) offices

(iv) educational institutions, including kindergartens, nurseries and all others where unaided voice communication is required

(v) places of public worship and courts of law

(vi) hospitals, clinics, convalescences and homes for the aged, diagnostic rooms and wards

(vii) amphitheatres and auditoria, libraries, performing arts centres and Country Parks

3.17 The appropriate Acceptable Noise Level (ANL) for a particular NSR is dependent on the character of the area in which the NSR is located, and the time of day under consideration. The Area Sensitivity Rating (ASR) is a function of the type of area within which the NSR is located and the degree of the effect on the NSR of particular Influencing Factors (IFs). IFs include any industrial area, major roads (ie. those with a heavy and generally continuous flow of vehicular traffic) and the area within the boundary of Hong Kong International Airport. Table 3.1 shows the Area Sensitivity Ratings given by the *Noise Control Ordinance*.

Table 3.1
Area Sensitivity Ratings

Type of Area containing NSR	Degree to which NSR is affected by IF	Not Affected	Indirectly Affected	Directly Affected
(i)	Rural area, including Country Parks or village type developments	A	B	B
(ii)	Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
(iii)	Urban area	B	C	C
(iv)	Area other than above	B	B	C

Notes:

'Country Park' means an area that is designated as a country park pursuant to section 14 of the *Country Parks Ordinance.*

'Directly Affected' means that the NSR is at such a location that noise generated by the IF is readily noticeable by the NSR and is a dominant feature of the noise climate of the NSR.

'Indirectly Affected' means that the NSR is at such a location that noise generated by the IF, whilst noticeable at the NSR, is not a dominant feature of the noise climate of the NSR.

'Not Affected' means that the NSR is at such a location that noise generated by the IF is not noticeable at the NSR.

'Urban Area' means and area of high density, diverse development including a mixture of such elements as industrial activities, major trade or commercial activities and residential premises.

Construction Noise

3.18 There are no statutory criteria for noise from construction work other than percussive piling generated during the daytime hours of 07:00-19:00, Monday to Saturday, excluding public holidays. However, EPD normally recommends 75 dB(A) L_{eq}(30 min) as the acceptable noise level during daytime hours at the facade of residential sensitive receivers and 70 dB(A) at schools (65 dB(A) during examinations) as outlined in the ProPECC paper (PN 2/93) on *Noise from Construction Activities - Non-Statutory Controls.*

3.19 Noise restrictions are imposed during the evenings (19:00-23:00), night-time (23:00-07:00) and all day on Sunday and public holidays. For construction activities during these hours, a Construction Noise Permit (CNP) is required from the Environmental Protection Department (EPD). The CNP application will be assessed in accordance with the Basic Noise Levels (BNLs) given in the *TM on Noise from Construction Works other than Percussive Piling*, as shown in Table 3.2.

Table 3.2
Basic Noise Levels for General Construction Noise

Time Period \ ASR	A	B	C
All days during the evening (19:00-23:00), and general holidays (including Sundays) during the daytime and evening (07:00-23:00)	60	65	70
All days during the night-time (23:00-07:00)	45	50	55

3.20 During daytime works, EPD recommends that the advice in EPD's *Practice Note ProPECC PN2/93* on construction noise abatement practice is followed.

Operational Noise

3.21 *HKPSG* states that noise levels from a new fixed source should be 5 dB(A) below the relevant ANL presented in the *TM on The Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places* or the prevailing background noise level, whichever is lower. The ANL from the TM for a given NSR is presented in dB(A) in Table 3.3 below.

Table 3.3
Acceptable Noise Levels during Operations

Time Period / ASR	A	B	C
Day (07:00-19:00) and Evening (19:00-23:00)	60	65	70
Night (23:00-07:00)	50	55	60

Road Traffic Noise

3.22 As outlined in the *HKPSG*, the severity of road traffic noise impact on sensitive uses depends on many variables, some of which can be controlled or influenced by land use planning. These variables include:

(i) road alignment, ie. providing distance separation between the noise receiver and the vehicles;

(ii) traffic composition and volume, ie. using traffic planning and management to control vehicle movements and type of vehicles at different times of the day;

(iii) line-of-sight, ie. using noise-tolerant buildings to reduce the angle of view of receiver on road traffic;

(iv) shieldings, eg. using barriers, road enclosures or road decking.

3.23 For road traffic noise, the *HKPSG* specifies the acceptable noise limit at the external facade of all domestic premises which rely on open windows for ventilation, including temporary housing areas, as L_{10} (1 hour) of 70 dB(A). See Table 3.4.

Table 3.4
Traffic Noise Standards

Use / Noise Source	Road Traffic Noise L_{10}(1 hr) dB(A)
All domestic premises including temporary housing accommodation	70
Hotels and houses	70
Offices	70
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	65
Places of public worship and courts of law	65
Hospitals, clinics, convalescences and homes for the aged: diagnostic rooms and wards	55
Amphitheatres and auditoria, libraries, performing arts centres and Country Parks	depends on locations and construction

Notes:

1 The above standards apply to uses which rely on open windows for ventilation
2 The above standards should be viewed as the maximum permissable noise levels at the external facade

Air Quality

3.24 The principal legislation regulating air emissions in Hong Kong is the *Air Pollution Control Ordinance (APCO) [Cap 311]* of 1983 and its subsidiary regulations. The whole of the Territory has been divided into Air Control Zones. Kam Tin falls within the topographically confined Deep Bay Airshed.

3.25 *HKPSG* states that "Air quality is affected by such factors as the emission rate of air pollutants, the separation distance between emission sources and receptors, topography, height and width of buildings as well as meteorology."

3.26 New environmental legislation entitled *Air Pollution Control (Construction Dust) Regulations* is currently under consultation. These regulations are to control the dust emission from construction sites by a notification and permit procedure..

Operational Emissions

3.27 The Hong Kong Air Quality Objectives (AQOs) state the maximum acceptable concentration of air pollutants. The AQOs for one and 24 hour concentrations of five major pollutants are shown in Table 3.5. The Government aims to achieve the AQOs throughout the Territory as soon as 'reasonably practicable'. Efforts are being made to control and reduce air pollution emitters in areas where the AQOs are already exceeded, eg. by controlling new developments. The AQOs will apply to the operational phases of the project.

Construction Dust

3.28 During the construction phase of the project, an hourly average TSP limit of 500 $\mu g/m^3$ is recommended by EPD for assessing construction dust impacts. This limit is not statutory, but nonetheless has been used in many construction works in Hong Kong as a contractual requirement.

Cement and Concrete

3.29 Cement works in which the total silo capacity exceeds 50 tonnes and in which cement is handled fall under the Specified Processes under the *Air Pollution Control Ordinance*. A licence from EPD is required to operate such a works.

Table 3.5
Air Quality Objectives

Pollutant	Concentration (μg)m^3					Health effects of pollutant at elevated ambient levels
	Average Time					
	1hr	8hrs	24hrs	3mths	1yr	
Sulphur Dioxide	800[2]		350[3]		80	Respiratory illness; reduced lung function; morbidity and mortality rates increase at higher levels.
Total Suspended Particulate			260[3]		80	Respirable fraction has effects on health.
Respirable Suspended Particulates			180[3]		55	Respiratory illness; reduced lung function; cancer risk for certain particles; morbidity and mortality rates increase at higher levels.
Nitrogen Dioxide	300[2]		150[3]		80	Respiratory irritation; increased susceptibility to respiratory infection; lung development impairment.
Carbon Monoxide	30000[2]	10000[3]				Impairment of co-ordination; deleterious to pregnant women and those with heart and circulatory conditions.
Photochemical Oxidants as ozone	240[2]					Eye irritation; cough; reduced athletic performance; possible chromosome damage.
Lead				1.5		Affects cell and body processes; likely neuro-psychological effects, particularly in children; likely effects on rates of incidence of heart attacks, strokes and hypertension.

Notes: Concentrations measured at 298°K (25°C) and 101.325 kPA

1 Suspended particles in air with a nominal aerodynamic diameter of 10 μm or smaller
2 Criteria not to be exceeded more than 3 times per year
3 Criteria not to be exceeded more than once per year

3.30 In order to obtain a licence to conduct a Specified Process, EPD may require the applicant to submit an air pollution control plan for the process. This will include:

(i) a description and technical particulars of the plant or equipment that may evolve an air pollutant;

(ii) details of pollution control equipment or measures proposed to minimise emissions and comply with the requirement to use the best practicable means of controlling air pollution;

(iii) a description (with maps) to identify sensitive receivers, eg. residential buildings, schools, hospitals;

(iv) an assessment of the resulting air quality and risk to human health, including supporting calculations and information;

(v) a statement that the best practicable means of controlling air pollution has been adopted or is proposed, including supporting calculations and information;

(vi) a plan for, or scheme of, monitoring the emission at source or the ambient concentration of any air pollutant.

3.31 The *HKPSG* recommends that any concrete batching plants and open storage areas should be located at least 100 m from any air sensitive receiver.

Water Quality

3.32 The principal legislation for controlling water pollution in Hong Kong is the *Water Pollution Control Ordinance (WPCO) [Cap 358]* of 1981 which allows for gazettal of Water Control Zones (WCZ) within which the discharge of liquid effluents and the deposit of matter into any water bodies, public sewers and drains are controlled. The WPCO is applicable for construction site discharges as well as for discharges during the operational phase.

3.33 The Study Area falls into the Deep Bay Water Control Zone, which was declared on 1 December 1990. Deep Bay (Hau Hoi Wan) has been threatened by gross pollution. The water quality objectives for Deep Bay are presented in Table 3.6.

Table 3.6
Statement of Water Quality Objectives
(Deep Bay Water Control Zone)

Water Quality Objective			Part or Parts of Zone
A.	AESTHETIC APPEARANCE		
	(a)	Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole Zone
	(b)	Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole Zone
	(c)	Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole Zone
	(d)	There should be no recognisable sewage-derived debris.	Whole Zone
	(e)	Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole Zone
	(f)	Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole Zone
B.	BACTERIA		
	(a)	The level of Escherichia coli should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in one calender year.	Secondary Contact Recreation Subzone and Mariculture Subzone *(L.N. 455 of 1991)*
	(b)	The level of Escherichia coli should be zero per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Sub-zones
	(c)	The level of Escherichia coli should not exceed 1000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
	(d)	The level of Escherichia coli should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calender month at intervals of between 3 and 14 days.	Yuen Long Bathing Beach Subzone *(L.N. 455 of 1991)*

Water Quality Objective			Part or Parts of Zone
C.	COLOUR		
	(a)	Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	(b)	Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
D.	DISSOLVED OXYGEN		
	(a)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	Inner Marine Subzone excepting Mariculture Subzone
	(b)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 milligrams per litre within 2 metres of the seabed for 90% of the sampling occasions during the year.	Outer Marine Subzone excepting Mariculture Subzone
	(c)	The dissolved oxygen level should not be less than 5 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface.	Mariculture Subzone
	(d)	Waste discharges shall not cause the level of dissolved oxygen to be less than 4 milligrams per litre.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters of the Zone
E.	pH		
	(a)	The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine waters excepting Yuen Long Bathing Beach Subzone
	(b)	Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones

Water Quality Objective			Part or Parts of Zone
	(c)	The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters
	(d)	The pH of the water should be within the range of 6.0-9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Yuen Long Bathing Beach Subzone
F.	TEMPERATURE		
	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.		Whole Zone
G.	SALINITY		
	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.		Whole Zone
H.	SUSPENDED SOLIDS		
	(a)	Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
	(b)	Waste discharges shall not cause the annual median of suspended solids to exceed 20 milligrams per litre.	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Ganges Subzone, Indus Subzone, Water Gathering Ground Subzones and other inland waters
I.	AMMONIA		
	The un-ionized ammonical nitrogen level should not be more than 0.021 milligram per litre, calculated as the annual average (arithmetic mean).		Whole Zone.
J.	NUTRIENTS		
	(a)	Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Inner and Outer Marine Subzones
	(b)	Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.7 milligram per litre, expressed as annual mean.	Inner Marine Subzone

Water Quality Objective			Part or Parts of Zone
	(c)	Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 milligram per litre, expressed as annual water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed).	Outer Marine Subzone
K.	5-DAY BIOCHEMICAL OXYGEN DEMAND		
	(a)	Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 milligrams per litre.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	(b)	Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 milligrams per litre.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
L.	CHEMICAL OXYGEN DEMAND		
	(a)	Waste discharges shall not cause the chemical oxygen demand to exceed 15 milligrams per litre.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones.
	(b)	Waste discharges shall not cause the chemical oxygen demand to exceed 30 milligrams per litre.	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
M.	TOXINS		
	(a)	Waste discharges shall not cause the toxins in water to attain such level as to produce significant toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole Zone
	(b)	Waste discharges shall not cause a risk to any beneficial uses of the aquatic environment.	Whole Zone
N.	PHENOL		
	Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 milligrams per litre as C_6H_5OH.		Yuen Long Bathing Beach Subzone
O.	TURBIDITY		
	Waste discharges shall not reduce light transmission substantially from the normal level.		Yuen Long Bathing Beach Subzone

3.34 The *TM on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* was issued in 1991. Under the provisions of this TM, all discharges must be licensed. Tables included within the document identify standards related to effluent flow rates ranging from <10 m^3/day to 6,000 m^3/day, providing guidance on a case-by-case basis. To illustrate this, standards for selected discharges to Deep Bay are shown in Table 3.7.

Table 3.7
Standards for Effluents discharged into the coastal waters of Deep Bay

Flow rate (m^3/day) Determinant	≤10	>10 to ≤200	>1000 to ≤1500	>3000 to ≤4000	>5,000 to ≤6,000
pH (pH units)	6-9	6-9	6-9	6-9	6-9
Temperature (^{0}C)	45	45	45	45	45
Colour (lovibond units) (25 mm cell length)	1	1	1	1	1
Suspended solids	50	50	25	25	25
BOD	20	20	10	10	10
COD	80	80	50	50	50
Oil & Grease	20	20	10	10	10
Iron	10	10	3	1	1
Boron	5	4	1.1	0.4	0.2
Barium	5	4	1.1	0.4	0.2
Mercury	0.1	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001
Other toxic metals individually	1	0.5	0.25	0.1	0.1
Total toxic metals	2	1	0.5	0.2	0.1
Cyanide	0.1	0.1	0.06	0.02	0.01
Phenols	0.5	0.5	0.1	0.1	0.1
Sulphide	5	5	2.5	1	0.5
Total residual chlorine	1	1	1	1	1
Total nitrogen	100	100	80	50	50
Total phosphorus	10	10	8	5	5
Surfactants (total)	15	15	10	10	7
E Coli (count/100 ml)	1000	1000	1000	1000	1000

Note: All units in mg/L unless otherwise indicated; all figures are upper limits unless otherwise indicated

Construction Site Discharges

3.35 Advice on the handling and disposal of construction site discharges, including site runoff and contaminated wastewaters, is provided in the ProPECC Paper (PN1/94) on *Construction Site Drainage*.

Waste Oil

3.36 The disposal of waste oil and other chemicals is controlled by the regulations for chemical waste control under the Waste Disposal Ordinance. Waste oil and other chemicals must be disposed of at the Government Chemical Waste Treatment Centre at Tsing Yi.

Solid Waste

3.37 Disposal of chemical, household, street, trade and livestock waste is controlled by the *Waste Disposal Ordinance [Cap 354]* of 1980. This legislation covers all aspects of the production, storage, collection and disposal, including the treatment, reprocessing and recycling of waste. In 1989, the formulation of a strategic Waste Disposal Plan for Hong Kong was founded on this legislation.

3.38 Construction waste generated during the construction phase should be sorted on site into inert and non-inert fraction for reuse and recycling as far as practical. The non-inert fraction containing no more than 20% by volume of inert content can be disposed of at landfills, whilst the inert fraction should be delivered to public dumps or other reclamation sites. Inert material means soil, rock, asphalt, concrete, brick, cement plaster/mortar, building debris, aggregates, etc.

3.39 The design of oil/fuel storage facilities is covered by the *Code of Practice for Oil Storage Installations* issued by the Building Authority. The handling of chemical spillages on land is regulated by the Fire Services Department.

Contaminated Land

3.40 The ProPECC guidelines PN 3/94 on *Contaminated Land Assessment and Remediation* prepared by EPD covers the disposal of contaminated land to landfill.

Ecology

Sites of Special Scientific Interest

3.41 There are various legislative and regulatory controls in place for the conservation of species and protection of the environment. Table 1.2 from *HKPSG's Chapter 9: Environment* highlights "ecologically sensitive areas such as Sites of Special Scientific Interest (SSSI) and areas with other particular vegetation and wildlife habitat characteristics" as Environmental Factors influencing Land Use Planning, and states that Nature Reserves and SSSI should be adequately protected from the effects of pollution and from the diversion of natural flows.

3.42 The *HKPSG* also highlight the need for care to be taken in planning and implementation of civil engineering construction works to avoid, minimise or ameliorate the occurrence of pollution from silt, oil and other sources on water bodies in unspoilt areas designated for conservation and in SSSI.

Wild Animals

3.43 Wild animals are protected by the *Wild Animals Protection Ordinance [Cap 170]* (1980), which fall under the Authority of the Director of Agriculture and Fisheries. The latest version of Cap 170 is the Second Schedule of the *Wild Animals Protection Ordinance [Cap 170]* which was revised in 1992. Protected wild animals listed under the Schedule include mammals, all wild birds, reptiles, amphibians and an insect.

Rare and Endangered Plant Species

3.44 Various species of plants are protected under the Forestry Regulations of the *Forestry and Countryside Ordinance [Cap 96]* (1950) and *Animals and Plants (Protection of Endangered Species) Ordinance [Cap 187]* (1976). The *Forestry and Countryside Ordinance [Cap 96]* and *Forestry Regulations [Cap 96 Sub. leg. A]* were revised in 1993. The *Animals and Plants (Protection of Endangered Species) Ordinance [Cap 187]* has been revised in 1995.

Tree Preservation

3.45 *Works Branch Technical Circular 24/94 (Planning, Environment and Lands Branch Circular 3/94) on Tree Preservation* states that:

"The need to preserve trees must be borne in mind particularly by those in charge of engineering, architectural and landscape projects ..... There are many projects such as ... service reservoirs, formation works and the like where virtually all trees and shrubs within the works area boundary may have to be destroyed. In these cases care should be taken to minimise the extent of the works area and thereby maximise the number of trees to be preserved."

3.46 According to *Lands Administration Office Instruction Section D-12 on Tree Preservation*, Government projects in particular should make "every effort to preserve as many trees as possible and in general, permission to lop or cut down any tree will not be granted unless good cause is shown". Agriculture and Fisheries Department keeps a 'Register of Unusual Trees'.

Tree Planting and Landscaping

3.47 General advice on tree planting and landscaping is presented in this section under the heading 'Visual Impact and Landscaping'.

4. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

Introduction

4.1 The imposition of a major Bypass on the bucolic tranquillity of a traditional farmland environment will inevitably impinge adversely on the area's visual quality. However, any definition of the extent of this adverse effect must be assessed in relation to the positive benefits it creates elsewhere. This is the situation for the Kam Tin Bypass.

4.2 The proposal for this Bypass has been known about and supported by the local population for many years. It is not a contentious issue. The purpose of this section of the report is to provide a thorough understanding of the visual issues and to suggest mitigation measures which support and enhance the final design and implementation of an accepted project.

4.3 To this end, this section describes and identifies the following:

(i) existing landscape and visual quality;
(ii) sensitive receivers;
(iii) visual impact;
(iv) mitigation measures; and
(v) summary and recommendations.

4.4 The approach adopted for this visual impact assessment is as follows:

(i) to concentrate on the impact and mitigation measures for known, existing developments;

(ii) to make observations and comments, where appropriate, on possible impacts on future development proposals. (This latter area of concern must necessarily be more subjective than the first);

(iii) to take into account the long-term land use planning as shown on the draft Kam Tin North OZP and comments, where appropriate, on possible impact on the future land use.

4.5 From a visual impact perspective, it could be argued that future development occurring between the existing village area and the new Bypass will totally change the visual environment. However, this visual impact assessment will assume that measures must be taken to ensure an acceptable visual environment is provided for the existing village configuration.

4.6 Finally, whilst the impact of the Bypass is the subject of this report, the adjacent drainage channel project will inevitably contribute to the cumulative visual changes in the area. Here the concentration will be on the Bypass itself. Comments and observations concerning the drainage channel will be made at appropriate points. However, it is assumed that the channel is an "existing" feature, and its impact and possible mitigation measure will not be specifically proposed.

Existing Landscape and Visual Quality

4.7 From a series of extensive site visits it was concluded early on that, from a visual impact point of view, only the area north of the Kam Tin was relevant. Figure 4.1 clearly illustrates that the landscape immediately affected by the Bypass is not visible from the southern parts of the village within the Study Area.

4.8 The dominant landscape features, looking north from Kam Tin (A) are:

(i) the extensive, flat and well-tended traditional farmland in the near distance;

(ii) a strong tree-line defining the extent of the farmland; and

(iii) the distant hills of Lam Tsuen Country Park, which appear to "sit" on the tree line

4.9 A minor, but significant, landscape feature in the middle distance, forming part of the tree line, is Kong A Leng hill which rises approximately 30 metres above the farmland. The nearest village settlements of Kam Hing Wai and Shiu Tau Tsuen, are almost totally obscured by trees.

4.10 The overwhelming landscape geometry, looking north, is a horizontal green plain with an undulating, hilly backdrop.

4.11 Looking south from ground level (B), the landscape is similar to that described above, except that the tree-line is replaced by the builtup edge of Kam Tin. The hilly backdrop (Tai Lam Country Park) appears more distant and less prominent.

4.12 From the higher vantage point of Kong A Leng hill (C), the builtup edge of Kam Tin becomes less prominent as the backdrop of hill becomes more prominent and the vast extent of the Kam Tin valley floor is revealed.

4.13 The farmland landscape also changes visually with the appearance of scattered, small groups of trees, particularly in the east and west.

4.14 On plan, the meandering course of the Kam Tin River appears as a strong landscape feature. From ground level, and from the more elevated vantage point of Kong A Leng, the river course does not appear prominently. Random groups of trees indicate its presence but do not impose a strong visual geometry.

4.15 Photograph D on Figure 4.1 shows the view from the small hill between Ko Po San Tsuen and Kat Hing Wai. The cultivated farmland (through which the Bypass will run) is hidden by the village development.

4.16 On completion, however, the new drainage channel will impose its own, quite severe geometry. Although basically below existing ground level, adjoining embankments and maintenance roads will create their own visual impact. Future discussion of the impact of the Bypass will include reference to this situation.

Representative Sensitive Receivers

4.17 Having established the landscape and visual qualities above, the identification of existing representative sensitive receivers is quite straight forward. These are shown on Figure 4.2 and are, briefly:

(i) the whole of the existing edge of the builtup central area of Kam Tin, which is predominantly 3 storey residential in character; and

(ii) isolated residential development at, and close to, Kam Hing Wai (marked 1 and 2 on Figure 4.2).

4.18 For most of the length of the Bypass, sensitive receivers on the south side are around 80-100 metres distant. Towards the western end, residential development in Kam Tin Shi is located very close to the carriageway. At the eastern end, most of the existing development are rural industrial establishments mixed with some residential use.

4.19 North of the Bypass developments 1 and 2 include quite new housing blocks approximately 100 metres from the road. They have an unobstructed view across open farmland towards Kam Tin. Two residential developments at 3 on Figure 4.2 are very close to the road. Currently they sit within quite mature woodland and are quite secluded visually.

4.20 Towards the eastern end, a few scattered one and two storey houses sit in a relatively well-treed landscape associated with farmland and the Kam Tin River (4 on Figure 4.2). Their potential view of the Bypass should be protected by the trees, assuming that a sensitive approach to construction of the Bypass and management of the work area is taken. This is discussed further in following sections.

4.21 Kong A Leng hill (5 on Figure 4.2) has been mentioned earlier as an elevated vantage point in the study area. At present, public access to the hill is difficult. There are no clear footpaths to the summit. It is zoned as Green Belt on the Kam Tin North Outline Zoning Plan (OZP) No. S/YL-KTN/1. This can allow construction of a pavilion or pergola. There are no current plans for providing such uses. However, given its prominence in a generally flat landscape, it can be considered as a possible sensitive receiver.

4.22 In general, possible future sensitive receivers are indicated on Kam Tin North OZP and Layout Plan No. L/YL-KT/1E. Specifically, the OZP shows an area zoned for R(C)1 housing abutting part of the eastern part of the Bypass. This zoning allows for building's up to 4 storeys (12 m) in height. No project layout scheme has yet been prepared. The (non-statutory) Layout Plan also shows this same land use, and incorporates a 10 m, non-building zone along the Bypass alignment.

4.23 On the OZP, the vast majority of land affected by the Bypass is zoned for village development. This allows for village type housing up to 3 storeys (8.23 m). The area has not been formed or serviced with infrastructure facilities. It is anticipated that after the area has been planned and serviced, planning applications to build up to 1,680 houses will be received.

4.24 There are two development proposals that have been submitted under Section 16 of the Town Planning Ordinance. These are indicated generally as 6 and 7 on Figure 4.2. Planning permission has been refused and it is understood appeals against these decisions are anticipated.

4.25 The Layout Plan quoted above shows that different forms of residential development (village expansion, rural public housing) is expected to fill the area between the existing Kam Tin village and the Bypass. At each end of the Bypass, at its junctions with Kam Tin road, non sensitive uses are indicated.

4.26 Although the exact locations and nature of future sensitive receivers are not known all future development as allowed under the current OZPs has been taken into account during mitigation planning. Future developments outside the scope of the current OZPs must accommodate solutions to the environmental impact of the Bypass within their own detailed proposals.

Visual Impact Assessment

4.27 Other sections of this report describe details of the road engineering and noise impacts. The visual impact assessment anticipates the outcome of these subjects. In particular it is anticipated here that mitigation measures against adverse noise impacts will also form the major elements of the visual impact.

4.28 The Bypass carriageway is raised approximately 2 metres above existing ground level for flood prevention reasons. Even this small elevation will create a significant visual impact. However, on the southern side of the Bypass a continuous earth mound of between 1.5 and 2.0 m higher than the carriageway is proposed. This results in an earth structure of up to 4.0 m above existing ground level. When viewed from the northern edge of Kam Tin, the mound will generally obscure the view of the carriageway.

4.29 An additional noise barrier is needed on top of the earth mound. The noise impact section describes this in more detail. For this section, a solid barrier of around 2.5 m is adopted to illustrate the principles of the visual impact.

4.30 No earth mound is currently proposed for the northern road embankment, although a noise barrier will be required in certain locations.

4.31 Consistent with statements made earlier, this section considers the visual impacts on existing sensitive receivers only. The following paragraphs describe the impact of the finished road scheme, than focus on impacts during the construction and operational phases.

Finished Scheme

4.32 Figures 4.3 and 4.4 illustrate the principles referred to above, for northern aspects from existing development. The section on mitigation measures will discuss proposed details which supplement these principles.

4.33 Figure 4.3(a) illustrates that the carriageway alone creates a new man-made element into the middle distance, but generally retains the integrity of more distant views. Figure 4.3(b) shows that the middle distance view is improved but distant views are compromised. Figure 4.4 illustrates the progression in an annotated perspective format.

4.34 Figures 4.5(a) and (b) show the perspective views from existing sensitive receiver north of the Bypass and Kong A Leng hill respectively. The drainage channel is included in these views, based on current knowledge of the details. It is assumed here that the service road alongside the channel will not include vehicular access for private vehicles.

4.35 The main visual impacts can be summarised as follows:

Looking north:

(i) the simple mound and noise barrier (without further mitigation) block existing views of the farmland and tree line from the lower floors of existing development;

(ii) views from higher floors will still enjoy the distant vistas, although the farmland view will be dominated by the road alignment;

(iii) views of the actual carriageway can be avoided by provision of the acoustic barrier.

Looking south:

(iv) from the sensitive receivers, the near foreground is dominated by the drainage channel;

(v) the carriageway will be visible beyond the channel, with the mound and barrier interfering with existing views of Kam Tin village;

(vi) any noise barrier required to protect these sensitive receivers will further exacerbate this impact;

(vii) from Kong A Leng, the carriageway will be quite prominent and dominate the existing farmland scenery, in the centre distance.

General

(viii) when future development proposals eventuate the points raised above will become invalid.

4.36 In concluding this section on the impact of the finished scheme without further, more sensitive mitigation measures, the Bypass will severely degrade the existing visual quality.

Construction Phase

4.37 Construction activity will involve the removal of vegetation, removal and stockpiling of material unsuitable for carriageway sub-structures, heavy machinery movements, and site office and materials storage areas.

4.38 All these will necessarily have adverse visual impacts on the peaceful, rural landscape. However, given that these are totally unavoidable necessities and can be regarded as only temporary, it is suggested that any visual impact created is acceptable. Some mitigation ideas are suggested in the next section.

Operational Phase

4.39 The operation phase of a road scheme is obviously the movement of vehicles. This will ordinarily include the whole range of motorised vehicles from motor-cycles to double-decker buses.

4.40 The visual impact of this will be the introduction of almost continuous movement into a scene which is currently only 'disturbed' by the gentle movements of traditional farmers. The noise mitigation provisions do not generally provide the same basis for the visual mitigation discussed earlier.

4.41 Vertical lighting poles and any overhead signage required will also introduce 'alien' elements into the existing landscape. During night time operation, the illumination emanating from these will also have an impact.

4.42 To sum up this whole section on visual impact, the package of engineering requirements for providing a major road conforming to legal standards, inevitably creates a substantial visual impact. Careful design and coordination of various environmental mitigation requirements can minimise the extent of the impact.

Mitigation Measures and Proposals

4.43 Many mitigation measures were alluded to in the previous section. Here, these measures are described in more detail, using the same sequence, i.e. finished scheme, looking north then south; construction phase and operational phase. Figure 4.6 illustrates where specific mitigation measures are proposed.

Finished Scheme - Looking North

4.44 Figure 4.7 illustrates how the simple acoustic mound and barrier design can be comprehensively treated to incorporate successful visual mitigation measures. This piece of landscaped structure provides a near foreground replacement of the existing background tree-line (ref. Figures 4.3, 4.4) It is recommended that this applies to the majority of the southern side of the Bypass.

4.45 To avoid accentuating the severe horizonal effect of the basic engineering requirements, a more free-form, wavy structure of planting 'boxes' is proposed. This also allows for variety in the shape and form of the lower slopes of the mound. Planting should also extend, as far as space permits, beyond the toe of the mound. This planting should be in irregular groups to further break up the linearity.

4.46 Planting, within practical operational requirements should be provided on the carriageway side, with climbing species introduced to cover the vertical barrier. Not only will this provide a pleasant view for motorists, it will help to soften the view looking southwards. Furthermore, it will act to some extent as a more sound-absorbent surface and thus reduce reflected noise from the traffic.

4.47 At selected locations, it is suggested that some gaps can be left in the vegetation to allow for glimpse views of the farmland beyond. This proposal accepts that visibility of passing vehicles is an acceptable compromise.

4.48 Where pedestrian crossings are proposed, access to these is incorporated in a tangential way up the mound to avoid noise and visual penetration. Figure 4.6 indicates the locations of the two pedestrian underpasses (A) and two pedestrian crossings at grade (B).

Finished Scheme - Looking South

4.49 In the area between the Bypass and the drainage channel, it is recommended that substantial tree planting and ground cover vegetation is provided. Here the works area is quite wide, and should easily accommodate this.

4.50 At point 1 on Figure 4.6, the noise mitigation barrier should be reinforced with extra tree planting to supplement existing tree cover.

4.51 At point 2 on Figure 4.6, the existing tree cover should be protected and supplemented with extra trees and shrubs, particularly in the area of the Kam Tin River.

4.52 Complete mitigation against the visual intrusion as perceived from Kong A Leng (*) is very difficult. Heavy tree planting along the northern road embankment and works area will help greatly. However, given the greater distance between the road and hill, the extent of the impact of the highway geometry will be acceptable.

Construction Phase

4.53 It is almost impossible to successfully mitigate against visual pollution during the construction phase of such an extensive, linear project. However, the following recommendations are made, and indicated on Figure 4.6:

(i) the removal and stockpiling of unwanted material can be pre-planned to form a temporary visual screen to construction works. e.g. around site office;

(ii) similarly, if space permits, the trees to be eventually used for landscaping could be gathered to form an on-site nursery within the works area and therefore help to screen the site office or storage areas;

(iii) suggest that the Constructor paints his vehicles and machinery in a neutral colour e.g. olive green;

(iv) use dust prevention measures to keep distant views clear.

Operational Phase

4.54 The general visual mitigation measures proposed for the finished scheme should also be adequate to deal with mitigation against the visual effects of moving vehicles.

4.55 Lighting poles will be normally around 9-10 metres in height. It is very difficult to prevent these vertical elements impinging on an otherwise horizontal landscape. Similarly, their illumination at night cannot be mitigated against.

4.56 Road signage will have to conform to statutory requirements. Where these occur, larger species of trees can be introduced if room and safety regulations permit.

Summary

4.57 Figure 4.8 illustrates the finished scheme with all mitigation proposals as seen looking northwards and southwards from ground level, and from Kong A Leng Hill.

4.58 The Bypass will inevitably, adversely affect the quality of the existing visual environment. Road engineering and statutory requirements dictate the geometry of the actual carriageway. The local inhabitants of Kam Tin support the need for this road.

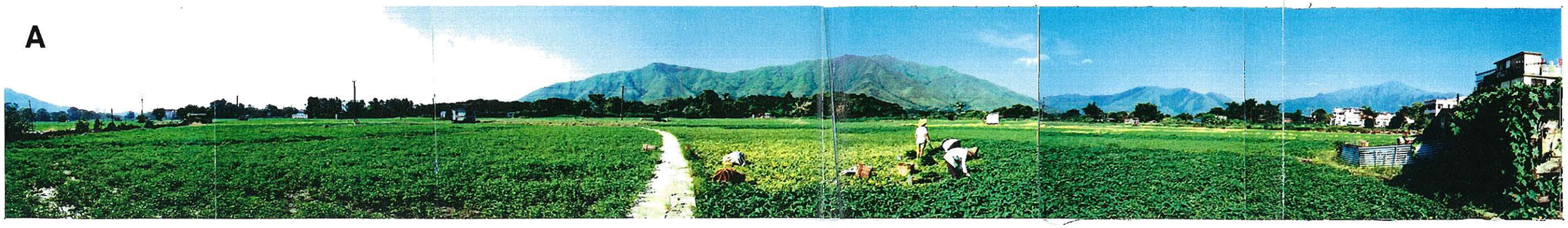
4.59 The eventual implementation of future planning and development proposals for the expansion of the village areas will also drastically alter the landscape and visual quality. These proposals will have to take into account the existence of the Bypass when considering their own environmental protection measures.

4.60 This report has concentrated on the visual impacts on known, existing development and commented where appropriate on the future situation.

4.61 The main recommendations concentrate on applying a comprehensive and systematic approach to the design and construction process. Temporary measures, using on site materials, can be employed from the very beginning of the process, using this comprehensive approach.

4.62 The same comprehensiveness is applied to the design of integrated mitigation measure, combining noise and visual screens together.

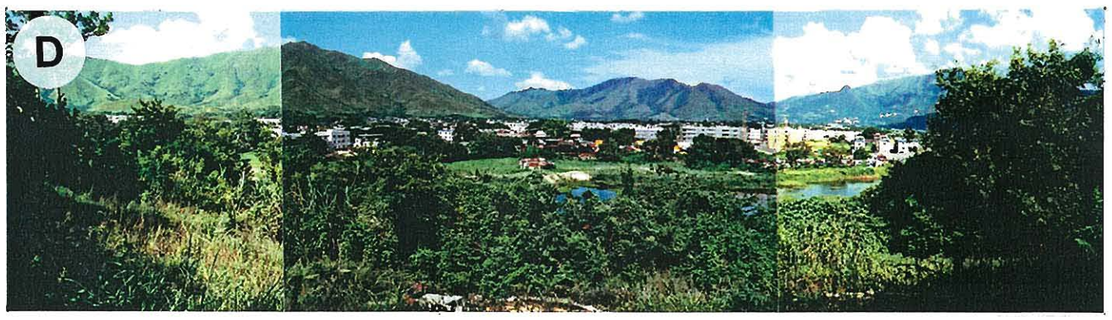
A

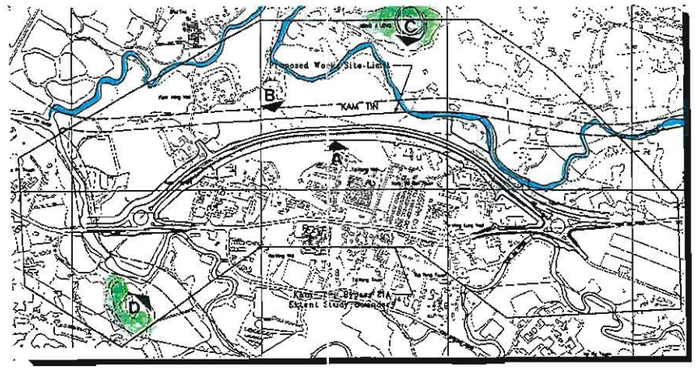


B

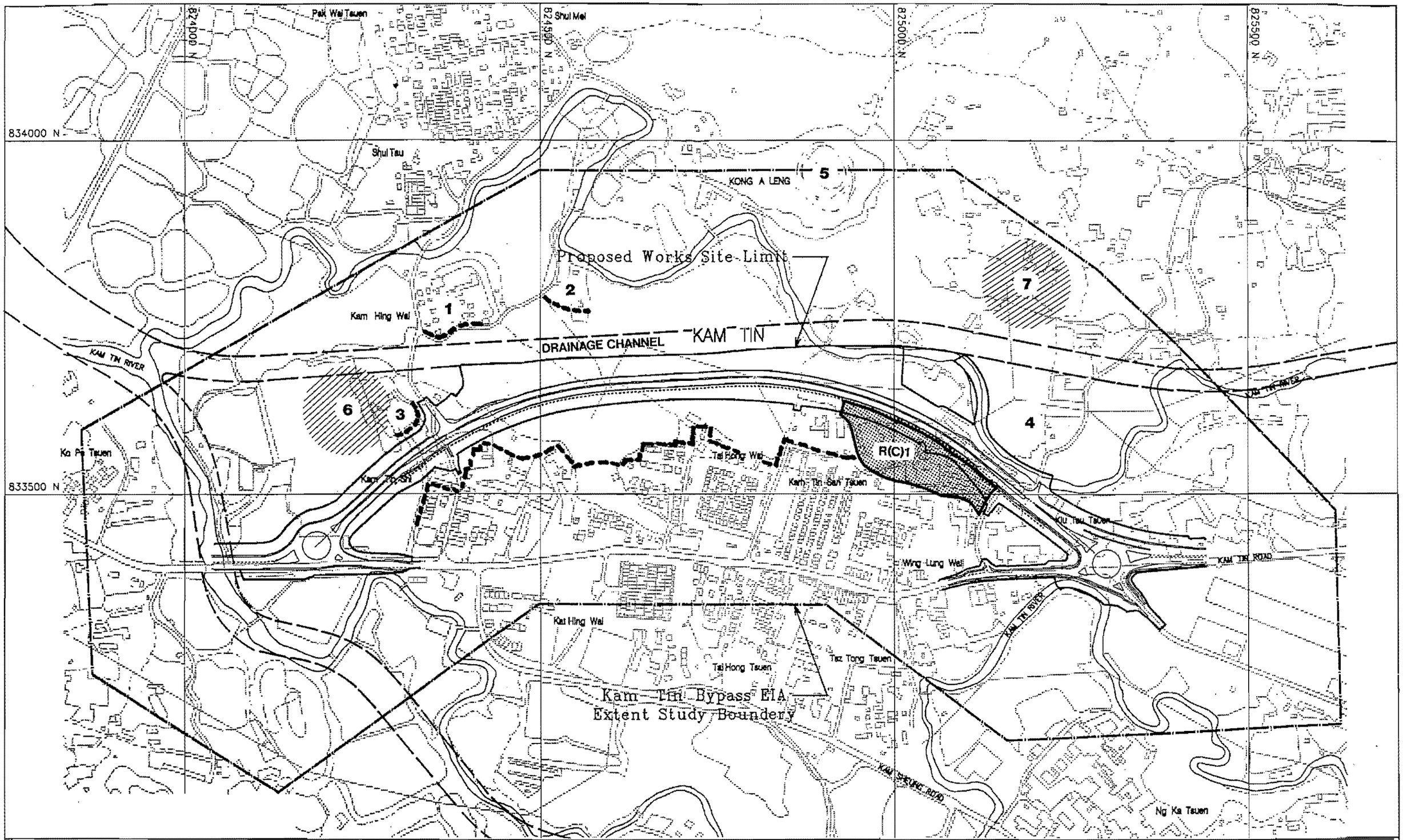
C

D

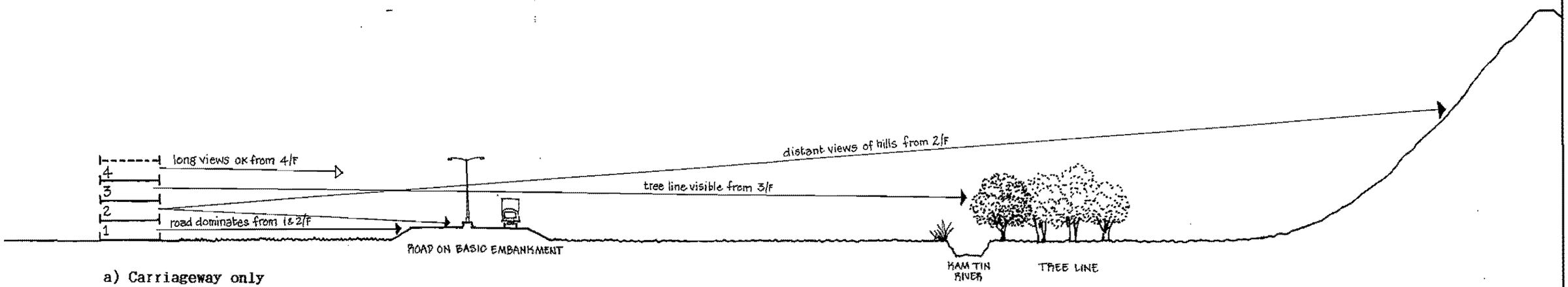




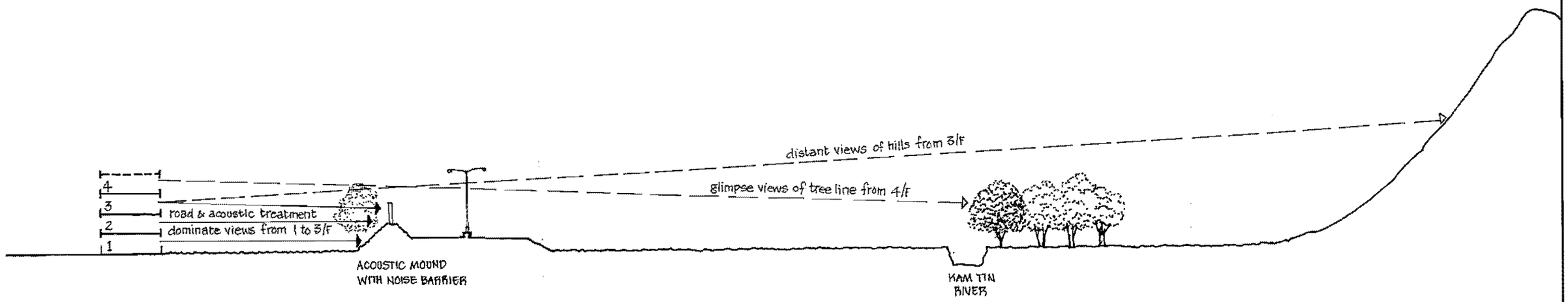
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : N.T.S.
Title : VISUAL IMPACT - LANDSCAPE & VISUAL QUALITY	Joint Consultants :	Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)		Figure No. 4.1



Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95 / Scale N.T.S.
Title : VISUAL IMPACT - SENSITIVE RECEIVERS	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)		Figure No. 4.2

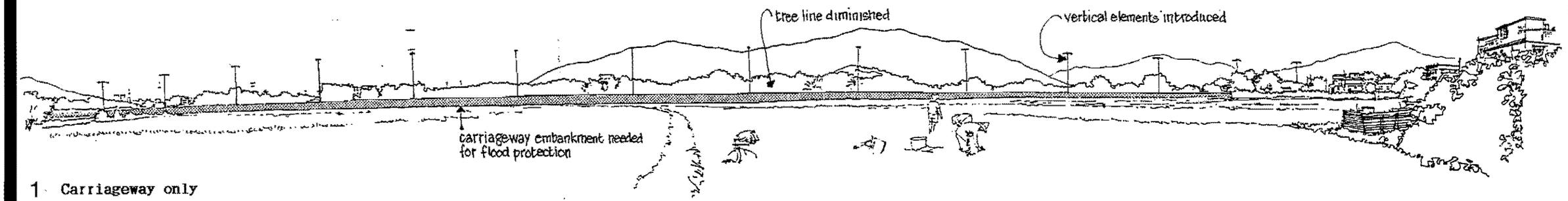


a) Carriageway only

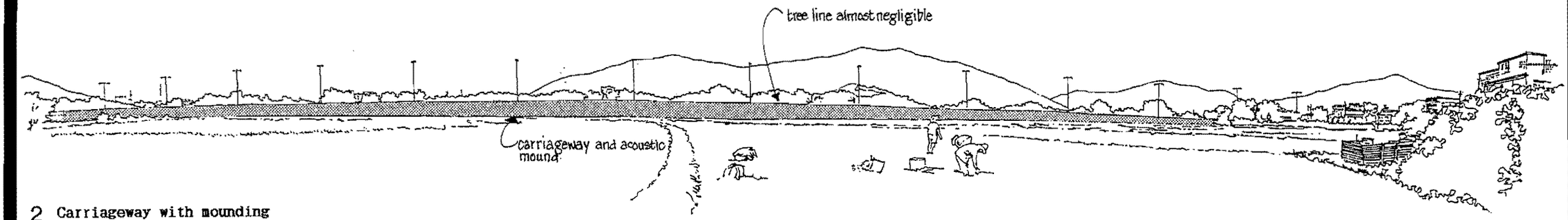


b) Carriageway with mounding and noise barrier

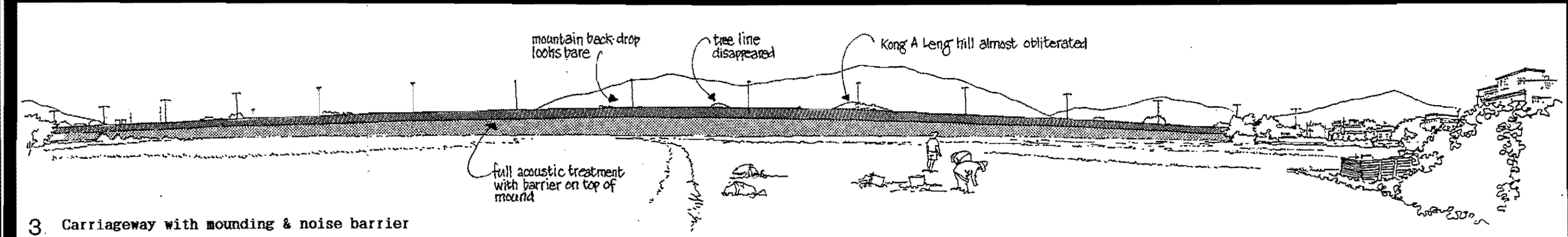
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : N.T.S.
Title : VISUAL IMPACT - IMPACT ASSESSMENT * SECTIONS	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 4.3



1 Carriageway only

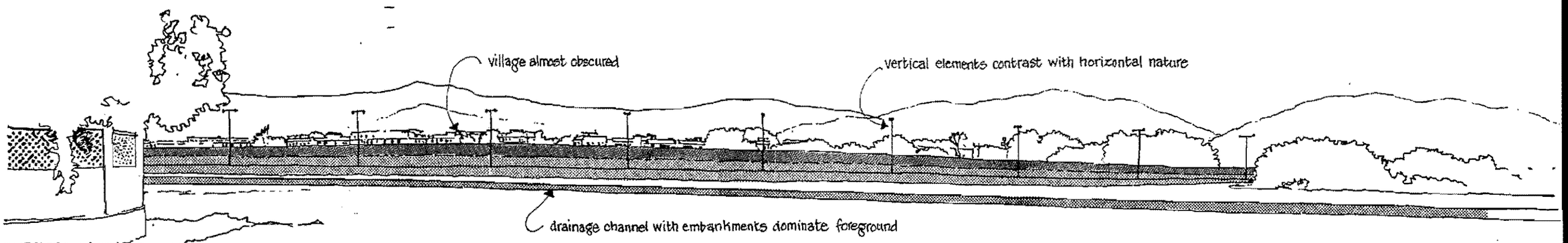


2 Carriageway with mounding

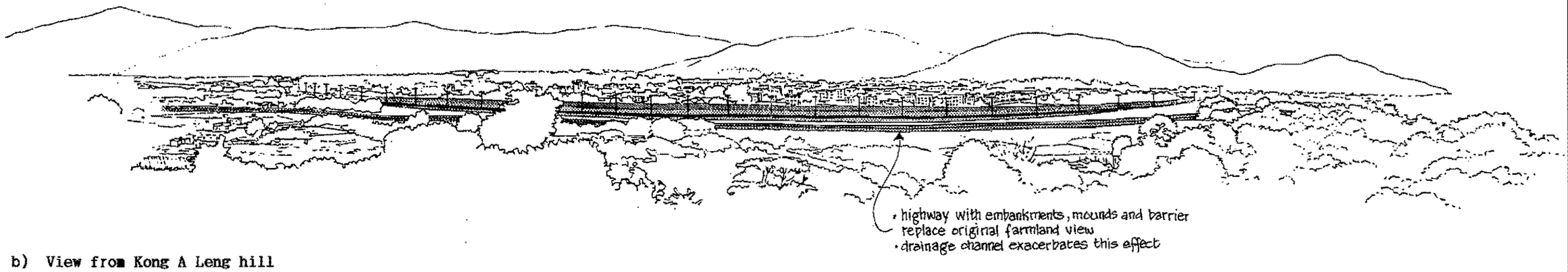


3 Carriageway with mounding & noise barrier

Agreement no. CE 7/94 Kam Tin By-pass		Ref. Figure No.	Rev.	Date : SEP. 95	Scale : N.T.S.
Title : VISUAL IMPACT - IMPACT ASSESSMENT * PROGRESSIVE VIEWS NORTH	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 4.4

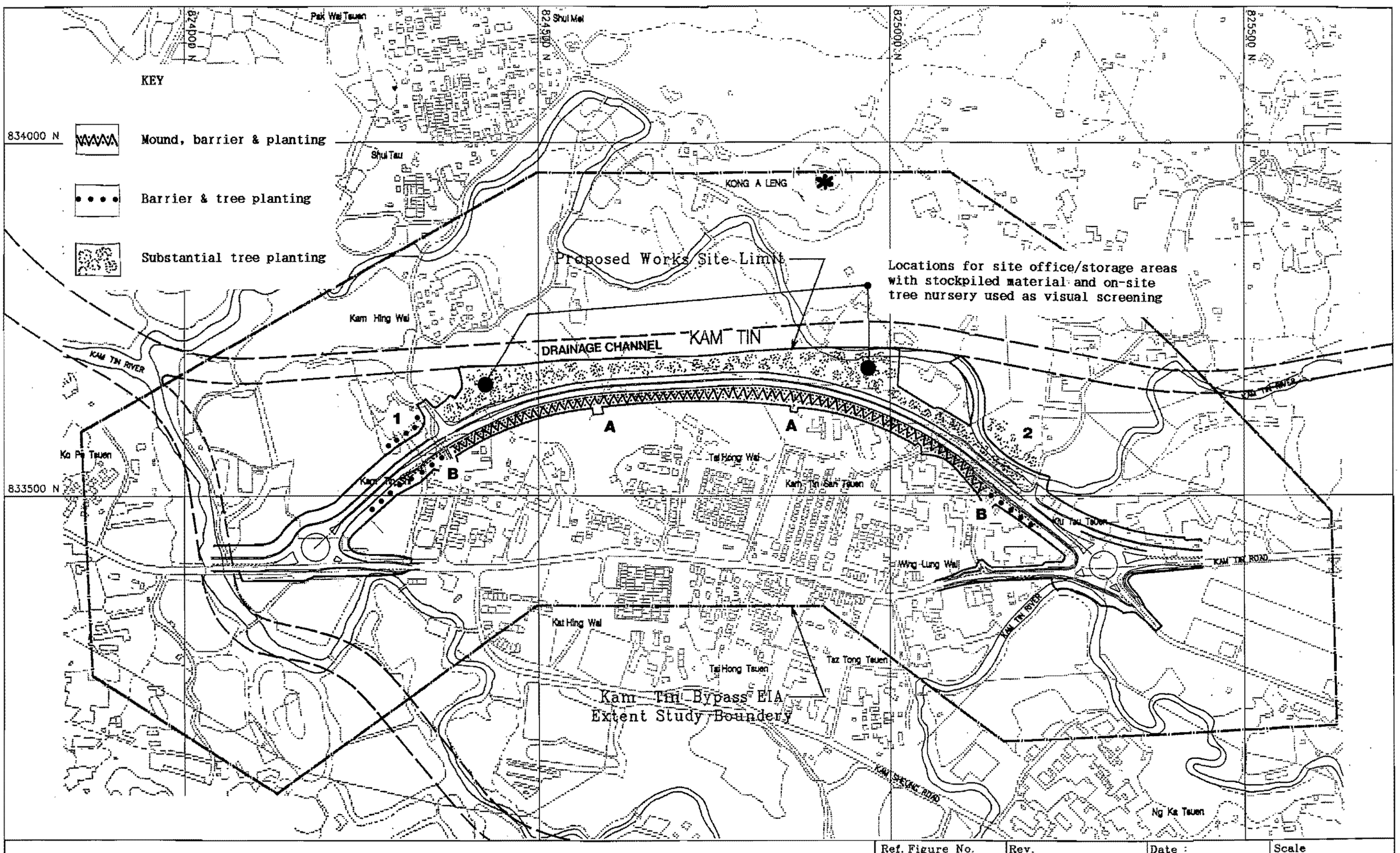


a) View from Kam Hing Wai



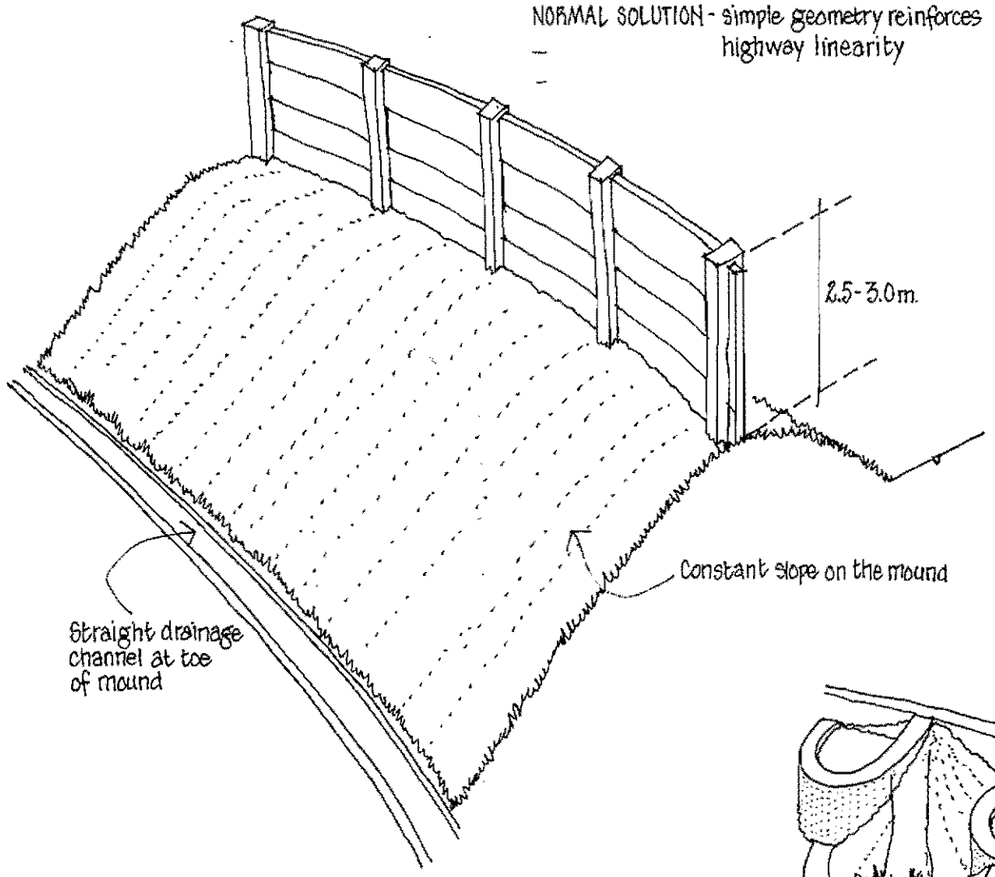
b) View from Kong A Leng hill

Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : N.T.S.
Title : VISUAL IMPACT - IMPACT ASSESSMENT * PROGRESSIVE VIEWS SOUTH	Joint Consultants :	Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)		Figure No. 4.5

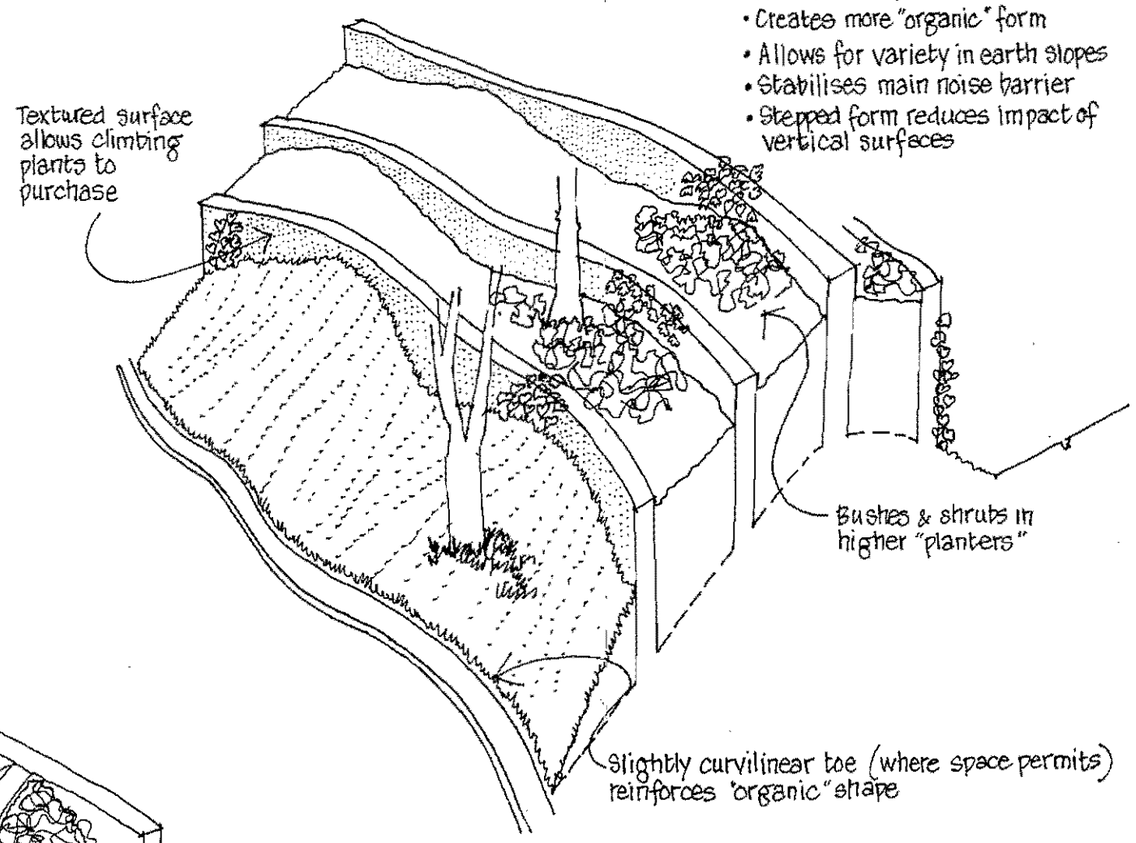


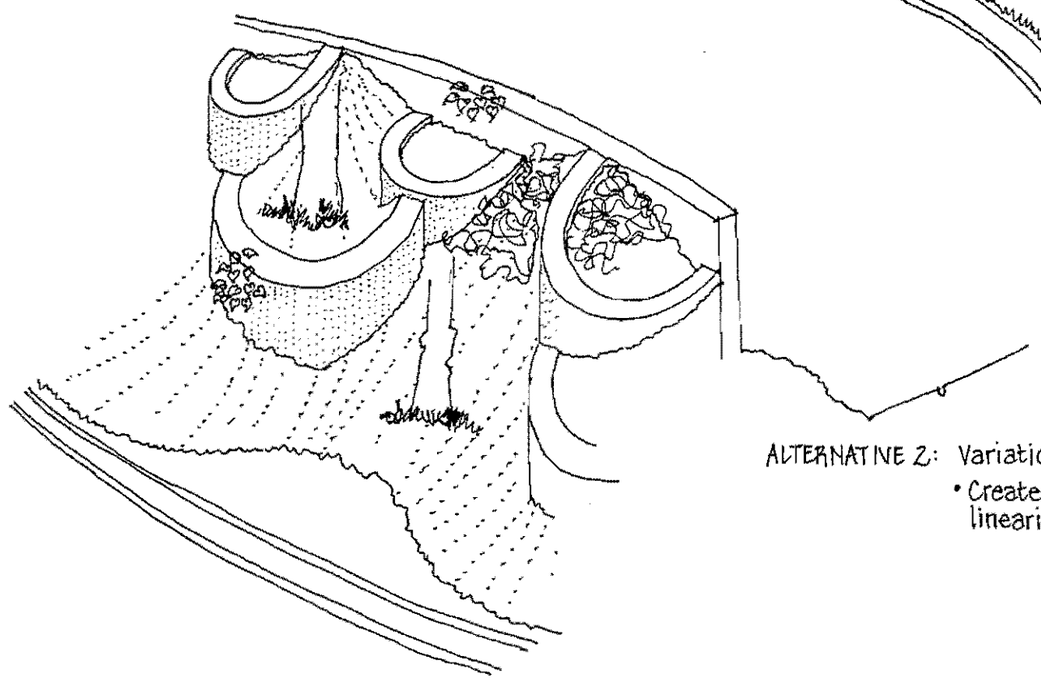
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale N.T.S.
Title : VISUAL IMPACT - MITIGATION MEASURES * KEY MAP	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 4.6

NORMAL SOLUTION - simple geometry reinforces highway linearity



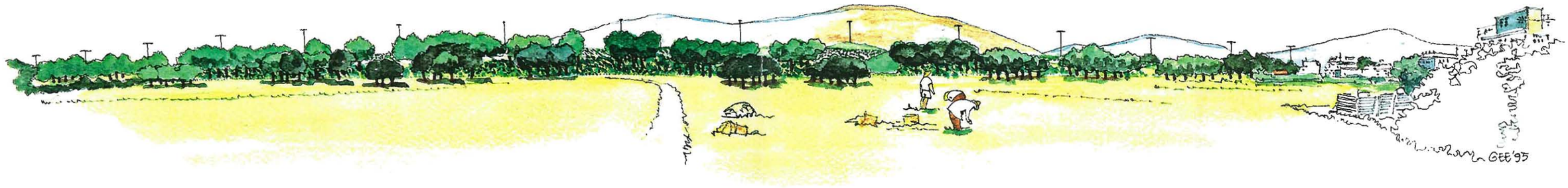
ALTERNATIVE 1:
- Curvilinear barrier wall supplemented with similar structures
- Creates more "organic" form
- Allows for variety in earth slopes
- Stabilises main noise barrier
- Stepped form reduces impact of vertical surfaces



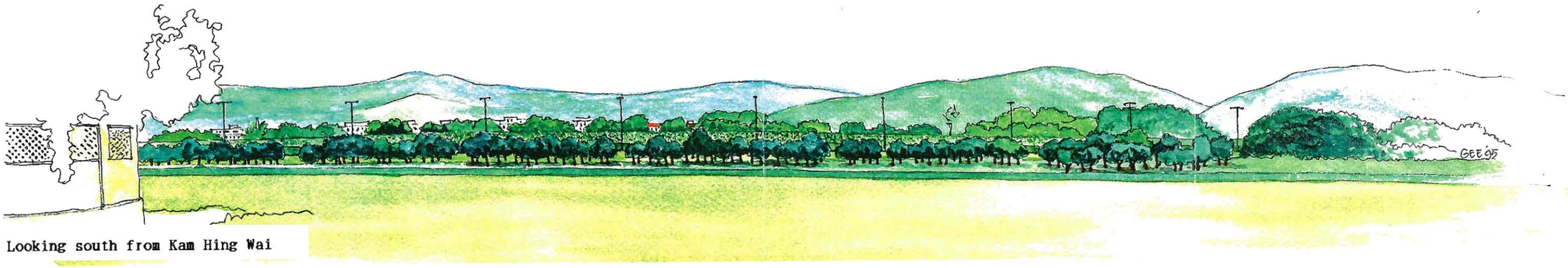


ALTERNATIVE 2: Variation on 1 using curved "boxes" to support main barrier
- Creates more random mound, breaking down the linearity of the carriageway engineering

Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : N.T.S.
Title : VISUAL IMPACT - MITIGATION INTEGRATION	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 4.7



Looking north from Kam Tin



Looking south from Kam Hing Wai

Looking south from Kong A Leng hill

Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : N.T.S.
Title : VISUAL IMPACT - MITIGATION * PERSPECTIVE VIEWS	Joint Consultants :	Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)		Figure No. 4.8

5. NOISE IMPACT ASSESSMENT

Introduction

5.1 Throughout the development and operation of the Kam Tin Bypass noise will be a significant environmental issue. Highways Department are committed to constructing the Bypass in a manner that has as little impact as possible. They are also committed to maintaining the long term acceptability of the noise environment for the residents of Kam Tin. The current noise impact assessment is carried out on behalf of the Highways Department to ensure that any potential noise problems are identified and solutions recommended.

5.2 This assessment is divided into three parts: the description of baseline noise conditions at the Study Area, including the monitoring results obtained at various sensitive receivers during August 1995; the assessment of potential noise impact during the construction phase and recommendations for short term noise control; the identification of any potential operational noise impact and requirements for long term noise reduction measures.

Noise Sensitive Receivers

5.3 All current and future noise sensitive receivers (NSRs) within the Study Area are shown in Figures 2.2 and 2.3. Representative NSRs for the EIA have been agreed with the Environmental Protection Department (EPD) as confirmed in writing in early August, 1995. Potential baseline monitoring locations were also agreed at this time.

5.4 Twenty four representative NSRs were originally chosen. The original NSR 1 is now empty and unlikely to be reoccupied during the construction period. The NSRs include a number of schools. For operational noise assessment purposes NSR 1 has been replaced by NSR 1a, a temple to the north of the Bypass. Details of these current NSRs are given in Table 5.1. Their locations are shown in Figure 5.1.

Table 5.1
Representative Noise Sensitive Receivers

NSR	General Description	No. of Storey	Ground Level (mPD)	Estimated No. of Dwellings/ Classrooms Affected	Distance from nearest Curbside of Kam Tin Bypass (m)
1*	Kam Kong Kindergarten	2	7.3	0	73
1a	Temple	1	6.5	1	155
2#	House at Kam Tin Road	3	7.3	2	110
3**	Village house at 174 Wing Lung Wai	3	7.0	1	21
4	Village house at 38 Wing Lung Wai	2	6.2	1	66
5**	Village house at Kam Tin (Shing Mun) San Tsuen	2	6.0	1	30
6	Village house at Kam Tin (Shing Mun) San Tsuen	1	5.0	1	65
7	Village house at 4 Wing Lung Wai	3	7.0	1	138
8	Village house at 85 Kam Tin San Tsuen	3	5.0	1	88
9	Kam Tin Tung Tak Public School	1	5.0	9	85
10**	Village house at 12B Tai Hong Wai	2	6.0	2	59
11	Village house at 42 Kam Hing Wai	3	5.0	1	105
12	Village house at 44 Kam Hing Wai	3	4.5	2	112
13	Village house at 35-C4 Kam Tin Shi	2	5.6	1	62
14*	Village house at 41 Kam Hing Wai	3	5.7	1	41
15	Village house at Kam Tin Shi	2	4.5	2	16
16	Village house at 51 Kam Tin Shi	1	5.0	1	50
17**	Village house at 27A Kam Tin Shi (DD109 Lot 1971)	3	4.5	1	29
18	Kam Tin Mung Yeung Public School	2	6.2	9+	72
19**,#	Kam Tin Dragon Kindergarten	3	6.2	9	110
20**	Village house at 152 Kat Hing Wai	2	6.2	1	192
21	Village house at 101 Kat Hing Wai	4	7.5	1	254
22	Village house at 43 Tai Hong Tsuen	3	6.1	2	261
23	Wing Lung House at 47 Wing Lung Wai	2	7.2	1	213
24	Salvation Army Kam Tin Nursery	2	6.0	2	123

* Empty
** Baseline Monitoring Locations
# Perpendicular distance to Bypass itself is given
\+ Currently only 7 classrooms in use

5.5 The representative NSRs include the residences close to the new Bypass and the schools within the Study Area. The NSRs have been used to assess both construction and operational noise.

5.6 Additional calculation points have been added along the Site boundary of the Bypass 10 metres from the Site boundary, as, according to the current Outline Zoning Plan, residences could be built close to the Kam Tin Bypass in the future. Details of currently committed projects are discussed in Section 2 of this document. The calculation points or "future sensitive receivers" have been chosen, such that they define worst case positions, and building heights in relation to the planning areas. For example calculation points were placed at both ends of the RC(1) area, 10 m from the Bypass boundary, as this zoning permits 4-storey development.

Baseline Noise Monitoring

5.7 Baseline noise monitoring was carried out at selected monitoring locations for 24-hour periods between 17 August 1995 and 5 September 1995. The monitoring locations and the direction of the monitoring are shown on Figure 5.1. These locations were chosen as being representative of the noise environment within the Study Area.

5.8 The monitoring data are shown in graphical form in Figures 5.2 to 5.7 at the back of this section.

5.9 Table 5.2 gives the range of noise levels recorded at the monitoring locations during different periods of the day. Noise was recorded in L_{eq}, L_{10}, L_{90} in the A-weighted fast response mode for 1 hour periods.

Table 5.2
Baseline Monitoring Results within the Study Area (dB(A))

Sensitive Receiver (Facade)	07:00 - 19:00		19:00 - 23:00		23:00 - 07:00	
	L_{Aeq} (1hr)	L_{10} (1hr)	L_{Aeq} (1hr)	L_{10} (1hr)	L_{Aeq} (1hr)	L_{10} (1hr)
NSR3*	58.6-69.8	60.5-67.0	56.1-62.9	57.0-60.5	51.9-67.7	48.5-61.0
NSR5	52.0-58.0	53.1-60.3	55.0-56.5	54.6-57.5	54.0-54.5	53.9-56.3
NSR10	47.8-59.9	49.5-56.0	58.3-65.2	63.5-67.5	53.1-69.3	54.0-70.5
NSR17	51.8-56.1	54.5-57.5	52.2-55.9	53.5-56.5	51.1-57.3	53.5-58.0
NSR19	71.0-77.1	74.0-76.5	67.9-70.9	70.5-74.5	64.0-70.0	67.5-73.5
NSR20	69.2-70.6	72.5-73.5	66.0-68.4	69.0-71.5	60.6-68.7	64.5-72.5

* Monitoring conducted from 30 Aug (15:00) was stopped on 31 Aug (11:00) because of the approach of Typhoon Kent

5.10 From the monitoring results it can be seen that the noise level at NSRs 19 and 20 already exceeds the recommended *Hong Kong Planning Standards and Guidelines* of an L_{10} level of 70 dB(A) for traffic noise.

Noise - Construction Phase

Noise Assessment Criteria

5.11 At this stage, construction work is not expected to be carried out in restricted periods, that is between 19:00-07:00 or on Sundays or holidays. There is no statutory noise limit for construction noise during 07:00-19:00 on any weekday. The EPD recommends a limit of 75 dB(A) during this period of normal working hours. Lower limits are recommended for schools: 70 dB(A) on normal days and 65 dB(A) during examinations.

5.12 If it is necessary to carry out construction works beyond 07:00-19:00 on weekdays, then the Contractor must apply for construction noise permits and abide by the permit conditions. The area rating for the Kam Tin area as defined in the *Technical Memorandum of Construction Works Other than Percussive Piling* is likely to be 'B'. The Acceptable Noise Levels (ANLs) would be 65 dB(A) during evenings (19:00-23:00) and Sundays and 50 dB(A) at night (23:00-07:00).

Data Sources

5.13 The sound power levels for the equipment used in this assessment are as prescribed in the following sources:

(i) *Technical Memorandum on Noise from Construction Work other than Percussive Piling*;
(ii) *Technical Memorandum on Noise from Percussive Piling*;
(iii) *BS 5228: Part 1: 1984 Noise Control on Construction and Open Sites.*

5.14 When the dump trucks are not dumping, but are travelling within the Site, a sound power level of 113 dB has been calculated for them. This is derived by logarithmically averaging the sound power levels of 35 ton dump trucks in Table 12 of BS 5228.

5.15 Table 5.3 shows the amount of fill to be imported, and the amount of material to be shifted. The capacity of the trucks is assumed to be 6 tons per truck, and it is expected that the number of trucks will be 100 per day. The number of working hours is assumed to be 10 per day, with an average of 10 trucks per hour. Eight trucks per hour will travel from the borrow area to the west. It is expected that the amount of concrete required will be 40 m^3 per day. Thus the average number of concrete lorries will be 10 per day and 1 per hour.

Table 5.3
Amount of Spoil Shifted and Fill Imported per day and the Average Number of Truck Movements

Activity	Approx. total volume of spoil removed/ fill imported (m^3)	Approx. volume of spoil shifted/ fill imported per day (m^3)	Average number of trucks to/from site per hour
Excavation	2,000	100	2
Fill import	140,000	500	8
Activity	Approx. volume of concrete required per day (m^3)		
Concreting	40		1

5.16 The process can be broken down into nine major activities. Each activity requires different construction equipment (Table 5.3). The equipment list is based on the previous on-site experience of the Design Engineer. The sound power level expected from each activity is also given in Table 5.3. The details of these calculations are given in Appendix A.

5.17 The proposed Kam Tin Bypass construction programme is given in Table 2.1. This programme indicates the start and finish dates of each activity within the two years scheduled for the completion of the Bypass.

Table 5.4
Major Activities/Tasks and the Associated Construction Equipment

	Task	Backhoe	Dump Truck	Bulldozer	Compaction Roller	Baby Roller	Grader	40T Crane Truck	Lorry Tipper	Milling Machine	Suction Sweeper	Concrete Truck	Silenced Electrical Generator	Silenced Air Compressor	Pneumatic Breaker	Water Pump	Vibrating Plate/ Poker	Total Sound Power Level dB(A)
1	Site Clearance/ Formation	1	1	1										1	(a)			119.9
2	Removal of Unsuitable Material	1							1									115.0
3	Backfill for Road Embankment	2	2		1		1											122.0
4	Slope and Drainage Work	2				1		2	1			1						119.7
5	Roadwork (Flexible Pavement)					1		1		1	1							115.6
6	Road (Rigid Pavement)							1				2		1			4	120.5
7	Temporary Drainage Diversion												1			6		100.8
8	Structural Work (Subway)							1	1			2	1	1			2	119.5

(a) 1 - limited use

Worst Case Prediction Scenarios

5.18 Several construction activities may run concurrently, while other activities may not start until the previous set is completed. The assessment scenarios describe broadly each group of overlapping facilities.

5.19 During the construction phase, activities will take place concurrently. However, each activity will be separated. In order to predict the worst case situations without over-estimating construction noise at any point, concurrent activities have been centred at 100 metre distances from each other for assessment purposes. For example during the earthworks each layer for each section of the work must be completed before the next stage can be started. In practice, these segments are 100 metres or more in length.

5.20 Table 5.5 is a summary of the construction noise assessment scenarios with their associated activities based on these assumptions.

Table 5.5
Construction Noise Assessment Scenarios

Scenario	Activities
I	1, 2, 7
II	3, 4 + Haul Road Traffic
III	5, 6

Noise Source Positions

5.21 Noise calculations have been based on the worst case scenario for each NSR, i.e. when the nearest section of the Bypass to that NSR undergoes construction. Depending on how much of the Site is visible from the receiver, and the receiver's location, it is possible to spread the noise source for each activity at the nearest visible part of Site. The source positions are shown on Figure 5.1. Sources A to C are for NSRs 1-7 and 23. Sources D to F are for NSRs 8-10, 21-22. Sources G to J are for NSRs 11-20 and 24.

Assessment Methodology

5.22 The methodology for assessing the noise levels due to stationary sources and mobile sources not on any fixed routes used the following equation:

Predicted noise level = Sound power level of each Activity - 20 log 10 D - 8

where D is the intervening distance in metres between noise source and the NSR.

5.23 The equation for assessing the construction noise due to mobile sources along a fixed route is listed in Section 3.4.2 of the BS 5228: Part 1: 1984:

LAeq = Sound Power Level of travelling dump truck - 33 + 10 log Q - 10 log V - 10 log D

Q = number of trips per hour
V = average vehicle speed in km/hr
D = intervening distance in metres.

5.24 A 3 dB facade correction is added to the predicted noise levels in order to account for the facade effect at each NSR.

5.25 If an activity is substantially screened from the view of the NSR, a correction of -10 dB is applied to account for the screening effect. NSRs can be substantially screened by erecting noise barriers of suitable material. Within the Study Area the land is flat and there is no screening effect due to topography.

Worst Case Noise Prediction Results

5.26 The haul road traffic noise levels have been calculated for three different haul route alternatives. The construction of Kam Tin Bypass could be undertaken from east to west, vice versa or even from both ends. Table 5.6 shows the noise levels caused by these three different alternatives. For Options 2 and 3 haul road traffic noise includes the noise generated by the trucks travelling along Kam Tin Road.

5.27 The predicted results for each of the construction scenarios are summarised in Tables 5.7 to 5.9 and include the worst case predicted for haul road traffic noise.

5.28 Other activities, either of short duration or limited in area, that have the potential for generating substantial noise levels at a few NSRs include construction of the subways during Scenario II and very limited use of breaking equipment during Scenario I. Construction work on one of the subways has the potential to raise noise levels at NSRs 8 and 9 by a few decibels if this is undertaken at the same time as other worst case Scenario II activities near these NSRs. At worst, the subway work on its own has the potential of causing noise levels of 76 and 78 dB(A) at NSRs 8 and 9. The construction of the second subway will have less impact on NSRs.

Table 5.6
Predicted Noise Levels due to Haulage Traffic

	Option 1 (haul route travelling from west to east in bypass Site)		Option 2 (haul route passes via Kam Tin Road and progresses through the Site from east to west		Option 3 (haul route travels in both directions 1 and 2, the traffic is split between two routes)	
NSR	Intervening distance (m)	Predicted noise level (dB(A))	Intervening distance (m)	Predicted noise level (dB(A))	Intervening distance (m)	Predicted noise level (dB(A))
2	210	60.2	10	73.4	10	70.8
3	45	66.9	45	66.9	45	64.3
4	85	64.1	85	64.1	85	61.5
5	51	66.3	51	66.3	51	63.7
6	63	65.4	63	65.4	63	62.8
7	169	61.1	80	64.4	80	61.7
8	107	63.1	107	63.1	107	60.5
9	106	63.7	106	63.2	106	60.5
10	87	64.0	87	64.0	87	61.4
11	104	63.2	104	63.2	104	59.8
12	106	63.7	106	63.2	106	59.7
13	60	65.6	60	65.6	60	62.2
14	40	67.4	40	67.4	40	64.0
15	48	66.6	48	66.6	48	63.2
16	100	63.4	100	63.4	100	60.0
17	65	65.3	65	65.3	65	61.9
18	112	62.9	27	69.1	27	66.5
19	170	61.1	15	71.6	15	69.0
20	225	59.9	19	70.6	19	68.0
21	275	59.0	23	69.8	23	67.2
22	285	58.9	12	72.6	12	70.0
23	240	59.6	10	73.4	10	70.8
24	185	60.7	72	64.8	72	62.2

Note: Haul road traffic calculation base on dump truck travelling at speed 20 km/hr, SWL of 113 dB(A). The options 1 and 2 had 22 trips/hr. Option 3 is split into two routes, the route from west to east along Bypass has 10 trips/hr and the route passing through Kam Tin Road had 12 trips/hr.

Table 5.7
Worst Case Predicted Noise Levels during Scenario I

Activity	Site Clearance/ Formation (1)		Removal of Unsuitable Material (2)		Temporary Drainage Diversion (7)		Total Predicted Noise Level (dB(A))
NSR	Intervening distance (m)	Predicted noise level (dB(A))	Intervening distance (m)	Predicted noise level (dB(A))	Intervening distance (m)	Predicted noise level (dB(A))	
2	115	73.7	116	68.7	198	49.9	74.9
3	123	73.1	23	82.8	110	55.0	83.2
4	185	69.6	99	70.1	113	54.7	72.9
5	273	66.2	164	65.7	57	60.7	69.6
6	319	64.9	210	63.6	102	55.6	67.6
7	240	67.3	165	65.7	142	52.8	69.7
8	87	76.2	111	69.1	210	49.4	76.9
9	98	75.1	86	71.3	173	51.0	76.6
10	207	68.6	119	68.5	62	60.0	71.9
11	172	70.2	300	60.5	427	43..2	70.7
12	130	72.7	194	64.3	312	45.9	73.3
13	174	70.1	80	72.0	150	52.3	84.2
14	149	71.5	60	74.4	154	52.1	96.2
15	140	72.0	19	84.4	125	53.9	84.7
16	114	73.8	61	74.3	164	51.5	77.1
17	157	71.0	37	78.6	111	54.9	79.3
18	209	68.5	101	69.9	92	56.5	72.4
19	277	66.1	175	65.1	122	54.1	68.8
20	195	69.1	233	65.7	307	46.1	70.0
21	355	63.9	300	60.5	260	47.5	65.6
22	294	65.6	262	61.6	261	47.5	67.1
23	288	65.8	232	62.7	216	49.1	67.6
24	132	72.5	158	66.0	244	48.1	73.4

Table 5.8
Worst Case Predicted Noise Levels during Scenario II

Activity	Backfill for Road Embankment (3)		Slope and Drainage Work (4)		Structural Work (Subway) (8)		Total Predicted Noise Level (dB(A))
NSR	Intervening distance (m)	Predicted noise level (dB(A))	Intervening distance (m)	Predicted noise level (dB(A))	Intervening distance (m)	Predicted noise level (dB(A))	
2	115	75.8	116	73.5	10	73.4	76.4
3	123	72.2	23	87.5	45	66.9	87.5
4	185	71.7	99	74.8	85	64.1	75.2
5	273	68.3	164	70.4	51	66.3	71.8
6	319	66.9	210	68.3	63	65.4	70.1
7	240	69.4	165	70.4	80	64.4	71.3
8	87	78.2	111	73.8	107	63.1	74.2
9	98	77.1	86	76.0	106	63.2	76.2
10	207	70.7	119	73.2	87	64.0	73.7
11	172	72.3	300	65.2	104	63.2	67.3
12	130	74.7	194	69.0	106	63.2	70.0
13	174	72.2	80	76.6	60	65.6	77.0
14	149	73.5	60	79.1	40	67.4	79.4
15	140	74.1	19	89.1	48	66.6	89.1
16	114	75.9	61	79.0	100	63.4	79.1
17	157	73.1	37	86.6	65	65.3	83.4
18	209	70.6	101	74.6	27	69.1	75.7
19	277	68.2	175	69.9	15	71.7	73.9
20	195	71.2	233	67.4	19	70.6	72.3
21	355	66.0	300	65.2	23	69.8	71.1
22	294	67.6	262	66.3	12	72.6	73.5
23	288	67.8	232	67.4	10	73.4	74.4
24	132	74.6	158	70.7	72	64.8	71.7

Table 5.9
Worst Case Predicted Noise Levels during Scenario III

Activity	Roadwork (Flexible Pavement) (5)		Roadwork (Rigid Pavement) (6)		Total Predicted Noise Level (dB(A))
NSR	Intervening distance (m)	Predicted noise level (dB(A))	Intervening distance (m)	Predicted noise level (dB(A))	
2	115	69.4	116	74.2	75.4
3	123	68.8	23	88.2	88.3
4	185	65.3	99	75.6	76.0
5	273	61.9	164	71.2	71.7
6	319	60.5	210	69.1	69.6
7	240	63.0	165	71.2	71.8
8	87	71.8	111	74.6	76.4
9	98	70.8	86	76.8	77.8
10	207	64.3	119	74.0	74.4
11	172	65.9	300	66.0	68.9
12	130	68.3	194	69.7	72.1
13	174	65.8	80	77.4	77.1
14	149	67.1	60	79.9	80.2
15	140	67.7	19	89.9	89.9
16	114	69.5	61	79.8	80.2
17	157	66.7	37	84.1	84.2
18	209	64.2	101	75.4	75.7
19	277	61.8	175	70.6	71.2
20	195	64.8	233	68.2	69.8
21	355	59.6	300	66.0	66.9
22	294	61.2	262	67.1	68.1
23	288	61.4	232	68.2	69.0
24	132	68.2	158	71.5	73.2

5.29 As can be seen from Tables 5.7 to 5.9, exceedances could occur particularly when activities are very close to an NSR. Because of their proximity to the site NSRs 3 and 15 are potentially the worst impacted. Residential NSRs 14, 16 and 17 could be severely impacted while NSRs 8, 13 and occasionally 4 are marginal.

5.30 It is recommended that NSRs 14, 15, 16 and 17 as well as NSR 3 are provided with substantial acoustic protection in the form of temporary noise barriers throughout the main construction period. NSR 13 would be partially protected by the barrier erected to protect NSR 14.

5.31 NSRs 9, 18, 19 and 24 are schools. These need special consideration. NSRs 18 and 19 lie close to Kam Tin Road and experience noise levels well in excess of the recommended 70 dB(A). Monitoring data for NSR 19 is given in Table 5.2 and Figure 5.2. During monitoring, the windows at NSR 19 were open indicating a lack of double glazing and only limited use of air-conditioning.

5.32 NSR 24 is partially sheltered from the Site by surrounding buildings and would be further protected from construction noise by the barrier built to protect NSRs 15, 16 and 17.

5.33 The school designated NSR9 could experience noise levels well above 70 dB(A) from nearby construction activities. It is recommended that a temporary barrier be erected to protect NSR9. This would give partial protection to NSR8.

5.34 Residual predicted noise levels assuming the erection of substantial temporary barriers are given in Table 5.10. As can be seen from the Table additional mitigation is required for NSRs 3 and 15. Thus it is recommended that the Contractor be asked to devise and carry out methods of working so as to minimise noise impacts on the surrounding environment.

5.35 Calculations on the different haul routes suggest strongly that where possible trucks should approach and enter the Site from the west, avoiding travelling through the central area along Kam Tin Road.

Table 5.10
Worst Case Predicted Noise Levels (CNL)
after the Erection of Substantial Temporary Barriers

NSR	Barriered CNL for Scenarios I dB(A)	Barriered CNL for Scenario II dB(A)	Barriered CNL for Scenario III dB(A)
3	73.2	77.7	78.3
4	62.9	66.5	66.0
8	66.9	69.6	66.4
9+	66.6	69.6	67.8
13	64.2	68.0	67.7
14	66.2	70.2	70.2
15	74.7	79.2	79.9
16	67.1	70.7	70.2
17	69.3	73.7	74.2
18+	62.4	66.1	65.7
19+	58.8	62.1	61.2
24+	63.4	66.1	63.2

\+ Schools

Mitigation Measures - Construction Noise

5.36 The construction of Kam Tin Bypass is not expected to cause the recommended noise levels to be exceeded, provided that the following good site practices are fully implemented and that noise barriers are constructed as recommended.

5.37 Noise-related clauses suggested for inclusion in the Contract Documents are given in the Environmental Monitoring and Audit Manual. Those clauses relating to noise mitigation are given below. If these are implemented noise levels during construction will comply with the recommended levels. Indeed if these measures are well implemented, substantial noise barriers may only be necessary for NSRs 3, 9 and 15. Less substantial barriers may be sufficient elsewhere. During construction of the subway, NSR9 will need particular attention.

5.38 Substantial barriers should completely screen the nearby construction activities from the top-floor view of the NSR and be made of material with a surface mass density of 20 kg/m^2 or above. The barrier can be made very effective by using double layers of material separated by a one inch air gap.

5.39 Barriers should be erected very early. Breaking equipment may be used for very short periods of time very early in the Works to break up existing concrete near NSRs 3, 4, 5 and 6 and near NSRs 13, 14, 15, 16 and 17. Although very limited in period of use, breakers can be particularly annoying to nearby residents. It is recommended that this operation be acoustically screened and quieter alternatives to pneumatic breakers considered.

5.40 The Contractor should devise, arrange methods of working and carry out the Works in such a manner so as to minimise noise impacts on the surrounding environment, and should provide experienced personnel with suitable training to ensure that these methods are implemented.

5.41 Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing measures intended to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the project.

5.42 All equipment to be used on the Site likely to cause excessive noise should be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers (NSRs). All hand-held percussive breakers and air compressors will comply with the *Noise Control (Hand-held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations* respectively under the *Noise Control Ordinance (Ordinance No. 75/88, NCO Amendment 1992 No. 6).*

5.43 It is recommended that construction noise is mitigated using the following measures:

(i) Noisy equipment and activities should be sited by the Contractor as far from close-proximity sensitive receivers as is practical. Prolonged operation of noisy equipment close to residences should be avoided.

(ii) Noisy plant or processes should be replaced by quieter alternatives where possible. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained.

(iii) Noisy activities should be scheduled to minimise exposure of nearby sensitive receivers to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours).

(iv) Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

(v) The power units of non-electric stationary plant and earth-moving plant should be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

(vi) Construction activities should be planned so that parallel operation of several sets of equipment close to a given receiver is avoided. The numbers of operating items of powered mechanical equipment should be minimised.

(vii) Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g. bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

(viii) Acoustic barriers should be used to protect the nearest residences from noise emitted by equipment when work is undertaken near these residences.

5.44 The Contractor should ensure that all plant and equipment to be used on site are properly maintained in good operating condition.

Noise - Construction Phase - Conclusions

5.45 A number of noise sensitive receivers will be in close proximity to plant and equipment during the construction of the Kam Tin Bypass. In addition there are a number of schools within the Study Area.

5.46 Unmitigated noise levels could exceed EPD's recommended maximum noise levels for day-time construction work at noise sensitive receivers when construction activities occur within 100 metres of these noise sensitive receivers.

5.47 The use of both quiet working methods and the use of substantial temporary barriers to protect the closest residences and school has been recommended.

5.48 Provided these recommendations are implemented, noise levels can be maintained below 75 dB(A) at residences during the daytime and below 70 dB(A) at schools. Particular care will be needed during school examination periods.

Noise - Operational Phase

5.49 Traffic noise is the only significant source of noise for the operation of the Kam Tin Bypass.

Standards for the Assessment

5.50 Road traffic noise is usually assessed as L_{10} (1 hour), that is the noise level exceeded for 10% of the one hour period during peak traffic flow. The noise is recorded as dB(A).

5.51 Noise standards for road traffic noise are given in the *Hong Kong Planning Standards and Guidelines Chapter 9* (HKPSG) published by the Planning Department of the Hong Kong Government. These standards are tabulated below.

NSRs	Road Traffic Noise[1,2] Standards L_{10} (1 hour) dB(A)
All domestic premises including temporary housing accommodation	70
Hotels and hostels	70
Offices	70
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	65
Places of public worship and courts of law	65
Hospitals, clinics, convalescences and homes for the aged - diagnostic rooms - wards	55
Amphitheatres, and auditoria, libraries, performing arts centres and Country Parks	depend on locations and construction

1 The standards apply to uses which rely on opened windows for ventilation.
2 The standards should be viewed as the maximum permissible noise levels at the external facade.

Methodology of Calculation and Assessment of Road Traffic Noise

5.52 Future traffic noise has been calculated at one metre away from the nearest facade and other selected facades of existing and planned sensitive receivers. The method used to calculate road traffic noise is the procedure described in the *Calculation of Road Traffic Noise* (CRTN) which is published by UK Department of Transport (HMSO 89).

5.53 Firstly, the road scheme is divided into a number of segments. Each segment is then treated as a separate road source and the noise contribution estimated according to the methods given below before summation.

Basic Noise

5.54 CRTN uses the following formula to calculate the basic noise level generated by the traffic flow.

Basic noise level hourly $L_{10} = 42.2 + 10\text{Log}_{10}\ q$ dB(A)

where q is the total hourly traffic flow.

Traffic Speed and Proportion of Heavy Vehicles

5.55 CRTN uses the following formula to calculate the correction for the percentage of heavy vehicles and traffic speed.

Correction $= 33\text{Log}_{10}(V+40+500/V) + 10\text{Log}_{10}(1+5P/V) - 68.8$ dB(A)

where V is the mean traffic speed (km/hour) and varies from segment to segment;
and P is the heavy vehicles percentage which varies from segment to segment.

Road Gradient

5.56 CRTN notes that the correction for traffic speed on a gradient has already taken account of gradient in the correction for heavy vehicles percentage and traffic speed. If the road is treated separately or is one-way traffic, the following correction only applies for the upward flow.

Correction $= 0.3G$ dB(A)

5.57 At Kam Tin the topography is predominantly flat, hence no road gradient correction has been applied.

Road Surface

5.58 The correction for road surface depends on the road surface type and traffic speed. CRTN is based on the following conditions and formulae to calculate the correction.

(i) For pervious road surfaces, the CRTN method is to subtract 3.5 dB(A) as the correction.

(ii) For impervious road surfaces, if the speed is lower than 75 km/hour, the correction is -1 dB(A) regardless of whether the surface is concrete or bituminous. If the speed is above 75 km/hour, following formulas will be adopted :

(a) for concrete surface

$$\text{correction} = 10\text{Log}_{10}(90\text{TD}+30) - 20 \text{ dB(A)}$$

(b) for bituminous surface

$$\text{correction} = 10\text{Log}_{10}(20\text{TD}+60) - 20 \text{ dB(A)}$$

where TD is the texture depth of the road surface.

5.59 The Kam Tin Road and Kam Sheung Road are both assumed to have a bituminous surface. In the initial runs it was assumed that the entire length of the Kam Tin Bypass will have a pervious, friction course surface. For the final runs, sections of the Bypass were treated differentially with separate sections with and without friction course. A correction of 3.5 dB(A) was applied to the section with friction course.

Distance Attenuation

5.60 CRTN uses the following formula to calculate the correction for the distance attenuation.

$$\text{Correction} = -10\text{Log}_{10}(d/13.5) \text{ dB(A)}$$

where d is the shortest distance between the source and the receiver in metres.

The above equation is valid only for $d \geq 4$ metres.

Ground Cover Attenuation

5.61 For ground cover attenuation, CRTN uses the following conditions and formulae to calculate the correction.

(i) For $0.75 \leq H < (d+5)/6$
correction = $5.2I \text{ Log}_{10}[(6H-1.5)/(d+3.5)]$ dB(A)

(ii) For $H < 0.75$
correction = $5.2I \text{ Log}_{10}[3/(d+3.5)]$ dB(A)

(iii) For $H \geq (d+5)/6$
correction = 0

where d is the shortest distance between the edge of the road and receiver in metres. H is the average height above the ground of the path between the segment source line and receiver. All the above equations are valid only for $d \geq 4$ metres.

5.62 I is the % factor of absorbent ground cover within the segment:

(i) If % of the absorbent ground < 10, I will be 0.
(ii) If % of the absorbent ground within 10 to 39, I will be 0.25.
(iii) If % of the absorbent ground within 40 to 59, I will be 0.5.
(iv) If % of the absorbent ground within 60 to 89, I will be 0.75.
(v) If % of the absorbent ground ≥ 90, I will be 1.0.

5.63 Due to the agricultural land in the Study Area, absorbent ground cover factor of 1 has been used for the calculation of ground cover attenuation.

Angle of View

5.64 For the angle of view, CRTN uses the following formula to calculate the correction.

Correction = $10\text{Log}_{10}(Q/180)$ dB(A)

where Q is the angle subtended by the segment boundaries at the receiver.

Barrier Corrections

5.65 For barrier corrections, CRTN uses the site geometry to evaluate path difference (δ) and hence calculate the correction. If the barrier is not parallel to the source line, it is necessary to divide the barrier into smaller segments and to determine the intersection point of the barrier and the segment angle. CRTN then uses the intersection point to rotate the barrier parallel to the source line to determine the potential correction.

Barrier correction = $A_0 + A_1x + A_2x^2 + ... + A_nx^n$

where $x = \log_{10}\delta$ and path difference between the direct and diffracted rays δ (metres) = a + b - c

(i) The range of validity for the shadow zone is:
$-3 \leq x \leq 1.2$

(ii) The range of validity for the illuminated zone is:
$-4 \leq x \leq 0$

Outside the above range of validity, the correction changes:

(i) The range of validity for the shadow zone is:
(a) for $x < -3 \Rightarrow A = -5.0$ dB(A)
(b) for $x > 1.2 \Rightarrow A = -30.0$ dB(A)

(ii) The range of validity for the illuminated zone is:
(a) for $x < -4 \Rightarrow A = -5.0$ dB(A)
(b) for $x > 0 \Rightarrow A = 0$ dB(A)

Facade Reflection

5.66 For the facade reflection effect, CRTN adds an additional 2.5 dB(A) as the correction.

CRTN uses the following formula to calculate the reflection correction.

Correction = $1.5\ (\Theta'/\Theta)$ dB(A)

where $\Theta'$is the total reflection angle
Θ is the angle of view

Summation Procedure

5.67 The final calculation procedures for the predicted noise level according to CRTN is to combine all the noise contributions from all the segments. The formula is:

$L = 10\log_{10}[\sum_1^N \text{Antilog}_{10}(Ln/10)]$ dB(A)

where L is the combined noise level
Ln is nth component noise level.

Software

5.68 Use was made of three major types of software. The programme used for the *Calculation of Road Traffic Noise* was developed by BCL internally and is known as *CRTN19*. Most Design Drawings for the Project have been produced on *MICROSTATION*. The road alignment was provided by Highways Department.

5.69 Information on the road alignment was digitised in MICROSTATION. MICROSTATION was used to divide Kam Tin Bypass, Kam Tin Road and Kam Sheung Road into small segments. The levels and co-ordinates for each of the segments include the edges of the roads, the centres of lanes and the centre line of the earth mound along the Bypass's southern alignment depending upon the curvature of the road.

5.70 All basic information needed about the Study Area was digitised using MICROSTATION. This information includes co-ordinates and levels for the facades of noise sensitive receivers and any important topography including the three roads being modelled.

5.71 Once all the parameters are keyed in, CRTN19 uses traffic flow to calculate the basic noise level generated from that segment.

5.72 To calculate the distance between the road segment and the sensitive receivers, CRTN19 uses the coordinates of the start point and end point of each segment and the coordinates of the noise sensitive receivers and applies the appropriate trigonometric formulae.

5.73 For the correction of an obstruction or barrier, CRTN19 first checks the location of the obstruction or barrier to see whether it is located between the source line and receiver. If it is behind receiver, no correction is made. CRTN19 also checks the height of the obstruction or barrier. If it is higher than the receiver, CRTN19 treats it as a reflection facade.

5.74 If the obstruction or barrier is situated between the receiver and source, CRTN19 checks whether the obstruction or barrier is parallel to the source line. If not, CRTN19 calculates the angle of view of the obstruction or barrier. It then draws a straight line bisecting the angle of view and passing through the receiver and the obstruction or barrier perpendicular to the source line. CRTN19 uses this intersection point at the obstruction or barrier as the centre point to rotate the obstruction or barrier parallel to the source line and calculate the barrier correction.

5.75 A barrier is simulated and checked to see whether it will screen the noise from the sensitive receivers or if it will reflect the noise to the sensitive receivers. CRTN19 uses the location and the elevation of the simulated barrier to determine the line of sight between the barrier and the sensitive receiver deciding whether the source is fully blocked, partially screened or can be fully viewed. If the line of sight is not fully blocked, CRTN19 calculates the path difference to find the potential correction.

5.76 The correction for the road surface calculated by CRTN19 is based on the conditions and formulae described in CRTN.

Traffic Data

5.77 Wilbur Smith Associates Limited's traffic flow forecast for the a.m. peak hour flow in year 2011 for several major roads within the Study Area has been used to predict the cumulative noise impact. Table 5.11 at the back of this section lists the peak hour traffic volumes expected during this period. The percentage of heavy vehicles is also included in this table.

5.78 The flows on the other minor access road are too small to produce any significant amount of traffic noise.

5.79 Current traffic data at the Kam Tin Road (Kam Sheung Road junction) and Kam Sheung Road traffic census coverage stations 6207 and 6208 from the Annual Traffic Census 1994, published by the Transport Department, have been used for a comparison with the monitored baseline noise levels.

5.80 Table 5.12 shows the Annual Average Daily Traffic (AADT) of the two stations from 1993 to 1994. As the two stations are not core stations, the percentage of heavy vehicles was not included in the Census. These figures are assumed to be the same as for the corresponding road link. Peak hour traffic has been taken as 8% of the AADT.

Traffic Speed

5.81 The legal speed limit for the Kam Tin Bypass including the roundabouts is 70 kph. The legal speed limit for Kam Tin Road and Kam Sheung Road is 50 kph. These are the speeds used in the following assessment. In practice, vehicles will not be able to travel around the roundabout at 70 kph; 30 kph is a more likely limit. However, due to stop/start operations, roundabout noise would be underestimated if a speed of 30 kph were to be used in the calculation of road traffic noise. A speed of 40 kph would give a more realistic evaluation of noise from the roundabout. However, the conservative approach has been maintained and 50 kph used in the assessments. Roundabout noise did not contribute significantly to the development of the noise barrier proposals.

5.82 After the issue of the draft EIA report, the Research & Development Division Highways Department opined that the practical driving actual speed at both ends of the bypass will be about 50 kph or less due to the presence of signalised junctions, the bus stops and the roundabouts and, due to maintenance consideration, have only agreed to friction course in the zone where vehicles are likely to travel at 70 kph. Transport Department have determined that the legal speed limit for the Kam Tin Bypass will be 70 kph and the Bypass is too short for changes in legal speed limit. However, Transport Department have recognised that motorists would choose a lower suitable speed to cope with the signalised junctions and roundabouts. Consequently in the final traffic noise level prediction runs, 70 kph has been used for the centre section of the Bypass with friction course and 50 kph for both end sections without friction course. A speed of 50 kph was used for the roundabout itself.

Preliminary Noise Assessment

5.83 Free field, L_{10} (1-hr), noise contour curves were generated with low resolution to give an indication of traffic noise levels in 2011 within the vicinity of the Kam Tin Bypass project area. These contour curves were generated using a simple alignment for the Bypass.

5.84 These preliminary contour plots at different floor levels are presented in Figures 5.8 to 5.11. As expected, they indicated the need for detailed traffic noise assessment and mitigation. Noise levels associated with Kam Tin Road and Kam Sheung are also high, indicating that traffic noise generated from these roads will also be above the standards recommended in the HKPSG.

5.85 CRTN suggests that when road traffic noise is above the noise standard as the result of a combination of existing and new roads, the new road project is deemed to be responsible if the increase in noise from the new project worsens noise levels by 1.0 dB(A) or more.

5.86 An area has been set aside within the Site for a 1.5 metre high earth bund along the southern main arc of the Bypass. As preliminary results indicated the necessity for this barrier mound plus additional mitigation, the mound was included in all further assessment of future road traffic noise.

Existing Noise Sensitive Receivers in 2011

5.87 The representative NSRs (Figure 5.12) chosen for the project are such that provided traffic noise levels at these NSRs are within the recommended limits, then all other existing and future NSRs would also experience acceptable levels of traffic noise. In this regard the positions of calculation points 28 and 29 were carefully chosen, as these points represent an area of "RC(1)" zoning which permits the future construction of 4-storey residences as compared to adjacent "V" zoning allowing 3 storey houses (Table 2.2).

5.88 Table 5.13 at the back of this section presents the results of calculations at the existing NSRs in 2011 unmitigated except for protection from the 1.5 metre high earth bund and friction course. Under this scenario, NSRs close to Kam Tin Road are predicted to experience noise levels well above 70 dB(A).

5.89 The Kam Tin Bypass project needs mitigation additional to the earth bund in order to shelter some facades of a number of existing NSRs from future noise levels. These NSRs are the residences 3, 4, 13, 14, 15, 17 and the school 18.

Future Noise Sensitive Receivers in 2011

5.90 The current zoning for the Study Area is illustrated in Section 2. The new drainage channel plus the project area itself forms a buffer zone for much of the area to the north.

5.91 Most of the future sensitive receivers are zoned "village development". This limits future development to three storey structures. Only one area adjoining the Bypass has been zoned to allow four storey development.

5.92 Calculations have been undertaken at selected points along the Bypass 10 metres from the project boundary and assuming either three or four storey development as appropriate (Figure 5.12).

5.93 Barriers have been designed to bring these points within acceptable noise limits for the Bypass. Predicted noise levels for these selected calculation points, when protected only by the earth bund and friction course, are given in Table 5.14.

Current Noise Levels

5.94 Current road traffic noise levels have been calculated for comparison with the monitored data. Table 5.15 presents this data. Reasonable correlation was noted.

Mitigation Measures - Operational Phase

5.95 Since the earliest studies for the Kam Tin Bypass, it has been recognised that construction of some form of noise barrier to protect the adjacent sensitive receivers is inevitable.

5.96 Noise calculations have confirmed that the construction of substantial permanent noise barriers is essential to protect existing and future residents of Kam Tin and the surrounding areas from the impact of traffic noise.

5.97 The friction course to be used on Kam Tin Bypass is shown on Figure 5.13.

5.98 Using this friction course and the speeds shown on Figure 5.13, barriers have been proposed to protect existing NSRs and as many potential future sensitive receivers as possible. These barriers are shown on Figure 5.14.

5.99 The final mitigated or residual traffic noise levels are given in Tables 5.16 and 5.17 at the end of this section.

5.100 All existing NSRs are protected and meet the standards recommended in the HKPSG.

Protection of NSRs to the north of the Bypass

5.101 Future sensitive receivers, that is sensitive land uses allowing further dwelling construction, are fully protected to the north of the Bypass by the direct mitigation measures.

5.102 Construction of the drainage channel and associated embankments and service roads adjacent to the northern side of the Bypass will buffer most of the northern NSRs from traffic noise, without the need for any additional protection.

5.103 Three sections of 1 m and 2 m high acoustic barriers will be built to protect both existing and future NSRs located in areas between the drainage channel and the Bypass and just north of the drainage channel.

5.104 Future construction of 3 storey houses up to the northern boundary of the drainage channel will necessitate construction of a 1 m noise barrier along the full length of the northern side of the Bypass. This 1 m barrier will also protect houses built on the north eastern side of the Bypass. On the western end the land is zoned for agriculture.

Protection of NSRs to the south of the Bypass

5.105 In order to protect both existing and future NSRs to the south of the Bypass, it will be necessary to construct a continuous noise barrier along the southern boundary of the Bypass broken only at the intersections and extending a little distance along the intersecting roads.

5.106 Most NSRs can be adequately protected by a 2 m barrier on top of the 1.5 m earth bund to be constructed alongside the Bypass (ie. total 'barrier' height along this section is 3.5 m above road level). Some short sections of the barrier will need to be 3.5-5.5 m high on top of the bund (ie. total height is 5-7 m).

5.107 Protection of NSR 3 from excessive traffic noise necessitates the construction of the only section of 5.5 m high cantilever type noise barrier on top of a 1.5 m high earth bund. The proposed cantilever type noise barrier consists of a 3.5 m high vertical section with a 2 m high barrier above bending 30 degrees towards the carriageway side. This barrier would not overhang the carriageway. It is illustrated in Figure 5.15.

5.108 In order to fully protect NSR 3 and all other current sensitive receivers nearest NSR 3, two stretches of barrier 3.5 m high (i.e. 5 m above road level), are required. This fully protects all future sensitive receivers within the RC(1) zone near the Bypass. An area at the eastern end of Bypass is currently occupied by non-sensitive uses (vehicle storage) with NSR 3 in the northwestern corner. The calculation point 30 was placed at the worst case position within this area. It is not possible to fully protect a future sensitive receiver at calculation point 30. Partial protection is offered to future development in the area between NSR 3 and NSR 30. It is recommended that the practice of non-sensitive use be continued. If future residential development is undertaken between NSR 3 and the roundabout corner, then the necessity for noise mitigative design would need to be assessed case by case.

5.109 The Kam Tin Mung Yeung Public School (NSR 18) has been the subject of intensive assessment. This school had been provided with air conditioning under NAMISP, a programme to provide noise abatement measures to schools affected by excessive noise. However, only 7 of the 9 classrooms were found to be air-conditioned. The upper storey was relatively noise non-sensitive on the facades facing Kam Tin Road or the Bypass. Only an office, with air conditioning, faces Kam Tin Road and a corridor separates classrooms from the facade facing the Bypass. Barriers have been designed to bring future noise levels down to 75 or 65 dB(A) depending on the presence or absence of air-conditioning at noise sensitive facades. The ground floor of the facade facing Kam Tin Road has offices and non-sensitive walls at its eastern end. Classrooms at the western end are sheltered by the barrier wall. Noise levels shown in Table 5.16 have been calculated at the least protected end of the classrooms.

Noise - Operational Phase - Conclusions

5.110 Road traffic noise levels experienced by NSRs close to the existing Kam Tin Road and Kam Sheung Road are expected to be higher than the standards of the HKPSG. Current noise levels are already considerable and can exceed the HKPSG standards.

5.111 Without appropriate noise mitigation, traffic levels on the Bypass are high enough to generate road traffic noise levels in 2011 higher than the standards recommended in the HKPSG.

5.112 In order to fully protect all existing and virtually all future noise sensitive receivers, that is, all currently planned land uses sensitive to traffic noise, the following mitigation measures will be implemented:

(i) construction of the planned 1.5 m high earth bund;

(ii) construction of extensive noise barriers both on the earth bund and extending beyond the bund and to the north of the Bypass as shown on Figure 5.14. It will cost approximately HK$7 million at today's prices to provide for 2½ km of barriers;

(iii) application and maintenance of friction course to the central section of the Bypass shown on Figure 5.13. It will cost at today's prices about HK$0.6 million to apply the friction course. The friction course will need to be repaved about every four years.

5.113 Without any direct technical remedies such as friction course or barriers, about 160 dwellings and 3 schools would suffer from traffic noise levels above the HKPSG criteria after completion of the roadworks. Without direct technical remedies such as bunds or barriers but with friction course applied to the entire Bypass about 130 dwellings and 3 schools would exceed the HKPSG criteria.

5.114 After completion of the works and the implementation of the direct technical remedies as shown in Figures 5.13 and 5.14, that is the earth bunds, about 2½ km of barriers and a section of friction course, 5 dwellings and 1 school will still exceed the HKPSG criteria. However, in every case the exceedance is due to traffic noise from Kam Tin Road. The school, Kam Tin Dragon Kindergarten, is air-conditioned.

5.115 No dwelling meets the "eligibility criteria" for indirect technical remedies.

Summary

5.116 The noise impact assessment has demonstrated that provided the requirements of this EIA Report and the Environmental Monitoring & Audit Manual are carried out, particularly with respect to erection of appropriate acoustic barriers and quiet working methods, noise impacts from both construction and road traffic noise will be within the recommended standards.

Table 5.11
Peak Hour Traffic Volume of the Major Road Links within the Study Area in the Year 2011

Road Links	Flow (veh/hr)	Percentage of heavy vehicles (%)+
Kam Tin Road - East of Shek Kong to Kam Tin Bypass Junction	2968	61.3
Kam Sheung Road	2695	51.8
Kam Tin Road - West of Shek Kong to Kam Tin Bypass Junction	562	15.1
Kam Tin Road - East of Kam Sheung Road Junction	464	30.0
Kam Tin Road - West of Kam Sheung Road Junction	3013	49.0
Kam Tin Road - West of Kam Tin Bypass West Junction	5486	59.1
Kam Tin Bypass - East of Junction with Access to Tai Kong Po	2420	71.9
Kam Tin Bypass - West of Junction with Access to Tai Kong Po	2444	71.5
Kam Tin Bypass - West of Junction with Access to Kam Hing Wai	2479	71.3

+ Heavy vehicles are all vehicles with an unladen weight exceeding 1525 kg.

Table 5.12
1994 Traffic Data

Coverage Station	A.A.D.T.	Peak Hour+	% of Heavy Vehicles
Kam Tin Road - near Kam Sheung Road Junction 6207	14920	1194	49.4
Kam Sheung Road - south of Junction with Kam Tin Road 6208	7210	577	49.4

+ 8% of A.A.D.T.

Table 5.13 : 2011 Road Traffic Noise Levels, L_{10} (1 hr) (dB(A)) - unmitigated but with 1.5 m earthbund south of the Bypass - existing NSRs

Existing Noise Sensitive Receiver	Floor	Total Noise Kam Sheung Road + Kam Tin Road	Total Noise Kam Tin Bypass + Roundabouts	Grand Total Noise Level (GT)	Increase due to Kam Tin Bypass if GT > 70.0	Further Mitigation Essential
01.a +	G/F	44.6	54.9	55.3		
02.1	G/F	74.8	62.7	75.1	0.3	
02.1	1/F	74.3	64.8	74.8	0.5	
02.1	2/F	73.5	66.0	74.2	0.7	
03.1	G/F	58.3	71.8	71.9	13.6	Yes
03.1	1/F	60.1	77.2	77.3	17.2	Yes
03.1	2/F	60.8	79.5	79.6	18.8	Yes
03.2	G/F	61.0	69.8	70.3	9.3	Yes
03.2	1/F	62.3	73.4	73.7	11.4	Yes
03.2	2/F	63.0	75.6	75.8	12.8	Yes
04.1	G/F	59.6	67.9	68.5		
04.1	1/F	61.8	70.9	71.4	9.5	Yes
05.1	G/F	60.1	64.5	65.8		
05.1	1/F	59.7	69.7	70.1	10.4	No
06.1	G/F	54.3	69.1	69.2		
07.1	G/F	57.4	58.7	61.1		
07.1	1/F	59.3	61.2	63.4		
07.1	2/F	59.9	62.6	64.5		
07.2	G/F	59.6	55.8	61.1		
07.2	1/F	61.6	59.8	63.8		
07.2	2/F	62.5	61.4	65.0		
08.1	G/F	54.7	58.4	59.9		
08.1	1/F	56.9	60.8	62.3		
08.1	2/F	57.8	63.3	64.4		
09.1*	G/F	52.6	58.6	59.6		
10.1	G/F	56.7	60.0	61.7		
10.1	1/F	57.7	64.1	65.0		
11.1	G/F	55.1	65.8	66.2		
11.1	1/F	57.7	67.4	67.8		
11.1	2/F	59.1	69.1	69.5		
12.1	G/F	57.4	66.3	66.8		
12.1	1/F	58.9	66.7	67.4		
12.1	2/F	60.1	68.5	69.1		
13.1	G/F	58.7	68.6	69.0		
13.1	1/F	61.5	71.2	71.6	10.1	Yes
14.1	G/F	60.2	71.3	71.6	11.5	Yes
14.1	1/F	62.3	74.0	74.3	12.0	Yes
14.1	2/F	63.2	75.4	75.7	12.5	Yes
15.1	G/F	62.9	67.3	68.7		
15.1	1/F	64.7	68.6	70.1	5.4	No
15.2	G/F	61.7	69.2	69.9		
15.2	1/F	63.9	72.2	72.8	9.0	Yes
16.1	G/F	63.3	61.5	65.5		
17.1	G/F	57.5	63.2	64.3		
17.1	1/F	58.2	65.8	66.5		
17.1	2/F	58.9	70.4	70.7	11.8	Yes
17.2	G/F	62.7	68.7	69.6		
17.2	1/F	64.6	70.0	71.1	6.5	Yes
17.2	2/F	66.1	73.3	74.1	8.0	Yes
18.1*	G/F	60.9	62.5	64.8		
18.1*	1/F	61.1	65.7	67.0	5.9	Yes
18.2*	G/F	75.9	57.5	75.9	0.1	
18.2*	1/F	78.4	60.5	78.5	0.1	
18.3*	G/F	69.6	65.2	71.0	1.3	Yes
18.3*	1/F	71.8	68.3	73.4	1.6	Yes
19.1*	G/F	79.5	63.2	79.6	0.1	
19.1*	1/F	81.8	66.2	81.9	0.1	
19.1*	2/F	82.0	67.6	82.2	0.2	
20.1	G/F	56.0	53.5	57.9		
20.1	1/F	58.3	56.8	60.6		
21.1	G/F	70.9	54.0	71.0	0.1	
21.1	1/F	71.9	56.6	72.0	0.1	
21.1	2/F	71.5	57.8	71.7	0.2	
21.1	3/F	71.2	58.7	71.4	0.2	
22.1	G/F	74.8	51.6	74.8	0.0	
22.1	1/F	75.2	54.9	75.2	0.0	
22.1	2/F	74.2	56.4	74.3	0.1	
23.1	G/F	58.1	55.9	60.2		
23.1	1/F	59.6	58.1	61.9		
24.1*	G/F	57.0	54.7	59.0		
24.1*	1/F	59.2	58.2	61.7		

+ Temple. Noise standard of 65 dB(A) recommended in the HKPSG.
(*) School. Noise standard of 65 dB(A) recommended in the HKPSG.

Table 5.14 : Road Traffic Noise Levels, L_{10} (1 hr) (dB(A)) - unmitigated but with 1.5 m earth bund south of the Bypass - future noise sensitive receivers

Future Noise Sensitive Receiver	Floor	Total Noise Kam Sheung Road + Kam Tin Road	Total Noise Kam Tin Bypass + Roundabouts	Grand Total Noise Level (GT)	Increase due to Kam Tin Bypass if GT > 70.0
25.1	G/F	60.6	69.7	70.2	9.5
25.1	1/F	63.4	71.8	72.4	9.0
25.1	2/F	64.6	74.5	74.9	10.3
26.1	G/F	52.5	65.0	65.2	
26.1	1/F	55.2	71.0	71.1	16.0
26.1	2/F	55.5	75.0	75.0	19.6
27.1	G/F	49.5	64.8	65.0	
27.1	1/F	51.9	70.7	70.8	18.9
27.1	2/F	53.0	74.8	74.8	21.8
28.1	G/F	48.5	64.6	64.7	
28.1	1/F	51.0	70.1	70.2	19.2
28.1	2/F	52.1	74.0	74.0	22.0
28.1	3/F	52.8	76.9	76.9	24.2
29.1	G/F	56.6	66.0	66.5	
29.1	1/F	59.1	70.5	70.8	11.7
29.1	2/F	59.9	73.4	73.6	13.7
29.1	3/F	60.5	75.7	75.9	15.3
30.1	G/F	65.2	75.6	76.0	10.8
30.1	1/F	67.3	78.0	78.4	11.1
30.1	2/F	68.2	79.1	79.4	11.2
31.1	G/F	55.6	69.0	69.2	
31.1	1/F	58.0	71.9	72.1	14.0
31.1	2/F	59.0	73.2	73.4	14.4
32.1	G/F	55.9	68.7	68.9	
32.1	1/F	58.5	70.4	70.7	12.2
32.1	2/F	60.0	72.0	72.3	12.3

\+ Temple. Noise standard of 65 dB(A) recommended in the HKPSG.
* School. Noise standard of 65 dB(A) recommended in the HKPSG.

Table 5.15 : Comparison of Calculated versus Monitored Noise Levels for the Existing Road System (1994-1995), L_{eq} (1 hr) (dB(A))

NSR	Calculated Noise Levels	Monitored Noise Levels
19	75.7	74.0 - 76.5
20	74.2	72.5 - 73.5

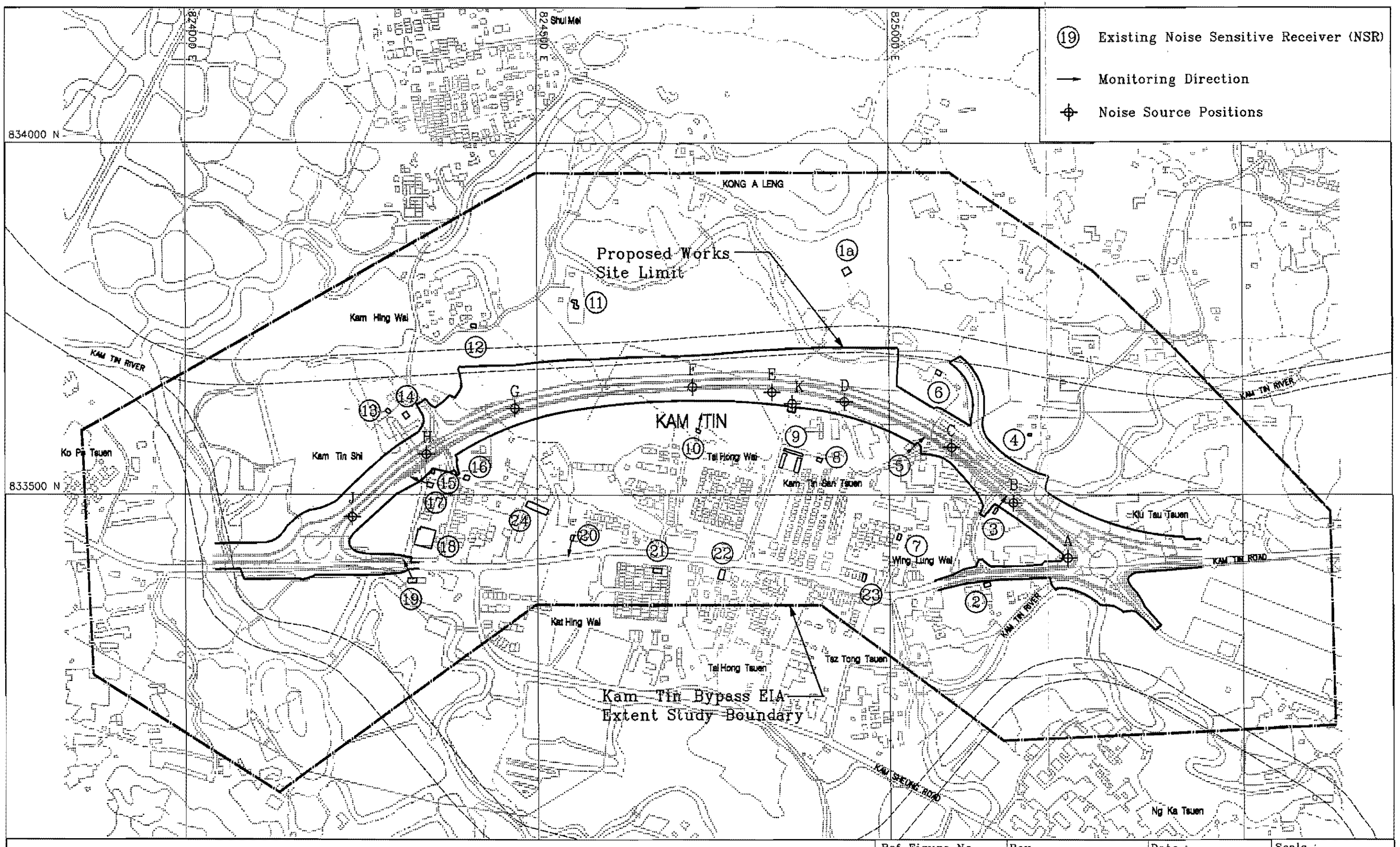
Table 5.16 : Road Traffic Noise Levels, L_{10} (1 hr) (dB(A)) - mitigated by barriers shown on Figure 5.14, existing NSRs (with speeds and friction course as on Figure 5.13)

Existing Noise Sensitive Receiver	Floor	Total Noise Kam Sheung Road + Kam Tin Road	Total Noise Kam Tin Bypass + Roundabouts	Grand Total Noise Level (GT)	Increase due to Kam Tin Bypass if GT > Applicable Standard
1a+	G/F	44.6	48.7	50.1	
02.1	G/F	74.8	58.9	74.9	0.1
02.1	1/F	74.3	61.4	74.5	0.2
02.1	2/F	73.5	62.9	73.9	0.4
03.1	G/F	57.2	64.3	65.1	
03.1	1/F	59.2	67.8	68.4	
03.1	2/F	60.1	69.6	70.1	
03.2	G/F	60.1	63.9	65.4	
03.2	1/F	61.5	67.3	68.3	
03.2	2/F	62.3	69.1	69.9	
04.1	G/F	58.0	62.4	63.7	
04.1	1/F	60.6	66.2	67.3	
05.1	G/F	59.9	58.6	62.3	
05.1	1/F	59.4	62.4	64.2	
06.1	G/F	52.3	60.8	61.4	
07.1	G/F	56.5	52.8	58.0	
07.1	1/F	58.6	55.5	60.3	
07.1	2/F	59.4	57.1	61.4	
07.2	G/F	58.2	47.6	58.6	
07.2	1/F	60.6	54.8	61.6	
07.2	2/F	61.8	56.3	62.9	
08.1	G/F	54.1	52.2	56.3	
08.1	1/F	56.6	54.3	58.6	
08.1	2/F	57.4	56.4	59.9	
09.1*	G/F	51.8	52.5	55.2	
10.1	G/F	56.4	54.1	58.4	
10.1	1/F	57.4	57.8	60.6	
11.1	G/F	53.4	56.9	58.5	
11.1	1/F	56.2	59.3	61.0	
11.1	2/F	57.9	62.0	63.4	
12.1	G/F	56.0	58.5	60.5	
12.1	1/F	57.3	59.1	61.3	
12.1	2/F	58.4	61.0	62.9	
13.1	G/F	56.5	58.2	60.5	
13.1	1/F	59.4	61.9	63.8	
14.1	G/F	58.9	61.1	63.1	
14.1	1/F	60.6	65.1	66.4	
14.1	2/F	61.5	68.0	68.9	
15.1	G/F	60.2	58.9	62.6	
15.1	1/F	62.2	60.8	64.5	
15.2	G/F	58.4	62.4	63.9	
15.2	1/F	61.0	65.2	66.6	
16.1	G/F	61.8	53.0	62.3	
17.1	G/F	56.9	58.9	61.0	
17.1	1/F	58.1	60.8	62.6	
17.1	2/F	58.8	64.4	65.5	
17.2	G/F	59.4	60.8	63.2	
17.2	1/F	61.6	62.5	65.1	
17.2	2/F	63.0	66.0	67.8	
18.1*	G/F	60.7	52.9	61.4	
18.1*	1/F	60.8	56.6	62.2	
18.2**	G/F	74.3	45.3	74.3	
18.2***	1/F	76.9	48.7	76.9	
18.3*	G/F	63.2	53.4	63.6	
18.3****	1/F	65.3	57.1	65.9	
19.1**	G/F	79.5	60.6	79.6	0.1
19.1**	1/F	81.8	63.7	81.9	0.1
19.1**	2/F	82.0	65.0	82.1	0.1
20.1	G/F	55.8	47.4	56.4	
20.1	1/F	58.2	50.7	58.9	
21.1	G/F	70.9	47.4	70.9	0.0
21.1	1/F	71.9	49.6	71.9	0.0
21.1	2/F	71.5	50.9	71.5	0.0
21.1	3/F	71.2	51.9	71.3	0.1
22.1	G/F	74.8	46.0	74.8	0.0
22.1	1/F	75.2	49.3	75.2	0.0
22.1	2/F	74.2	50.8	74.2	0.0
23.1	G/F	57.4	50.3	58.2	
23.1	1/F	59.2	52.8	60.1	
24.1*	G/F	56.5	49.3	57.3	
24.1*	1/F	58.9	52.6	59.8	

\+ Temple. Noise standard of 65 dB(A) recommended in the HKPSG.
* School. Noise standard of 65 dB(A) recommended in the HKPSG.
** Classrooms with air-conditioning. Noise standard of 75 dB(A).
*** Almost non-sensitive facades. Only small windows for office with air-conditioning.
**** School has corridor on sensitive side.

Table 5.17 : 2011 Road Traffic Noise Levels, L_{10} (1 hr) (dB(A)) - mitigated by barriers shown on Figure 5.14, future noise sensitive receivers (with speeds and friction course as on Figure 5.13)

Future Noise Sensitive Receiver	Floor	Total Noise Kam Sheung Road + Kam Tin Road	Total Noise Kam Tin Bypass + Rounabouts	Grand Total Noise Level (GT)	Increase due to Kam Tin Bypass if GT > 70.0
25.1	G/F	60.2	62.3	64.4	
25.1	1/F	62.9	64.8	67.0	
25.1	2/F	64.1	67.7	69.3	
26.1	G/F	52.5	58.9	59.8	
26.1	1/F	55.2	63.4	64.0	
26.1	2/F	55.5	66.6	66.9	
27.1	G/F	49.5	58.6	59.1	
27.1	1/F	51.9	63.1	63.4	
27.1	2/F	53.0	66.3	66.5	
28.1	G/F	48.5	58.2	58.7	
28.1	1/F	51.0	62.5	62.8	
28.1	2/F	52.1	65.5	65.7	
28.1	3/F	52.8	68.2	68.3	
29.1	G/F	56.5	59.0	60.9	
29.1	1/F	59.0	63.2	64.6	
29.1	2/F	59.9	65.3	66.4	
29.1	3/F	60.4	66.7	67.6	
30.1	G/F	65.2	73.8	74.4	9.2
30.1	1/F	67.3	77.2	77.6	10.3
30.1	2/F	68.2	78.5	78.9	10.7
31.1	G/F	54.9	60.5	61.6	
31.1	1/F	57.2	64.4	65.2	
31.1	2/F	59.0	66.6	67.3	
32.1	G/F	55.9	60.9	62.1	
32.1	1/F	58.5	63.3	64.5	
32.1	2/F	60.0	65.8	66.8	



Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 5000
Title : EIA - REPRESENTATIVE NOISE SENSITIVE RECEIVERS AND CONSTRUCTION NOISE SOURCE POSITIONS	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 5.1

Figure 5.2 Noise Monitoring at NSR 19 (17 August - 18 August 1995)

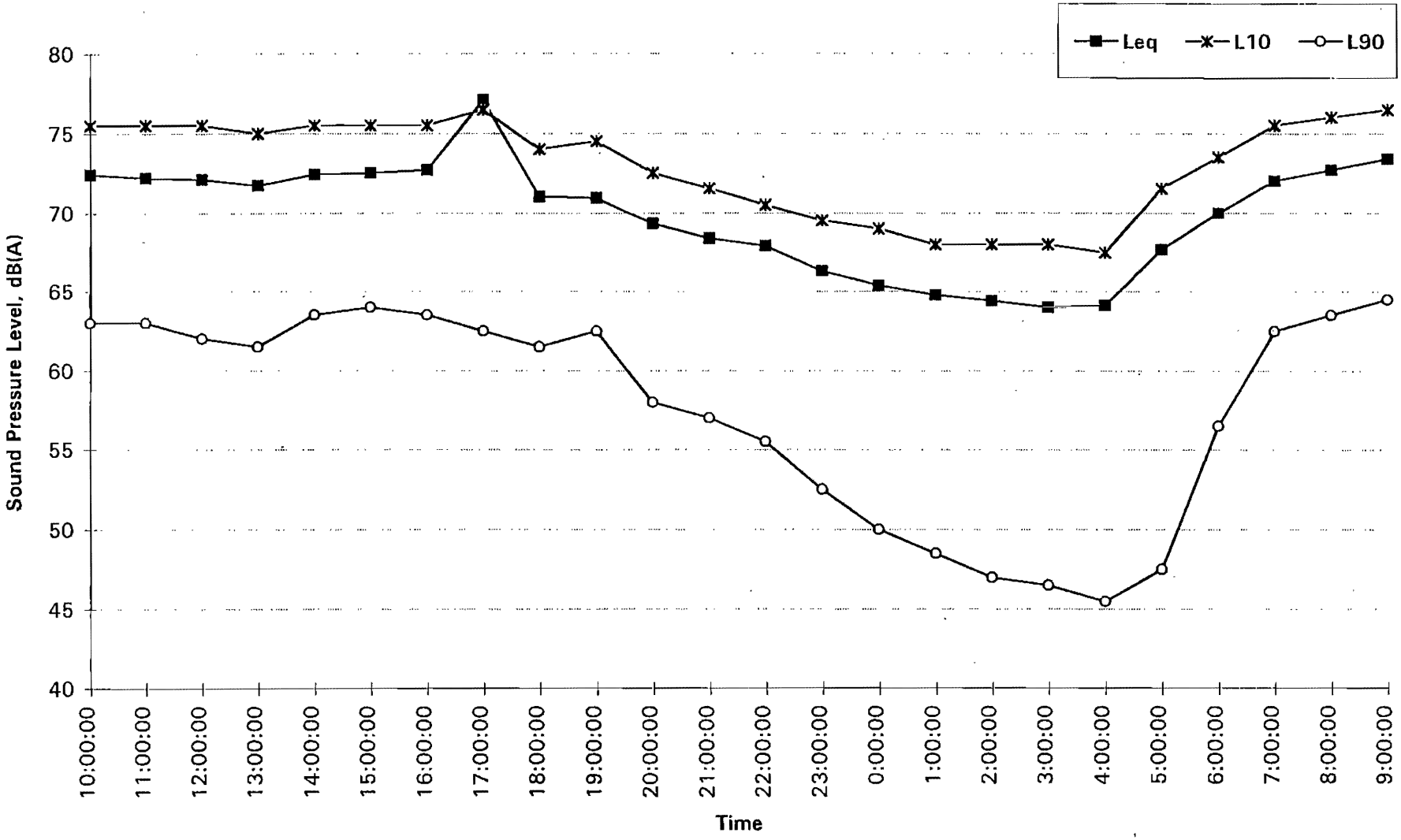


Figure 5.3 Noise Monitoring at NSR 3 (30 August - 31 August 1995)

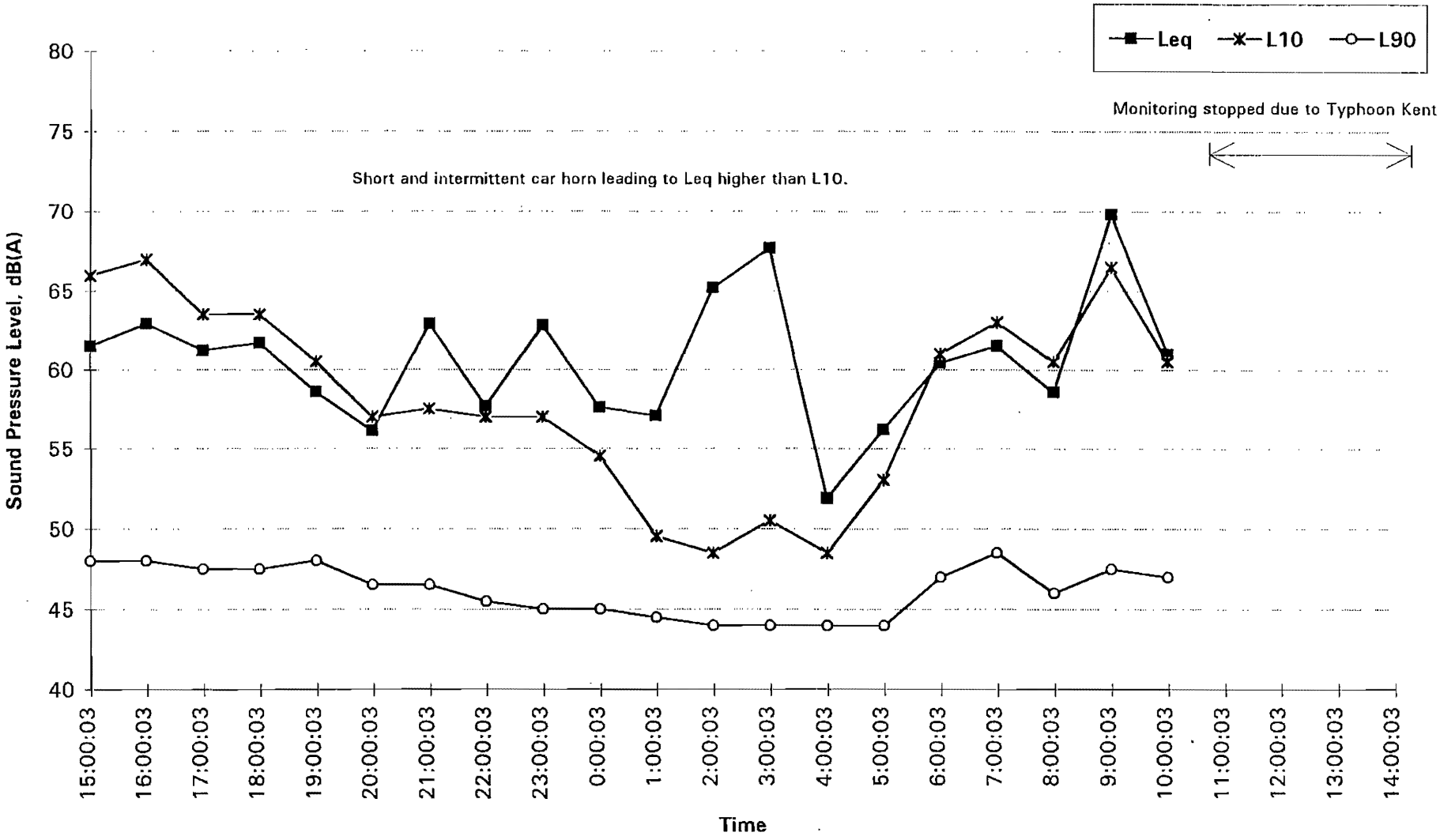


Figure 5.4 Noise Monitoring at NSR 5 (29 August - 30 August 1995)

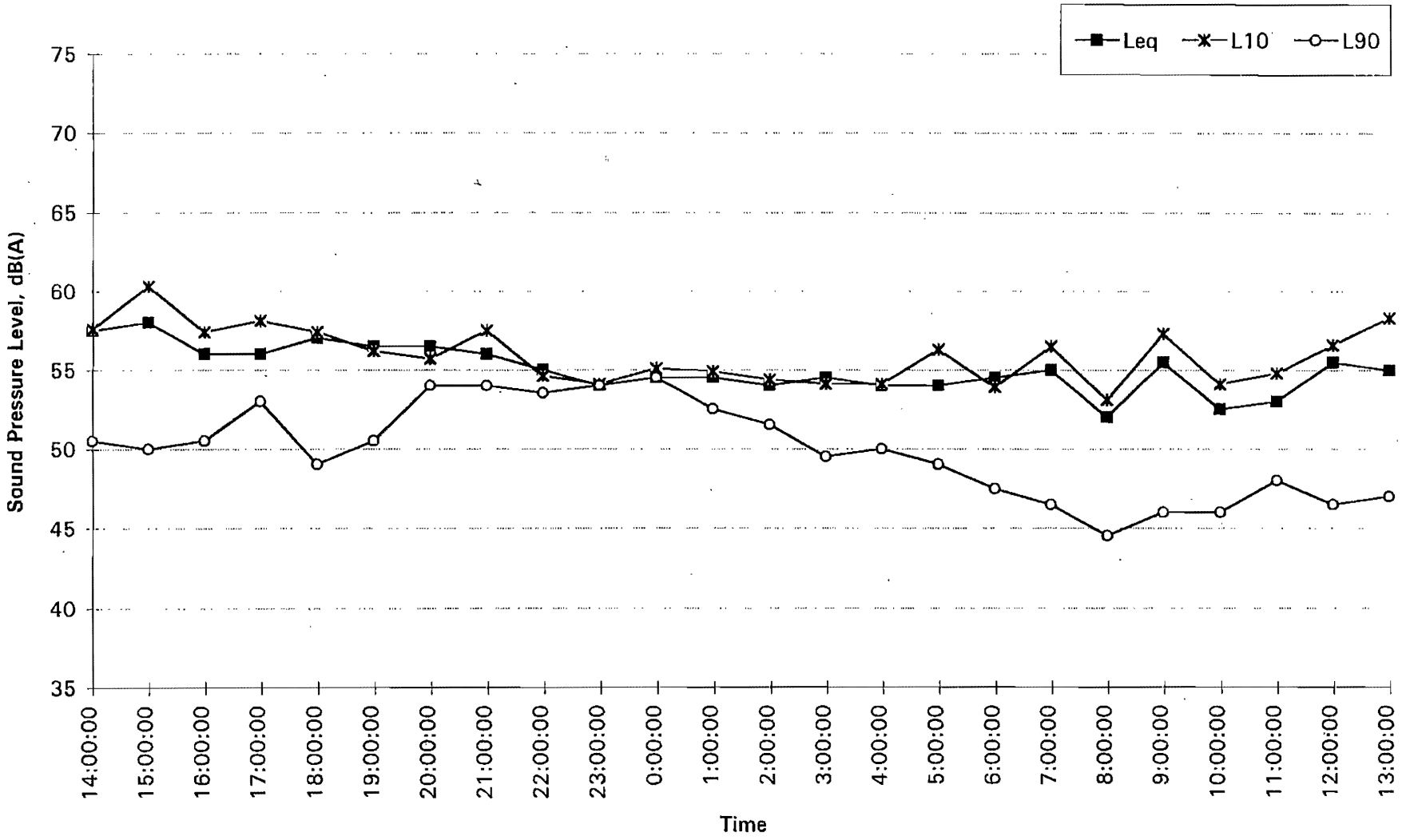


Figure 5.5 Noise Monitoring at NSR 10 (23 August - 24 August 1995)

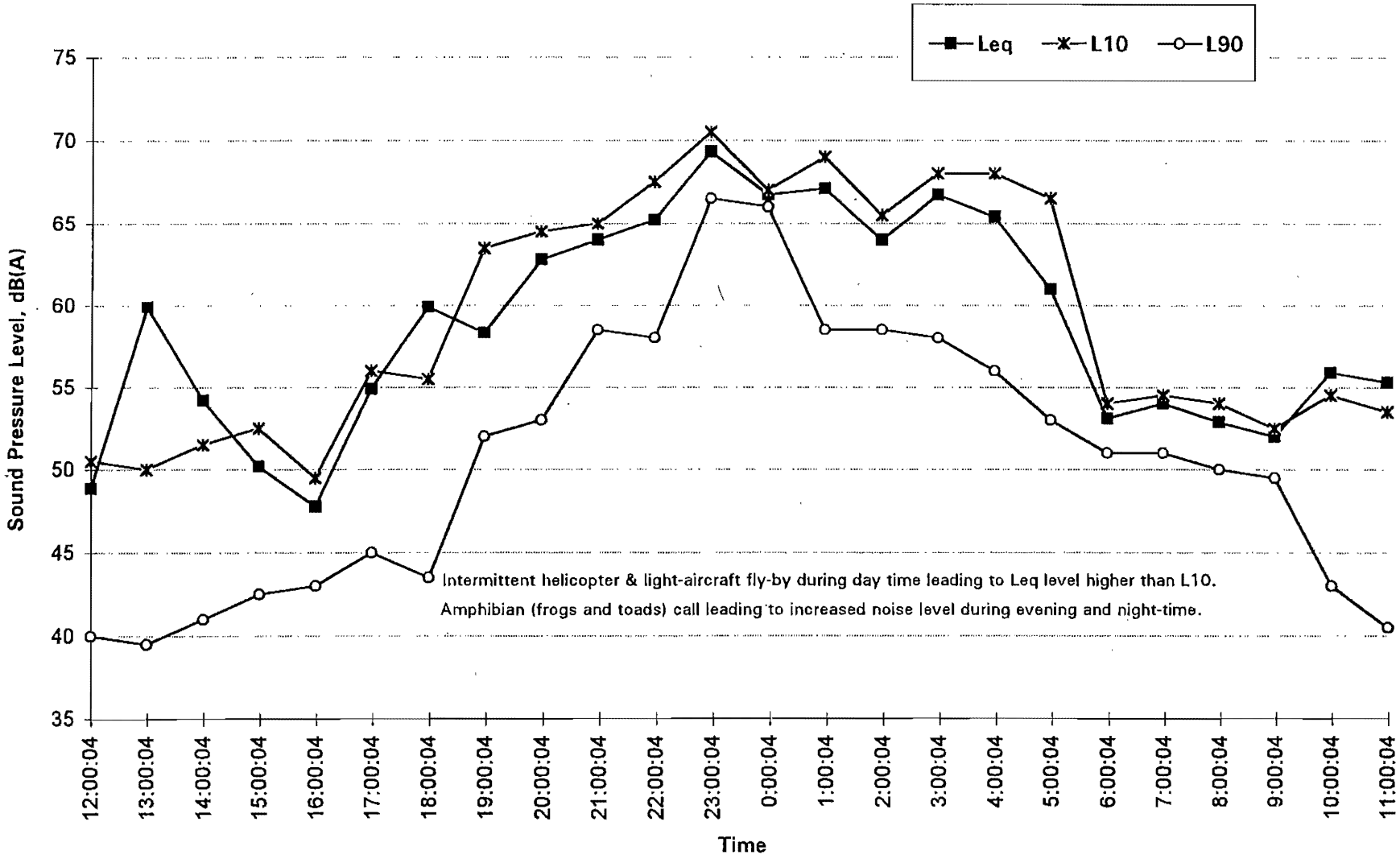


Figure 5.6 Noise Monitoring at NSR 17 (21 August - 22 August 1995)

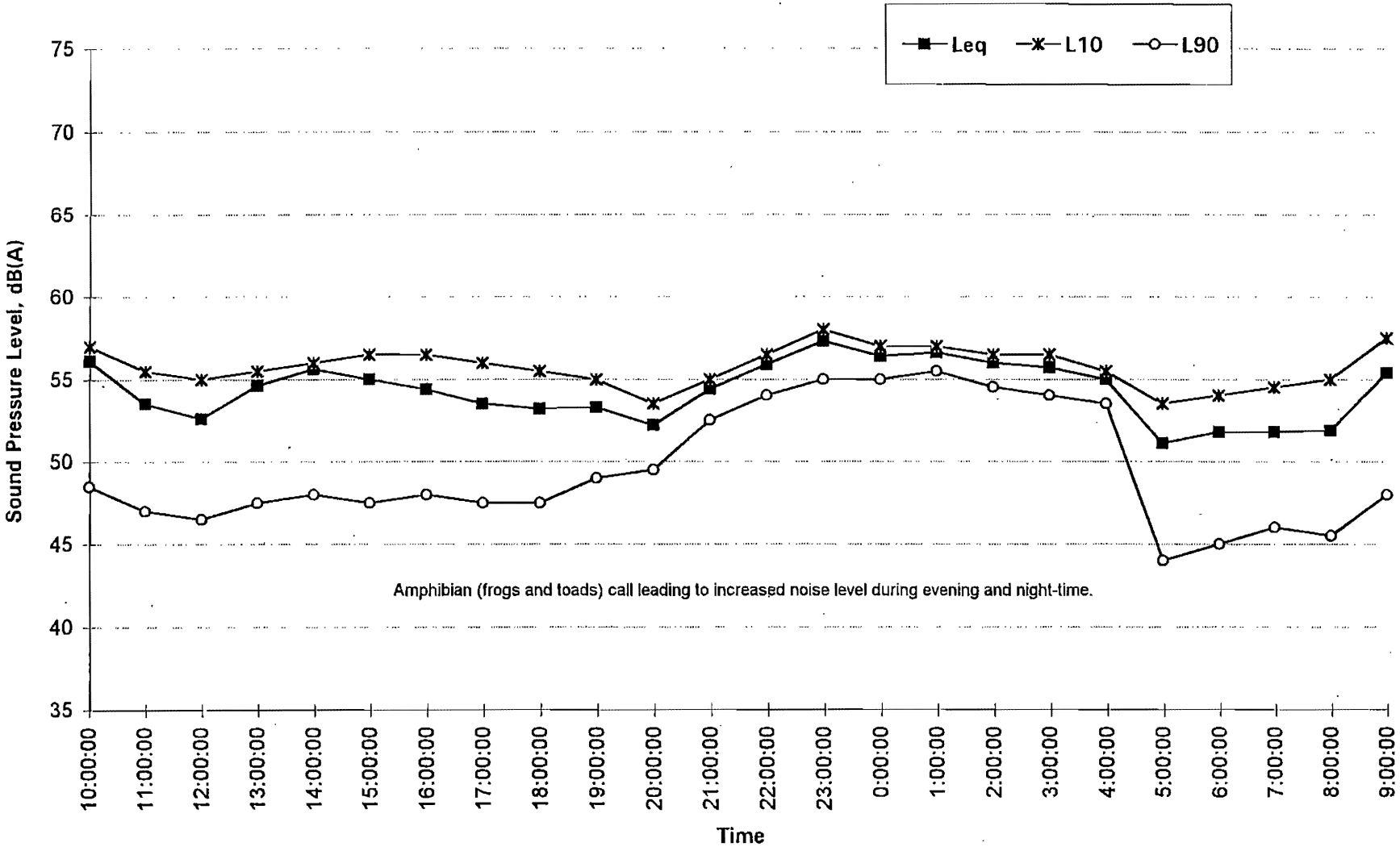
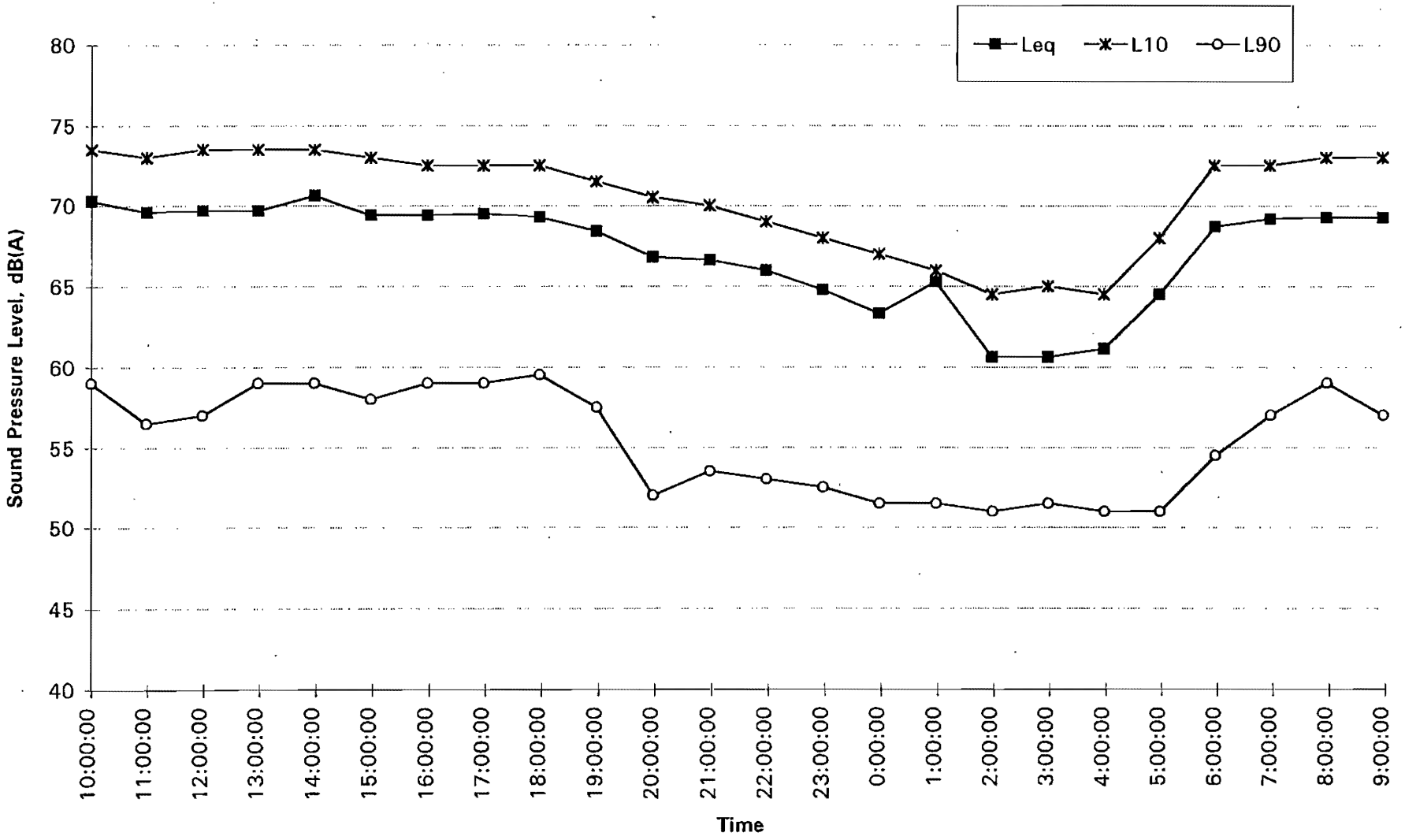
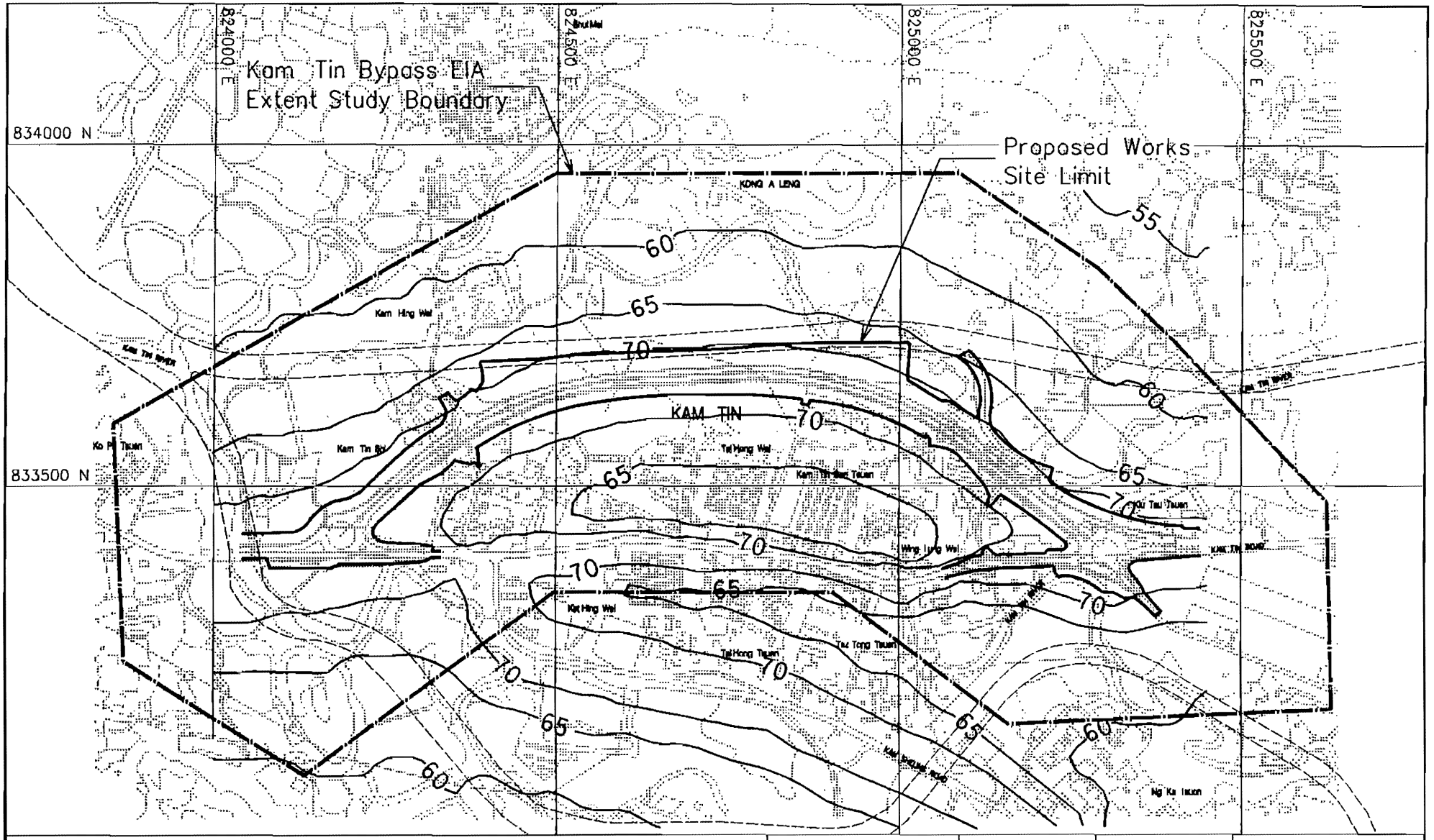
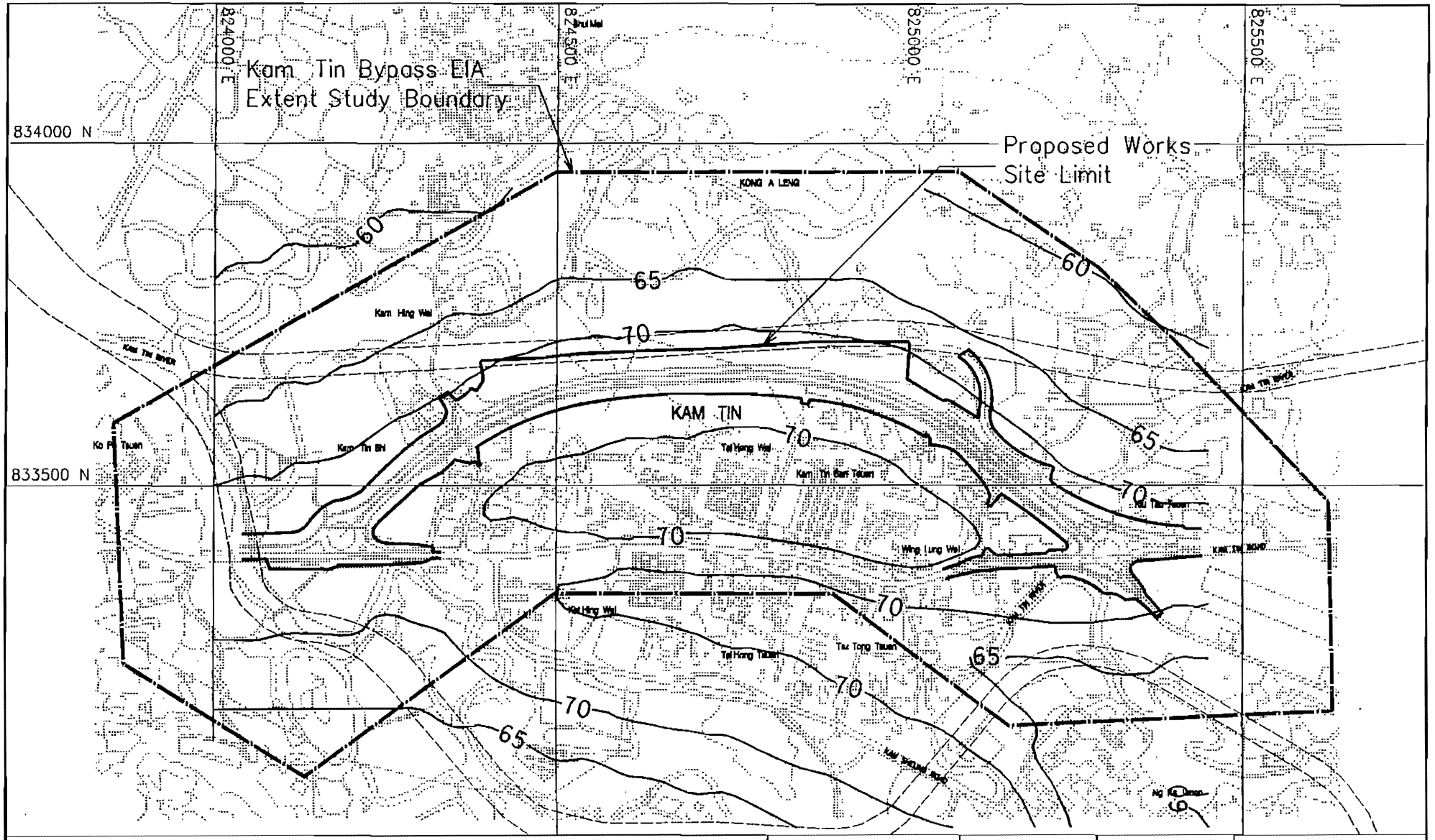


Figure 5.7 Noise Monitoring at NSR 20 (4 September - 5 September 1995)

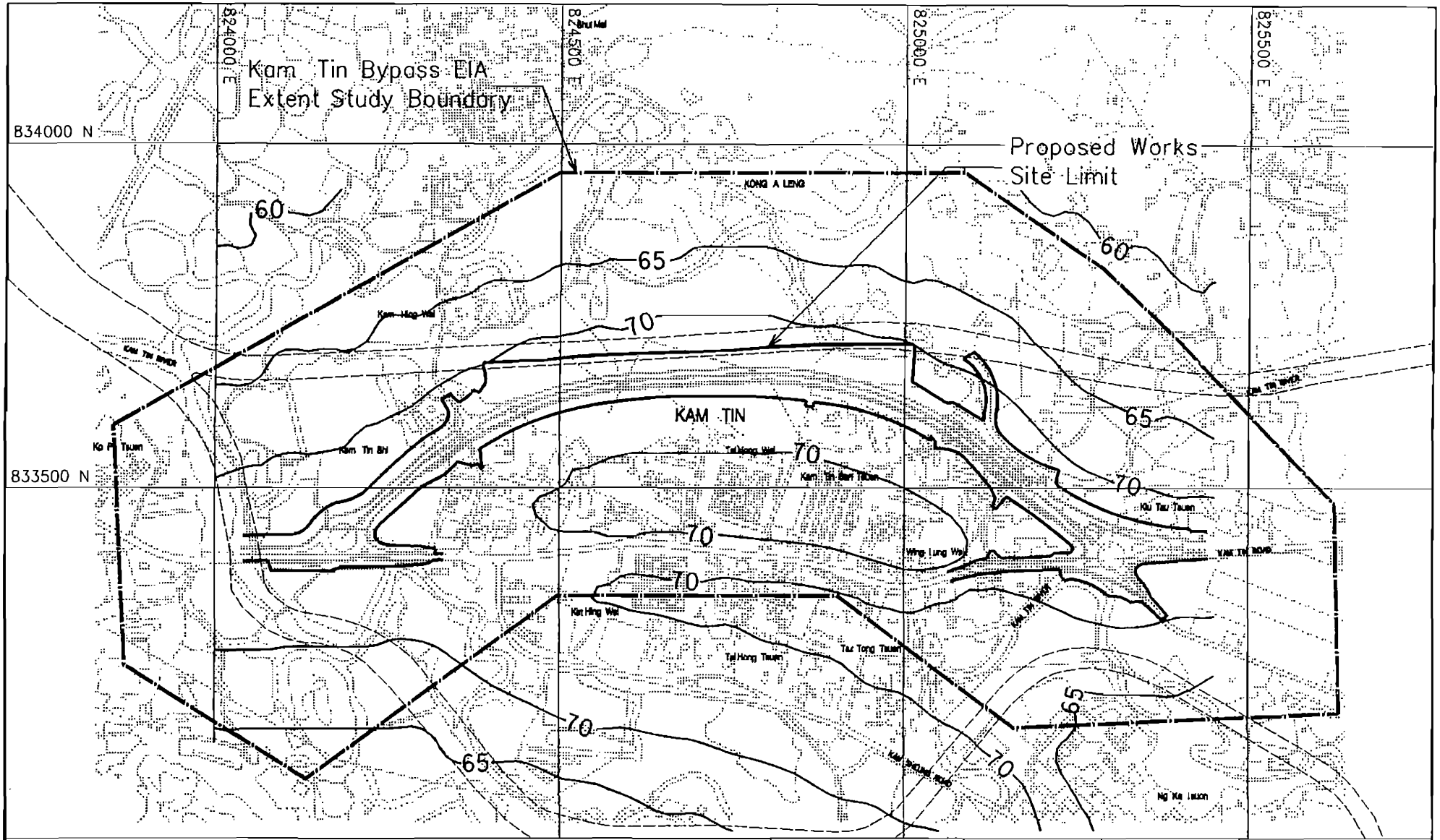




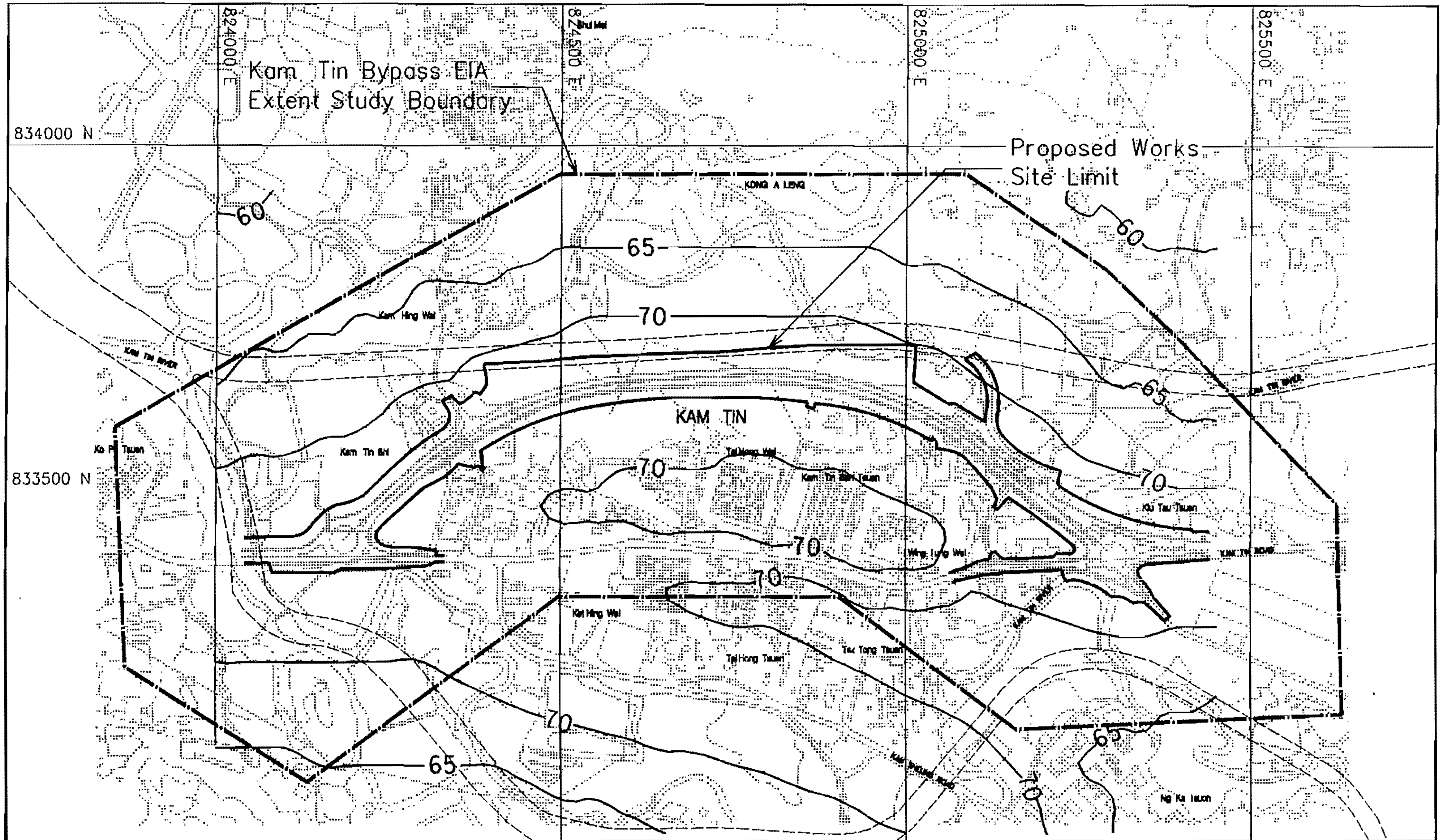
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - Free Field L10 (1~hr) (dB(A)) Noise Contour for Kam Tin Bypass (Ground floor level)	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 5.8



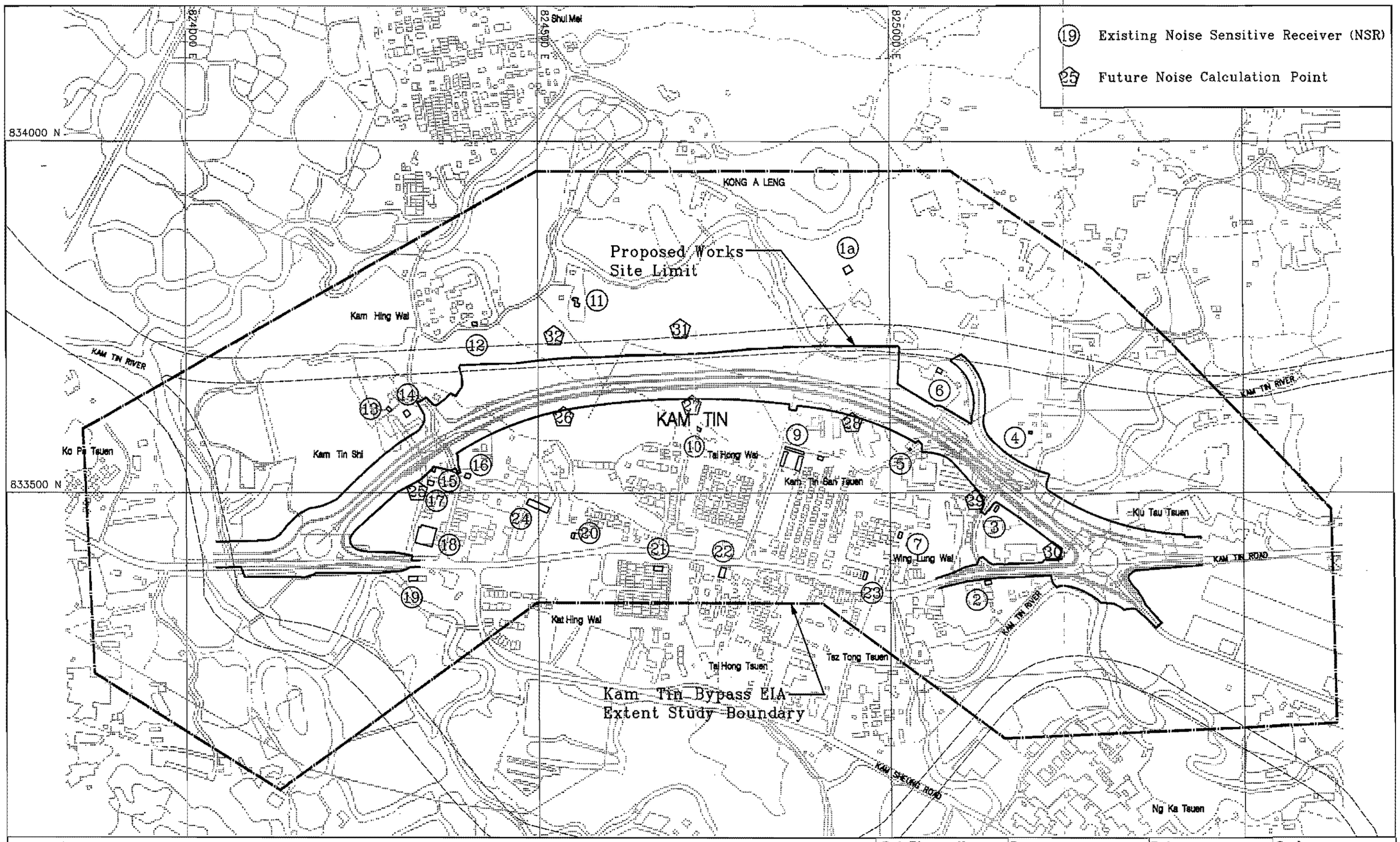
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - Free Field L10 (1-hr) (dB(A)) Noise Contour for Kam Tin Bypass (First floor level)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 5.9



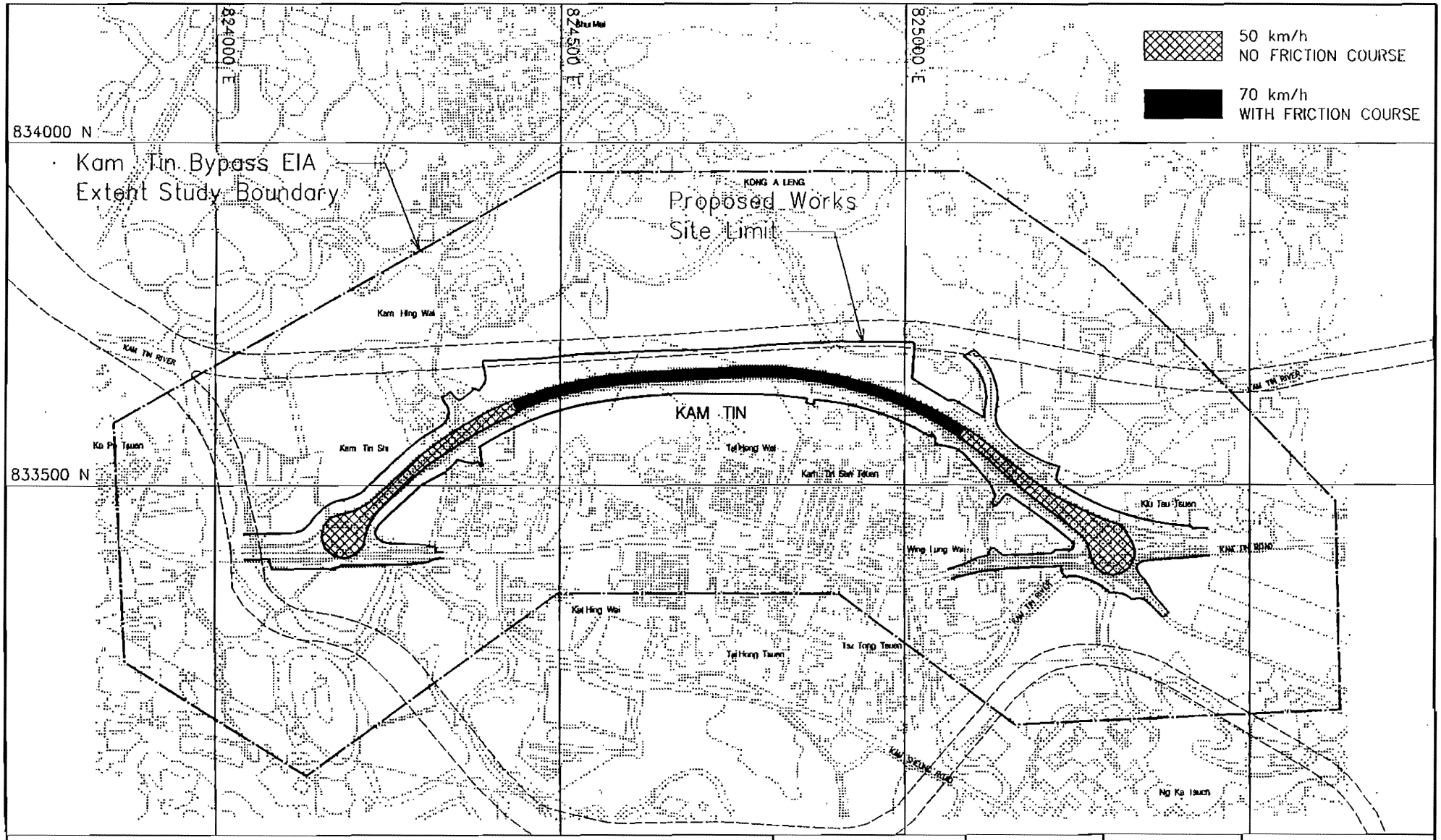
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - Free Field L10 (1~hr) (dB(A)) Noise Contour for Kam Tin Bypass (Second floor level)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 5.10



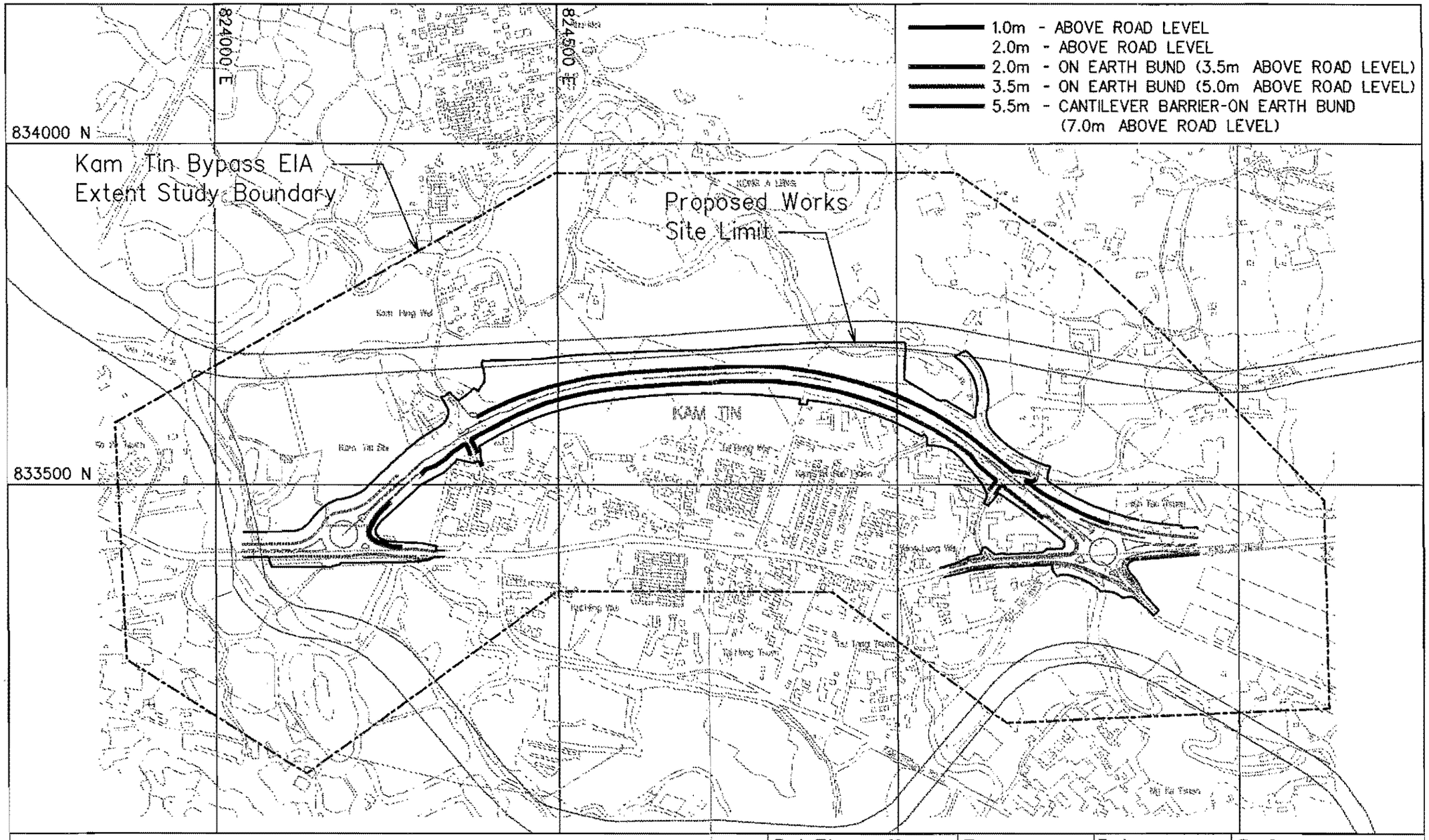
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - Free Field L10 (1~hr) (dB(A)) Noise Contour for Kam Tin Bypass (Third floor level)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 5.11



Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95 / Scale : 1 : 5000
Title : EIA - LOCATION OF EXISTING NSRS AND FUTURE NOISE CALCULATION POINTS	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)		Figure No. 5.12

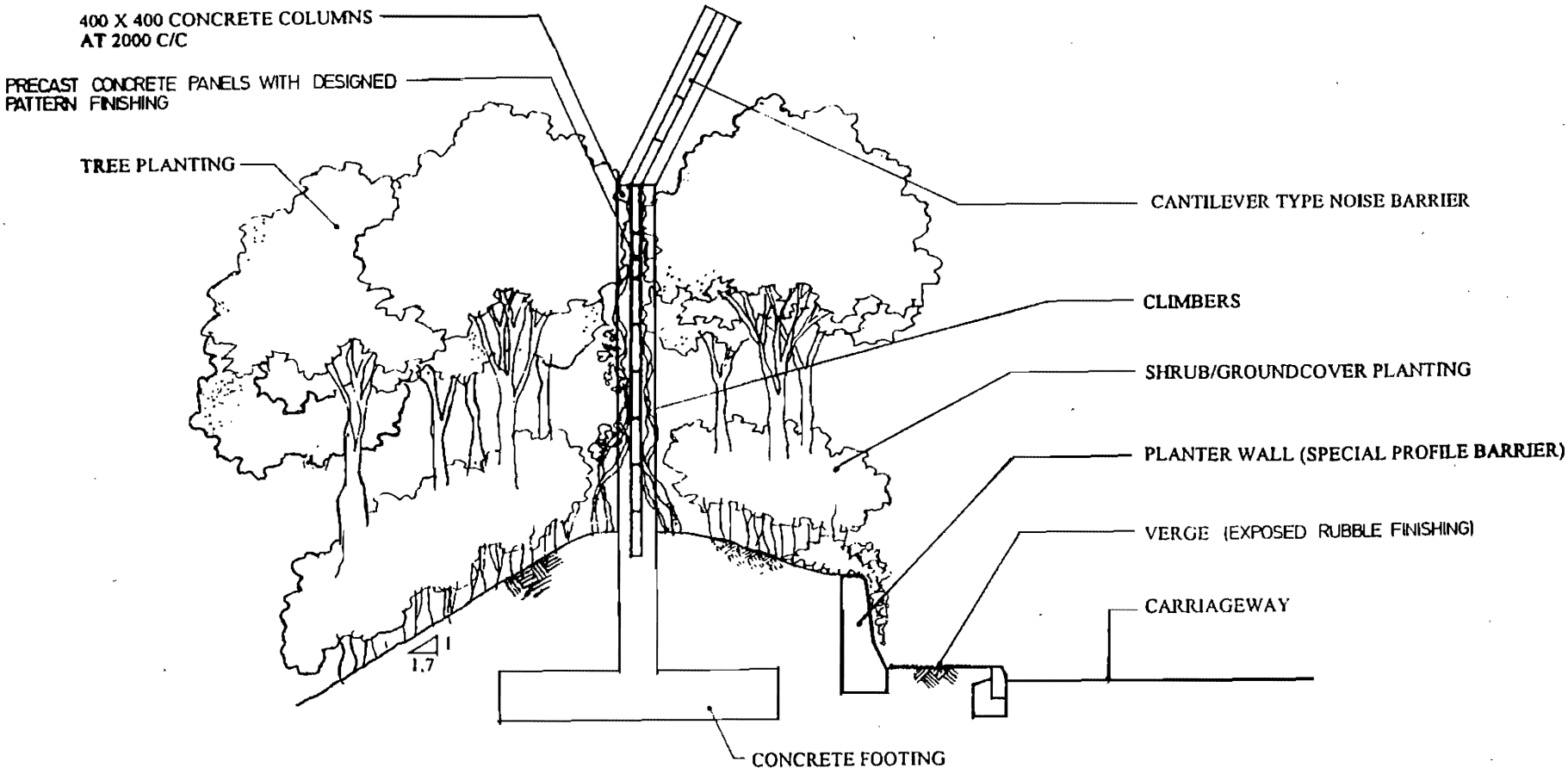


Agreement No. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : NOV. 95	Scale : 1 : 8000
Title : EIA - THE SEGMENTS OF FRICTION COURSE AND SPEEDS ALONG KAM TIN BYPASS	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 5.13



Agreement No. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date :	Scale :
	—	3	JAN. 96	1 : 6000

Title :	Joint Consultants :	Figure No.
EIA - RECOMMENDED BARRIERS TO PROTECT EXISTING AND FUTURE NSRS FROM ROAD TRAFFIC NOISE IN 2011	Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)	5.14



Agreement No. CE 7/94 Kam Tin Bypass	Reference : ACABAS Submission	Rev. 0	Date : JAN. 96	Scale : -
Title : EIA - CANTILEVER TYPE NOISE BARRIER ALONG THE WESTBOUND CARRIAGEWAY	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 5.15

6 AIR QUALITY

Introduction

6.1 This section addresses the air quality impacts due to the construction and operation of the Kam Tin Bypass near Kam Tin. The section also recommends mitigation measures required to ameliorate significant impacts identified to acceptable levels. Only two major sources of air pollutants are likely in the Study Area from the implementation of the facility. These are:

(i) the temporary source of dust generated during site formation works,

(ii) the permanent pollutant sources of traffic emissions due to exhausts from vehicles travelling to, along and from the Kam Tin Bypass as well as vehicle movements on the Kam Tin Road and Kam Sheung Road.

Air Quality Assessment Criteria

6.2 The principal legislation regulating air emissions in Hong Kong is the Air Pollution Control Ordinance (APCO) [Cap 311] of 1983 and its subsidiary regulations. The whole of the Territory has been divided into Air Control Zones. The Study Area falls within the topographically confined Deep Bay Airshed. The Hong Kong Air Quality Objectives (AQO) stipulate maximum acceptable concentration of air pollutants. The AQOs for one, 24 hour and annual concentrations of four major pollutants are shown in Table 6.1.

Table 6.1
Hong Kong Air Quality Objectives (AQOs)

Pollutants	Concentration in Micrograms per Cubic Metre ($\mu g/m^3$)		
	Averaging Time		
	1 hour[1]	24 hour[2,3]	1 year[3]
Nitrogen Dioxide (NO_2)	300	150	80
Sulphur Dioxide (SO_2)	800	350	80
Total Suspended Particulates (TSP)	500[5]	260	80
Respirable Suspended Particulates (RSP)[4]	-	180	55

Notes: Concentrations measured at 298K(25°C) and 101.325 kPa (one atmosphere).

1 One hour criteria not to be exceeded more than 3 times per year.
2 24 hour criteria not to be exceeded more than once per year.
3 Arithmetic means.
4 Respirable suspended particles means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometre (μm) or smaller.
5 Not statutory, but recommended by EPD for assessing construction dust impacts.

Air Sensitive Receivers

6.3 The nearest air sensitive receivers that will be exposed to the construction and operational air impacts from the project are tabulated in Table 6.2. The locations of these are shown in Figure 6.1. These sensitive receivers will be representative of the future residential developments planned for Kam Tin as in some instances they are closer to the curbside than virtually all future development areas. The site boundary of the Kam Tin Bypass is at minimum 20 metres from the nearest curbside, but is often 30 metres or more away. For some sections the site boundary is more than 60 metres away. Kam Tin Bypass is classified as a district distributor. No future air sensitive receivers can be less than 30 metres from the Kam Tin Bypass.

Table 6.2
Representative Air Sensitive Receivers

ASR	General Description	Distance from Kam Tin Bypass Haul Road (m)[1]	Distance from the centre of Kam Tin Bypass (m)	No. of Storeys	Height above Ground Level (mPD)
1*	Kam Kong Kindergarten	105	81	2	7.3
2	House at Kam Tin Road	210	119	3	7.3
3	Village house at 174 Wing Lung Wai	45	30	3	7.0
4	Village house at 38 Wing Lung Wai	85	75	2	6.2
5	Village house at Kam Tin (Shing Mun) San Tsuen	51	39	2	6.0
6	Village house at Kam Tin (Shing Mun) San Tsuen	63	74	2	5.0
7	Village house at 4 Wing Lung Wai	169	147	3	7.0
8	Village house at 85 Kam Tin San Tsuen	107	97	3	5.0
9	Kam Tin Tung Tak Public School	106	94	1	5.0
10	Village house at 12B Tai Hong Wai	87	68	2	6.0
11	Village house at 42 Kam Hing Wai	104	114	3	5.0
12	Village house at 44 Kam Hing Wai	106	121	3	4.5
13	Village house at 35-C4 Kam Hing Wai	60	71	2	5.6
14	Village house at 41 Kam Hing Wai	40	50	3	5.7
15	Village house at Kam Tin Shi	48	25	2	4.5
16	Village house at 51 Kam Tin Shi	100	59	1	5.0
17	Village house at 27A Kam Tin Shi (DD109 Lot 1971)	65	38	3	4.5
18	Kam Tin Mung Yeung Public School	112	81	2	6.2
19	Kam Tin Dragon Kindergarten	170	119	3	6.2
20	Village house at 152 Kat Hing Wai	225	201	2	6.2
21	Village house at 101 Kat Hing Wai	275	263	4	7.5
22	Village house at 43 Tai Hong Tsuen	285	270	3	6.1
23	Village house at 47 Wing Lung Wai	240	222	2	7.2
24	Salvation Army Kam Tin Nursery	185	132	2	6.0
25	Kin Sing Plastic Factory	65	32	1	5.4
26	Market at Tai Hong Wai	225	226	1	6.5

* Currently empty

Note: [1] Measured perpendicularly from the sensitive receiver to the northern boundary of the proposed haul road

Baseline Air Quality

Existing Conditions

6.4 A recent site visit (7 July 1995) identified the presence of industrial activities within the Study Area. These activities included a plastic factory, a toy factory, numerous vehicle repair shops and a few storage plants. There were no visible chimneys nearby.

6.5 No baseline air quality is available for the Study Area. However, a two-week continuous monitoring assessment was carried out at Yuen Long Kau Hui from 4-19 March 1992, measuring nitrogen dioxide (NO_2), sulphur dioxide (SO_2), total suspended particulates (TSP) and respirable suspended particulates (RSP) concentrations[1]. These values have been used as the baseline air quality data for the Study Area. The baseline values are certainly over-estimates for the Kam Tin area as there is much less industrial activity around Kam Tin than in Yuen Long Kau Hui. Table 6.3 summarises the data and shows that the measured values of pollutants are well below the AQOs.

Table 6.3
Maximum Measured Pollutant Concentrations Compared to AQO

Pollutants	Averaging Time	AQO ($\mu g/m^3$)	Maximum Levels ($\mu g/m^3$)
SO_2	1hr 24hr	800 350	84 25
NO_2	1hr 24hr	300 150	81 52
TSP	24hr	260	103
RSP	24hr	180	82

[1] *EIA for Yuen Long Kau Hui Development: Draft Report* (1992) Binnie Consultants Ltd for Territory Development Department

6.6 Because of the rural nature of the project area, the background annual TSP level is not expected to be significant. The background annual TSP level has been approximated to 30 $\mu g/m^3$. Taking 50% of the TSP level as an approximation of the RSP level gives an annual background RSP level of 15 $\mu g/m^3$.

6.7 In the case of rural areas where the pollutant levels are not acute, the one hour average reading and the daily average reading are not substantially and quantitatively different; thus the one hour average can be approximated to the daily average.

Future Conditions

6.8 As the Kam Tin Bypass reaches its peak operational mode, it is expected that the air quality in the vicinity will deteriorate slightly due to vehicle emissions from increased vehicular movements along the road. In addition, large scale construction of concurrent projects such as Main Drainage Channels for Ngau Tam Mei, Yuen Long and Kam Tin especially the section 43CD of the MDC Works, Route 3 (Country Park Section) and the Western Corridor Railway is likely to worsen the air quality within the vicinity of Kam Tin. Accumulative impacts are discussed at the end of Section 2.

Air Quality - Construction Phase

Scenarios

6.9 The worst case scenario has been selected based on the following criteria:

(i) proximity of dusty processes to the sensitive receivers; and
(ii) relatively high dust emission from individual processes in a day.

6.10 The scenario that has been chosen is embankment formation. This construction activity will include: movement of vehicles and fill materials on-site; unloading and compaction of fill materials; stockpiling and wind erosion of the whole exposed area.

6.11 Blasting will not be required. No rock crushing or concrete batching plant will be required on site.

6.12 The location of 'worst case scenario' activities is illustrated in Figure 6.2.

Fugitive Dust Model

6.13 In order to assess the impact of the construction dust emissions on the surrounding area, the Fugitive Dust Model (FDM) has been used. A detailed description of the model is given by the User's Guide[2]. FDM, an atmospheric dispersion model, is specifically designed for the analysis of fugitive dust emissions. The model is based on the widely used Gaussian Plume formulation for estimating pollutant concentrations, but has been adapted to incorporate a gradient-transfer deposition algorithm which accounts for the settling out of dust particles, and to include the wind dependence factor on the dust emission rates.

6.14 Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) impact has been evaluated. The Study Area has been divided into one single 1,500 by 1,000 m domain which fully covers the impacts on all sensitive receivers. The domain has a grid spacing of 50 m. A ground level of 6.0 mPD has been chosen as the level of the contour plot. The assessment has been based on the 1994 sequential meteorological data collected at the Lau Fau Shan Station containing the hourly wind direction, wind speed, stability and temperature. A surface roughness coefficient of 10 cm has been chosen for the rural area.

Dust Sources

6.15 The dust sources associated with the construction activities have been identified as following:

(i) Loading and unloading
(ii) Unpaved roads and haul routes
(iii) Aggregate storage
(iv) Top soil removal
(v) Wind erosion of the whole exposed area

6.16 The dust sources from the disposal of spoil (on-site and off-site), the processes of loading and unloading, as well as traffic movements on unpaved roads have been included. The dust emission rates for the Kam Tin Bypass Works have been calculated, summarised at the Appendix B2 for easy reference and presented below as an illustration.

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[2] *User's Guide for the Fugitive Dust Model (FDM), Revised* Report for Region 10, USEPA, EPA-910/9-88-202R (1990) TRC Environmental Consultants

Loading and unloading

6.17 The dust sources associated with the loading and unloading on site have been considered as area sources. The quantity of particulate emissions generated by a batch drop or continuous drop operation, per ton of material transferred, may be estimated with an emission factor rating of C using the following empirical expression (USEPA, 1994[3]; p. 2.2-3):

$$E=k(0.0016)\frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}(kg/Mg)...(6.1)$$

where:

E = emission factor,
k = particle size multiplier (dimensionless),
U = mean wind speed, m/s, (mph)
M = material moisture content (%),

6.18 Equation (6.1) can be rewritten as following:

$$E'=Q_o U'^{w}.....(6.2)$$

where Q_o is the 'unadjusted' emission factor which does not consider the change of hourly wind speed and direction, U is the hourly wind speed and w is the wind dependent factor. E is the mean value of Es. It is noted that equation (6.2) is a general equation for all emission factors. In equation 6.1, the power of U is 1.3, ie. w is 1.3.

6.19 Using equation (6.1) and (6.2), the emission factors for TSP and RSP can be estimated by the required data listed in Table 6.4.

[3] Draft for proposed fifth revision of *USEPA AP42* (1994) United States Environmental Protection Agency

Table 6.4
Physical Data for Evaluating the Impact of Loading and Unloading

Parameters of Equation (1)	TSP	RSP
Particle Size Multiplier (k)	0.74 (USEPA, 1994: page 13.2.2-3)	0.35 (USEPA, 1994: page 13.2.2-3)
Material Moisture Content (M)	2% (USEPA, 1994: page 13.2.2-3)(1)	2% (USEPA, 1994: page 13.2.2-3)(1)

(1) 2% moisture content is assumed for very dry environment (BCL borehole data is not available at the time of writing this report)

6.20 By the use of equation (6.1), the 'unadjusted' emission factor for TSP becomes:

$$Q_o = 0.74(0.0016)\frac{(\frac{1}{2.2})^{1.3}}{(\frac{2}{2})^{1.4}}(kg/Mg)...(6.3)$$

$$= 4.25\times10^{-4}\ kg/T$$

6.21 The 'unadjusted' emission factor for RSP becomes:

$$Q_o = 0.35(0.0016)\frac{(\frac{1}{2.2})^{1.3}}{(\frac{2}{2})^{1.4}}(kg/Mg)...(6.4)$$

$$= 2.01\times10^{-4} kg/T$$

6.22 The wind dependent factor, w, in this case is 1.3.

6.23 Assuming a density of $1.987\text{x}10^3$ kg/m^3 and 9 hour working day, 24 days a month and 280 days, the material to be shifted per hour is 110.4 T/hr, ie.

$$\frac{140000m^3 x 1.987 x 10^3 kg/m^3}{280x9hr} = 110388.8(kg/hr)...(6.5)$$

6.24 The unadjusted emission rate for TSP is 0.013g/sec,

$$\frac{4.25x10^{-4}kg/Tx110.4T/hr}{3.6}=0.013(g/sec)...(6.6)$$

where 3.6 is the conversion factor for the change of kg/hr to g/sec. The unadjusted emission rate for RSP is 0.006 g/sec.

$$\frac{2.01x10^{-4}kg/Tx110.4T/hr}{3.6}=0.006(g/sec)...(6.7)$$

6.25 An area of 40573 m^2 has been used as the loading area for the Kam Tin site. Consequently, the unadjusted emission rate per unit area can be calculated from equation (6.6) and (6.7) and then substituted into equation (6.2). The emission rate for:

TSP: = 3.21 X 10^{-7} g/s/m^2,
RSP: = 1.52 X 10^{-7} g/s/m^2.

Unpaved road and haul routes

6.26 The top soil and other fill materials at the excavation site will be transported by dump trucks that will cause dust emission when they travel over unpaved roads and haul routes. The emission factor to be used is from AP-42 (USEPA, 1985[4]; equation 1, p 2.1-1) with emission factor rating A:

$$E=k(1.7)(\frac{s}{12})(\frac{S}{48})(\frac{W}{2.7})^{0.7}(\frac{w}{4})^{0.5}(\frac{365-p}{365})(kg/VKT)..(6.8)$$

where E = emission factor
k = particle size multiplier (dimensionless)
s = silt content of road surface material (%)
S = mean vehicle speed, km/hr
W = mean vehicle weight, Mg(ton)
w = mean number of wheels
p = number of days with at least 0.254 mm of precipitation per year
VKT = vehicle kilometre travelled

[4] *Compilation of Air Pollution Emission Factors, Volume 1: Stationary Point and Area Sources (AP/42)* (1985) United States Environmental Protection Agency

6.27 The data for estimating the emission rates of unpaved road and haul routes due to construction are summarized in Table 6.5:

Table 6.5
Physical Data for Evaluating the Impact of Unpaved Road and Haul Road

Parameters	TSP	RSP
Particle size Multiplier (k)	0.8	0.36
Silt content of Road Surface Material (s)	16%*	16%*
Mean Vehicle Speed (S) km/hr	20	20
Mean Vehicle Weight (W) tonnes	24	24
Mean number of Wheels (w) (Nissan Motor Co. and Caterpiller Inc. USA)	10	10
Number of Rainy Days per year (Royal Observatory)	100 days	100 days

* Site Investigation data is not available. Binnie's experience suggests the 16% figure.

6.28 A safe maximum speed of 20 km/h for the vehicles travelling on the dirt roads within the site is suggested. The maximum distance that the dump trucks travel on this site is the dirt road distance which is roughly 3.0 km for a round trip. These doubling distances have been simulated by modelling the line sources twice in the FDM run. The construction supplies have been assumed to be entering the site via the west of Kam Tin Road and leaving the site via east of Kam Tin Road. The dust source due to dump truck traffic on dirt roads is identified as a line source.

6.29 VKT can be expressed as total vehicle movement per hour. Construction vehicle movement per hour has been calculated by dividing the total material to be moved by 7.0 m^3 (this being the mean dump truck capacity). This is the average load carried by the dump trucks planned for the site. The number of vehicle roundtrips per hr is roughly 22 veh/hr, a vehicle rate plus a small number of delivery lorries to carry pipes, batching materials and reinforcement.

6.30 For constructional dust, the wind dependent factor is zero. So the emission factor becomes:

$$E=0.8(1.7)(\frac{16}{12})(\frac{20}{48})(\frac{24}{2.7})^{0.7}(\frac{10}{4})^{0.5}(\frac{365-100}{365})(kg/VKT)..(6.9)$$

ie. E = 4.0 kg/VKT.

6.31 With 22 Veh/hr and kg/VKT in terms of g/m/s by a conversion factor of:

$$(\frac{vehicle/hour}{3.6x1000}),$$

the emission rate for TSP is:

$$(\frac{4.0}{3.6x1000})x22=0.024g/m/s..(6.10)$$

6.32 For RSP, the emission rate is 0.011 g/m/s.

6.33 A single category of particle size for unpaved roads (namely the particles less than 30 microns), is likely to underestimate the TSP impact. A more realistic particle size distribution for haul roads (SENES, 1992[5]; Table 6.1) has been used for the FDM as given below in Table 6.6:

[5] *Proposed Vertical Expansion of West Edmonton Landfill and Recycle Facility, Assessment of Air Quality and Noise Impacts, Reference Document* (1992) Senes Consultants Ltd for WMI Waste Management of Canada Inc

Table 6.6
Particle Size Distribution

Particle mass mean diameter (μm)	Haul Roads Dust Distribution %
0.6	0.0
1.5	7.5
5.1	8.5
5.6	11.5
8.6	8.5
15.5	28.0
31.1	23.0
55.3	9.0
85.9	4.0

Aggregate Storage

6.34 For emissions from wind erosion of active storage piles, the emission rate for TSP is from AP-42 (USEPA 1985, equation 3, p 2.3-5) with rating C for sand and gravel material:

$$E=1.9(\frac{s}{1.5})(\frac{f}{15})(\frac{365-p}{235})(kg/day/hectare)..(6.11)$$

where E = emission rate
s = silt content of aggregate (%)
f = percent of time that wind speed exceeds 5.4 m/s at mean pile height
p = number of days with at least 0.254 mm of precipitation per year

6.35 The parameter f requires some modification. Royal Observatory (RO) measures the wind speed at a height of 10 metres above ground level. In case of heights of less than 10 metres, a log wind profile (Roland, 1988[6], p. 666) can be used to estimate the wind speed at the pile height (Appendix B1). The ratio between the wind speed at 10 metres and that at pile height is the conversion factor that converts the percentage provided by RO to the percentage at pile height. For an example, at a pile height of 5 m, the conversion factor is 83%. Given the RO percentage of 11.44% that wind speed exceeds 5.4 m/s at mean pile height, the percentage at pile height is thus 11.44% x 0.83 = 7.0 %.

6.36 With this 7.0 % percentage and 1.6 % silt content of aggregate, based on Table 11.2.3-1 in AP-42 (mean value for stone processing), the emission rate is 1.06 kg/day/hectare,

$$E=1.9(\frac{1.6}{1.5})(\frac{7}{15})(\frac{365-100}{235})=1.06(kg/day/hectare)..(6.12)$$

Given 1 hectare = 10^4 m^2, the emission rate is for TSP = 1.2 E-6 g/s/m^2.

6.37 Since there is no specified emission rate for RSP given in AP-42, 50% TSP is assumed as the emission for RSP. Thus, the emission rate is for RSP = 0.6 E-6 g/s/m^2. The stockpiles are illustrated on Figure 6.2.

Top soil removal

6.38 The emission factor for top soil removal is 0.02 kg/Mg (USEPA 1985, Table 11.24-4). For example, the surface area of site area is 10000.m^2. Assuming the depth of top soil to be 0.2 metre, the volume of top soil is 2000 m^3. Assuming the relative density of topsoil is 1.987 x 10^3 kg/ m^3, then the mass of the soil removed is given by:

$$Mass(T)=(\frac{2000X1987}{1000})=3974.0(T)..(6.14)$$

6.39 The time required is 150 days (from the end of July 1997 to the end of February 1998). So the rate of removal is:

$$(\frac{3974.0}{150X9})=2.94(T/hr)..(6.15)$$

[6] *An Introduction to Boundary Layer Meteorology* (1988) B S Roland, Kluwer Academic Publishers

6.40 The TSP emission rate is:

$$0.02 \text{ kg/T} \times 2.94 \text{ T/hr} = 0.016 \text{ g/s}$$

6.41 The emission rates per unit area at site are:

TSP : 1.64E-6 g/s/m^2
RSP : 8.18E-7 g/s/m^2.

Wind erosion of the whole exposed area

6.42 The TSP emission factor of wind erosion of exposed areas (USEPA, 1985; Table 24-4) is 0.85 Mg/hectare/yr. Given that 1 hectare = 10^4 m^2, the emission rate for TSP becomes:

$$\frac{0.85x1000}{10^4x365x24x3.6} = 2.69E\text{-}6g/s/m^2 \quad .....(6.16)$$

6.43 Since the emission rate of RSP is not available in AP-42, 50 % of TSP is assumed to be the emission rate of RSP. Thus the emission rate of wind erosion of the whole exposed area:

for RSP = 1.34 x 10^{-6} g/s/m^2.

6.44 All the emission rates calculated are summarized in Appendix B2 for easy reference.

Model Results

6.45 The predicted maximum (unmitigated and mitigated) annual, 24hr and 1hr average dust levels at individual sensitive receivers obtained for TSP and RSP are discussed below. It is noted that all the tabulated results and contour figures have included the baseline dust levels. FDM assumes a flat terrain. Figures and Tables referred to are presented at the end of this section.

6.46 During site formation (the worst case scenario), the loading and unloading activities, stockpiling and the use of the haul roads area have been assumed to take place concurrently. Tables 6.7 and 6.8 show that dust due to truck movements on the dirt roads on the site constitutes the highest dust concentrations. Other dust sources including loading and unloading, stockpiling, wind erosion and top soil removal generate a minor dust concentration. The cumulative hourly impacts including all the dust sources plus the background dust level shows that the predicted concentration levels at all sensitive receivers exceed the AQO. SR4, SR6, SR13 and SR14 register the highest dust levels due to their proximity to the project area.

6.47 The dust impacts due to truck movements over the dirt road are probably very conservative for this assessment. During the construction of the road embankment, it has been assumed that all trucks will travel the whole section of the unpaved haul road. In fact, it is likely that the trucks may only travel on part of the unpaved haul road. Therefore, the realistic dust levels at the sensitive receivers would register dust levels that are much less than has been presented in Table 6.7 and Table 6.8.

6.48 In addition, the dust impacts caused by the activities of the unloading of fill materials, the removal of top soil, stockpiling and wind erosion of the whole exposed area is not significant because there are no large scale excavations and the volume of material handled is also relatively small. In fact, only 140,000 m^3 of fill material is required for construction of the road embankment. There is 2,000 m^3 of material to be excavated, and since a very large proportion of excavated material is expected to be unsuitable for reuse, the volume of stockpiled materials will be very small (2,000 m^3 or less). Thus the impact due to these activities is very minor.

6.49 Figures 6.3 to 6.7 illustrate the dust isopleths on Kam Tin at ground level where villages are clustered. The dominant northeasterly wind (see Figure 6.13, showing the wind rose for Lau Fau Shan station) will not decrease the dust concentrations in this area because of the low dispersion potential of the Deep Bay Airshed.

6.50 The haul road will constitute the greatest dust generation. It is shown that watering twice a day can reduce the haul road dust emission rate by half, thereby lowering dust level concentrations by 50% (Jutze et al, 1974[7]). For a very dry day (or worst dust situation), it is recommended that watering should be conducted as often as possible. Experience shows that if watering is done at least once every three hours during the day, it is possible to attain invisible dust emission levels. It is thus interpolated that the emission rate associated with the dirt road would be dramatically reduced (95% is assumed) if the watering on the dirt road is conducted as often as possible. Sufficient haul road watering would ensure that the AQO can be met at all sensitive receivers including public and private schools (SR1, SR9, SR18, SR19, SR24) as shown in Table 6.9, Table 6.10 as well as Figures 6.8 to 6.12.

[7] *Investigation of Fugitive Dust - Sources, Emissions and Control* Pub. No. EPA-450/3-74-046a (1974) G A Jutze, K Aetell Jr and W Parker, United States Environmental Protection Agency

Mitigation Measures - Construction Phase

6.51 The construction of Kam Tin Bypass is not expected to cause any significant dust impact in relation to the AQO standard, providing that the following good site practices are fully implemented. The recommendations are presented in the form of contractual clauses.

6.52 The Contractor shall implement dust suppression measures which shall include, but not be limited to the following:

(i) Watering of unpaved areas, access roads, construction areas and dusty stockpiles shall be undertaken at least twice daily during dry and windy weather. Watering of the haul road shall be undertaken four times daily during dry or windy weather. Water sprays may be either fixed or mobile to allow individual areas to be wetted as and when required.

(ii) Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate, and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.

(iii) Stockpiles of sand, aggregate or any other dusty materials greater than 20 m^3 shall be enclosed on three sides, with walls extending above the pile and 2 metres beyond the front of the pile.

(iv) Suitable chemical wetting agents shall be used, where appropriate, on completed cuts and fills to reduce wind erosion.

(v) Areas within the Site where there is a regular movement of vehicles shall have an approved hard surface and be kept clear of loose surface material.

(vi) Should a conveyor system be used, the Contractor shall implement the following precautionary measures. Conveyor belts shall be fitted with windboards. Conveyor transfer points and hopper discharge areas shall be enclosed to minimize dust emission. All conveyors under the Contractor's control, and carrying materials which have the potential to create dust, shall be totally enclosed and fitted with belt cleaners.

(vii) Where dusty materials are being discharged to vehicles from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented to a suitable fabric filter system.

(viii) The Contractor shall restrict all motorized vehicles within the Site, excluding those on public roads, to a maximum speed of 20 km per hour and confine haulage and delivery vehicles to designated roadways inside the Site.

(ix) Construction working areas will be restricted to a minimum practicable size.

(x) The Contractor shall ensure that no earth, rock or debris is deposited on public or private rights of way as a result of his activities, including any deposits arising from the movement of plant or vehicles.

(xi) The Contractor shall provide a wheel washing facility at the exits from works areas to the satisfaction of the Engineer and to the requirements of the Commissioner of Police. Water in wheel washing facilities shall be changed at frequent intervals and sediments shall be removed regularly.

(xii) In the event of any spoil or debris from construction works being deposited on adjacent land, or streambed, or any silt being washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Engineer.

(xiii) If spoil cannot be immediately transported out of the Site, stockpiles should be stored in sheltered areas.

(xiv) Plant and vehicles shall be regularly inspected to ensure that they are operating efficiently and that exhaust emissions are not causing a nuisance. All Site vehicle exhausts should be directed vertically upwards or directed away from ground.

Air Quality - Operational Phase

Vehicular Emissions (NO_2 and RSP) Impacts

6.53 The major source of air pollution is the vehicular emissions from traffic on Kam Tin Bypass and Kam Sheung Road. The impacts from the other access roads are minor. The traffic air pollution is mainly NO_2 and RSP. Only maximum hourly concentrations of NO_2 and RSP need assessment to check compliance with the AQO. These have been predicted using CALINE4.

6.54 The assessment has been based on 2011 traffic flows which are predicted by Wilbur Smith Associates. In addition to the percentage of heavy goods vehicles provided, a detailed breakdown of other types of vehicles is also given in terms of the percentage of passenger cars, taxis, public light buses, school buses, light goods vehicles and medium goods vehicles. The traffic flows and traffic mix are shown in Appendix B3.

6.55 Only passenger cars have been assumed to use petrol while the other vehicles have been assumed to be diesel powered. Gases have been assumed to be inertial, and concentrations of NO_2 have been taken as 20 percent of the total NO_X concentration. The assumed vehicular emissions factor for pollutants such as particulates and NO_2 in 2011 are supplied by the Vehicle Emission Control Section of EPD. These factors originated from the USEPA MOBILE IV program.

6.56 Worst-case meteorological conditions have been assumed:

Wind speed	1 m/s
Wind direction	(worst case for individual receiver)
Stability Class	D

Vehicle Emissions: Impact Assessment

6.57 The traffic impact assessment shows that the majority of heavy goods vehicles will flow along Kam Tin Bypass (22.8%) and Kam Sheung Road (12.9%) with a minority entering and leaving the Kam Tin Road.

6.58 Peak-hour average pollution contours (including background NO_2 and RSP concentrations) at pedestrian level are shown in Figures 6.14 and 6.15. The concentrations at the twenty-six air sensitive receivers are shown in Table 6.11.

Table 6.11
RSP and NO_2 Concentrations at the Pedestrian Level

Air Sensitive Receivers	Concentration in Micrograms per Cubic Metre ($\mu g/m^3$)	
	NO_2	RSP
	1hr[a]	1hr[b]
SR1	114.8	99.9
SR2	126.1	104.9
SR3	118.6	102.1
SR4	107.3	97.1
SR5	114.8	100.0
SR6	111.0	97.5
SR7	99.8	91.7
SR8	99.8	91.5
SR9	96.0	90.8
SR10	96.0	90.5
SR11	103.5	94.5
SR12	103.5	93.6
SR13	111.0	98.6
SR14	118.6	101.2
SR15	133.6	110.4
SR16	111.0	98.9
SR17	126.1	106.3
SR18	122.3	103.1
SR19	133.6	109.6
SR20	107.3	95.7
SR21	107.3	95.1
SR22	122.3	103.9
SR23	103.5	93.4
SR24	103.5	94.3
SR25	107.3	96.9
SR26	103.5	93.6

Notes: a Background 81 $\mu g/m^3$ is included
b Background 82 $\mu g/m^3$ is included

6.59 Table 6.11 as well as Figure 6.14 and Figure 6.15 show that maximum cumulative concentrations of NO_2 at the twenty-six sensitive receivers and the area within the vicinity of the project area remain significantly under the hourly AQO maximum of 300 $\mu g/m^3$.

6.60 There is no hourly AQO maximum for RSP against which the findings shown in Figure 6.11 can be compared. It is notable that the peak hour RSP concentrations are well below the 24-hour RSP maximum concentration in the AQO (Table 6.11) and thus meet the 24-hour criteria. The highest concentrations predicted occur to the west of the western roundabout along Kam Tin Road. These hourly RSP concentrations approach the 24-hour RSP standards in this area (Figure 6.14). The area surrounding the western roundabout and to the north and south of this section of Kam Tin Road are zoned as AGR or O (i.e. agricultural purposes or open space). All future air sensitive receivers in the study area (Figure 2.3) will have predicted air quality levels well below the AQO. No buffer distance from the boundary of Kam Tin Bypass is necessary. There are no air quality constraints to development in the area.

Impact of Noise Barriers on Air Quality

6.61 As detailed in Section 5: Noise, without appropriate noise mitigation, traffic levels on the Bypass are high enough to generate road traffic noise levels in 2011 higher than the standards recommended in the HKPSG. In order to fully protect both existing and future noise sensitive receivers, it will be necessary to build extensive noise barriers on both sides of the Bypass.

6.62 Assuming flat ground, CALINE4 shows that the air quality during the operation of Kam Tin Bypass will not exceed the AQO standard. Although a 1.5 m high earth bund and extensive acoustic barriers are proposed to be built both on the earth bund and to the north of the Bypass, it is not anticipated that these barriers would cause adverse air quality impacts to the air sensitive receivers.

6.63 Topographical effect does have an influence on the flow pattern, thereby impacting the air quality. This is because eddies are likely to be generated at the bottom of the earth bund, depending on the stability of the atmosphere and the strength of wind[8,9]. In physical terms, for strong winds and neutral stability (ie. Froude number[10] approaches infinity) near the top of the earth bund, the streamlines which represent the flow pattern are packed together, causing a speed up of the wind. Immediately downwind of the bund in a strong wind (greater than 11.0 m/s) situation, there is often found a cavity (eddies) associated with boundary layer separation[11]. These eddies are the convergent zones where air pollutants will be potentially accumulated or trapped.

6.64 The Wind Rose from Lau Fau Shan station shows the dominant easterly wind. Based on the information from Royal Observatory, the occurrence of eddy generation is rare because only 0.5% of wind in a year is classified as strong wind (greater than 11.0 m/s) in this area. Thus, it is not expected that deterioration of air quality at the sensitive receivers would result from these noise barriers.

Mitigation Measures - Operational Phase

6.65 The cumulative impacts for RSP and NO_2 are mainly generated from vehicular emissions and have been assessed to be below the AQO.

6.66 Pollution levels due to vehicular traffic are expected to be acceptable, and no mitigation measures are considered necessary to reduce their impact.

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[8] *An Introduction to Boundary Layer Meteorology* (1988) BS Roland, Kluwer Academic Publishers.

[9] *Handbook of Air Pollution Technology, Chapter 34 Atmospheric Dispersion* (1984) S Calvert and H M England.

[10] In simple terms, Froude number can be interpreted as a ratio between the depth of the column that the wind flows from the hill and the height of the hill.

[11] *Separation features of boundary-layer flow over valleys.* Boun. layer Meteor., 40 (1987) pp 295-308 F Tampieri.

Summary

6.67 The Air Quality Assessment has addressed two sources of emissions: road traffic (RSP and NO_2 emissions) and dust due to construction. The assessment concludes the following:

(i) Dust associated with the disposal of spoil for on-site and off-site impacts is minor. However, the transportation of the spoil materials and construction materials associated with the traffic movements on haul roads generate the worse unmitigated dust levels.

(ii) If good site practice is maintained, particularly regular watering of haul roads, airborne dust levels can be held well within the AQOs. Watering may need to be increased to four times a day during dry conditions and periods of heavy haul road usage.

(iii) Neither of the two emission types (NO_2 and RSP emissions) produces an unacceptable impact on the sensitive receivers within the vicinity of the Study Area. The AQOs are not likely to be exceeded.

(iv) Construction of the noise barriers is not expected to lead to deterioration of air quality at the sensitive receivers.

Table 6.7
Predicted Maximum Hourly, Daily and Yearly TSP Concentrations ($\mu g/m^3$) - Unmitigated

Air SR	Total Hourly Impacts - (except unpaved roads) - (1)	Trucks Movements over Unpaved Roads (hourly impacts)	Total Hourly Impacts - (2)	Cumulative Hourly Impacts - (3) Total Hourly Impacts + background) - (4)	Cumulative Daily Impacts - (5) Total Daily Impacts + background) - (4)	Cumulative Yearly Impacts - (6) Total Yearly Impacts + background) - (7)
1	17.02	1535.24	1552.26	1655.26	894.69	283.96
2	10.63	1144.12	1154.75	1257.75	795.50	258.15
3	19.26	2425.20	2444.46	2547.46	1504.76	660.04
4	11.79	4373.65	4385.44	4488.44	916.94	187.09
5	15.61	2533.41	2549.02	2652.02	1432.53	663.83
6	14.11	3664.23	3678.34	3781.34	1149.79	245.25
7	6.63	1083.05	1089.68	1192.68	744.62	294.63
8	9.49	1463.45	1472.95	1575.95	972.95	427.35
9	9.31	1489.49	1498.79	1601.79	979.52	426.18
10	12.13	1700.43	1712.57	1815.57	1104.38	455.13
11	10.63	2945.93	2956.57	3059.57	1286.40	306.96
12	10.57	2823.87	2834.43	2937.43	1260.93	326.92
13	14.82	4212.85	4227.67	4330.67	1511.24	621.54
14	18.40	5714.50	5732.90	5835.90	1917.72	848.74
15	20.97	2961.66	2982.63	3085.63	1779.98	581.39
16	14.66	1832.70	1847.36	1950.36	1226.92	424.76
17	18.21	2479.01	2497.22	2600.22	1512.11	493.02
18	13.75	1439.83	1453.58	1556.58	945.14	291.88
19	11.96	1160.98	1172.94	1275.94	789.69	226.78
20	4.72	951.84	956.56	1059.56	689.49	227.21
21	3.15	716.00	719.14	822.14	569.05	187.32
22	2.95	755.37	758.31	861.31	587.69	197.31
23	4.51	846.06	850.57	953.57	631.73	215.29
24	7.22	1278.24	1285.46	1388.46	842.23	285.53
25	20.71	2229.15	2249.86	2352.86	1449.29	548.69
26	3.41	816.09	819.50	922.50	623.43	218.06

Note :
(1) Total hourly impact included emissions due to loading & unloading, top soil removal, wind erosion and stockpiling.
(2) Total hourly impact is the sum of all hourly impacts including unpaved roads.
(3) Cumulative hourly impact is the sum of the total hourly impact and the background TSP level.
(4) The background TSP level is taken to be 103 $\mu g/m^3$ for both hourly and daily TSP impacts.
(5) Cumulative daily impact is the sum of the total daily impact and the background TSP level.
(6) Cumulative yearly impact is the sum of the total yearly impact and the background TSP level.
(7) The background TSP level is taken to be 30 $\mu g/m^3$ for yearly TSP impacts.

Table 6.8
Predicted Maximum Daily and Yearly RSP Concentration ($\mu g/m^3$) - Unmitigated

Air SR	Total Daily Impacts - (except unpaved roads) - (1)	Trucks Movements over Unpaved Roads (daily impacts)	Total Daily Impacts - (2)	Cumulative Daily Impacts - (3) Total Daily Impacts + background) - (4)	Cumulative Yearly Impacts - (5) Total Yearly Impacts + background) - (6)
1	4.11	353.27	357.38	439.38	129.65
2	2.97	309.57	312.54	394.54	117.98
3	3.97	628.52	632.49	714.49	299.25
4	2.65	364.64	367.28	449.28	85.88
5	3.55	596.33	599.89	681.89	300.95
6	2.67	469.62	472.29	554.29	112.11
7	1.91	287.60	289.51	371.51	134.41
8	2.70	389.86	392.56	474.56	194.28
9	2.63	392.89	395.51	477.51	193.75
10	3.77	448.16	451.93	533.93	206.84
11	2.65	531.26	533.91	615.91	139.95
12	2.70	519.73	522.43	604.43	148.96
13	3.57	631.81	635.38	717.38	281.88
14	3.96	814.77	818.73	900.73	384.36
15	3.99	752.63	756.62	838.62	263.79
16	3.25	503.90	507.14	589.14	193.13
17	3.70	632.09	635.79	717.79	223.92
18	2.56	377.43	379.99	461.99	133.16
19	2.55	307.32	309.88	391.88	103.79
20	1.34	263.27	264.61	346.61	103.98
21	0.99	209.27	210.26	292.26	85.98
22	1.00	217.67	218.67	300.67	90.48
23	1.31	237.24	238.55	320.55	98.60
24	2.00	331.55	333.55	415.55	130.29
25	4.70	602.86	607.56	689.56	249.06
26	1.16	233.64	234.80	316.80	99.85

Note :
(1) Total daily impact included emissions due to loading & unloading, top soil removal, wind erosion and stockpiling.
(2) Total daily impact is the sum of all daily impacts including unpaved roads.
(3) Cumulative daily impact is the sum of the total daily impact and the background RSP level.
(4) The background RSP level is taken to be 82 $\mu g/m^3$ for daily RSP impacts.
(5) Cumulative yearly impact is the sum of the total yearly impact and the background RSP level.
(6) The background RSP level is taken to be 15 $\mu g/m^3$ for yearly RSP impacts.

Table 6.9
Predicted Maximum Hourly, Daily and Yearly TSP Concentration ($\mu g/m^3$) - Mitigated

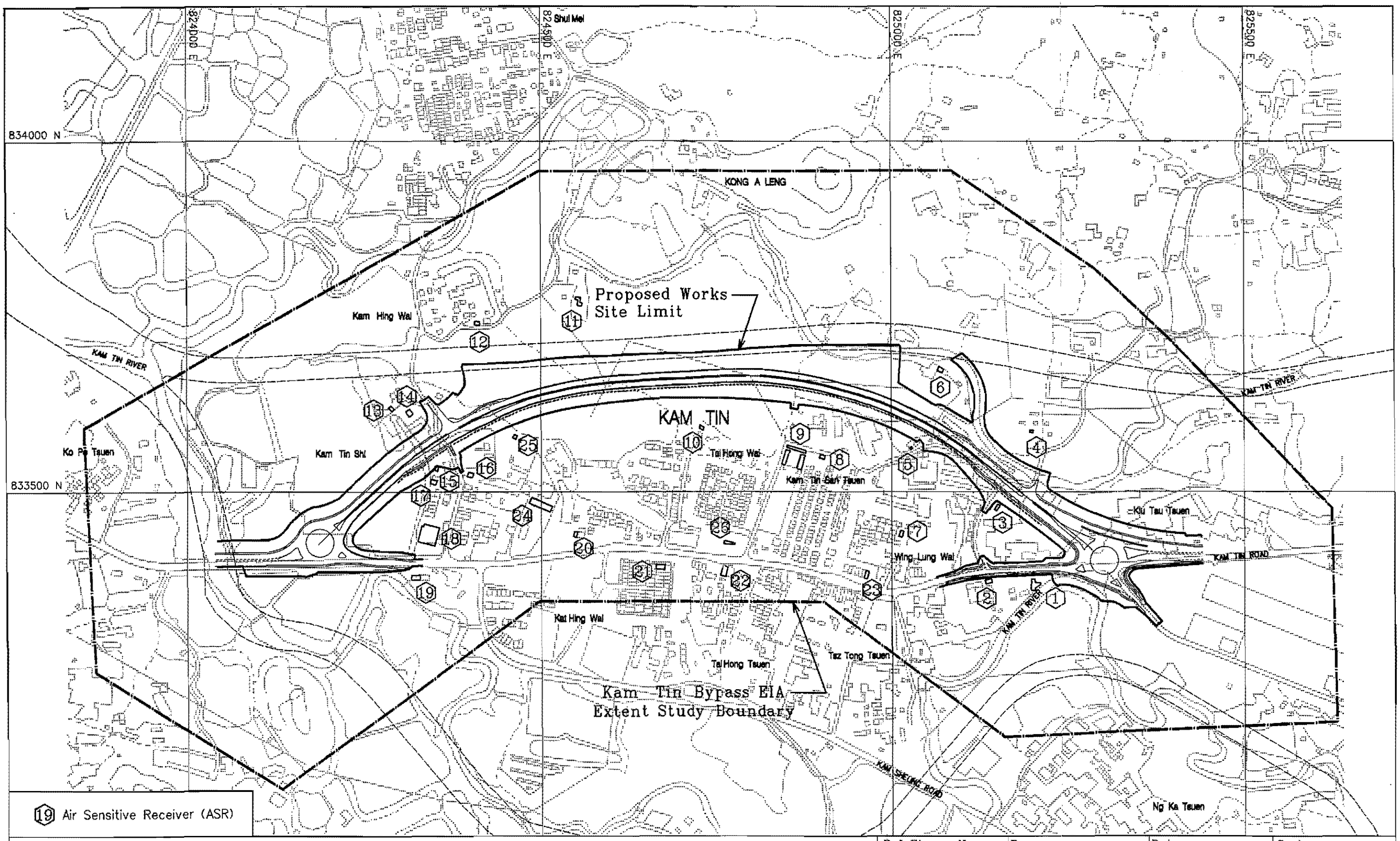
Air SR	Total Hourly Impacts - (except unpaved roads) - (1)	Trucks Movements over Unpaved Roads (hourly impacts with 95% reduction)	Total Hourly Impacts - (2)	Cumulative Hourly Impacts - (3) Total Hourly Impacts + background) - (4)	Cumulative Daily Impacts - (5) Total Daily Impacts + background) - (4)	Cumulative Yearly Impacts - (6) Total Yearly Impacts + background) - (7)
1	17.02	76.76	93.78	196.78	150.53	45.60
2	10.63	57.21	67.83	170.83	143.39	43.46
3	19.26	121.26	140.52	243.52	180.76	64.18
4	11.79	218.68	230.48	333.48	148.83	38.65
5	15.61	126.67	142.28	245.28	176.34	64.28
6	14.11	183.21	197.33	300.33	160.53	41.64
7	6.63	54.15	60.78	163.78	138.79	44.77
8	9.49	73.17	82.66	185.66	151.70	51.84
9	9.31	74.47	83.78	186.78	151.89	51.79
10	12.13	85.02	97.15	200.15	160.32	53.93
11	10.63	147.30	157.93	260.93	167.29	45.09
12	10.57	141.19	151.76	254.76	166.11	46.14
13	14.82	210.64	225.47	328.47	180.32	61.99
14	18.40	285.73	304.13	407.13	201.40	73.82
15	20.97	148.08	169.05	272.05	194.55	60.48
16	14.66	91.64	106.29	209.29	165.46	52.00
17	18.21	123.95	142.16	245.16	180.60	55.72
18	13.75	71.99	85.74	188.74	150.08	44.52
19	11.96	58.05	70.01	173.01	142.30	40.81
20	4.72	47.59	52.32	155.32	134.91	40.74
21	3.15	35.80	38.95	141.95	128.22	38.52
22	2.95	37.77	40.72	143.72	129.17	39.04
23	4.51	42.30	46.81	149.81	131.98	40.22
24	7.22	63.91	71.13	174.13	143.83	44.06
25	20.71	111.46	132.17	235.17	179.36	59.23
26	3.41	40.80	44.21	147.21	131.26	40.19

Note :
(1) Total hourly impact included emissions due to loading & unloading, top soil removal, wind erosion and stockpiling.
(2) Total hourly impact is the sum of all hourly impacts including unpaved roads (with 95% reduction).
(3) Cumulative hourly impact is the sum of the total hourly impact and the background TSP level.
(4) The background TSP level is taken to be 103 $\mu g/m^3$ for both hourly and daily TSP impacts.
(5) Cumulative daily impact is the sum of the total daily impact and the background TSP level.
(6) Cumulative yearly impact is the sum of the total yearly impact and the background TSP level.
(7) The background TSP level is taken to be 30 $\mu g/m^3$ for yearly TSP impacts.

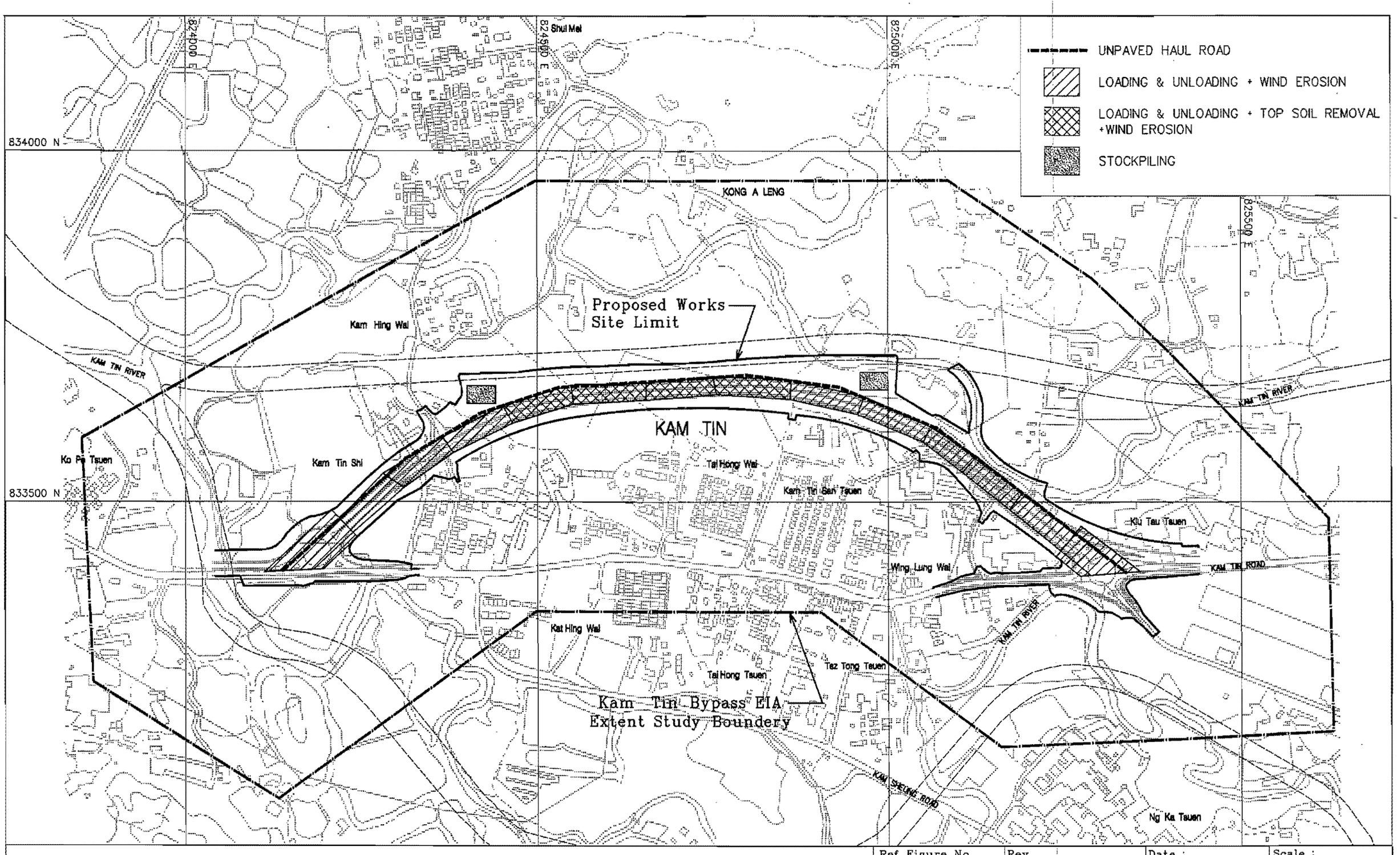
Table 6.10
Predicted Maximum Daily and Yearly RSP Concentration ($\mu g/m^3$) - Mitigated

Air SR	Total Daily Impacts - (except unpaved roads) - (1)	Trucks Movements over Unpaved Roads (daily impacts with 95% reduction)	Total Daily Impacts - (2)	Cumulative Daily Impacts - (3) Total Daily Impacts + background) - (4)	Cumulative Yearly Impacts - (5) Total Yearly Impacts + background) - (6)
1	4.11	17.66	21.77	103.77	22.16
2	2.97	15.48	18.45	100.45	21.15
3	3.97	31.43	35.39	117.39	30.53
4	2.65	18.23	20.88	102.88	18.93
5	3.55	29.82	33.37	115.37	30.57
6	2.67	23.48	26.15	108.15	20.29
7	1.91	14.38	16.29	98.29	21.72
8	2.70	19.49	22.19	104.19	24.93
9	2.63	19.64	22.27	104.27	24.91
10	3.77	22.41	26.17	108.17	25.91
11	2.65	26.56	29.21	111.21	21.86
12	2.70	25.99	28.69	110.69	22.33
13	3.57	31.59	35.16	117.16	29.53
14	3.96	40.74	44.70	126.70	34.89
15	3.99	37.63	41.62	123.62	28.87
16	3.25	25.19	28.44	110.44	25.02
17	3.70	31.60	35.31	117.31	26.71
18	2.56	18.87	21.44	103.44	21.61
19	2.55	15.37	17.92	99.92	19.92
20	1.34	13.16	14.50	96.50	19.88
21	0.99	10.46	11.46	93.46	18.87
22	1.00	10.88	11.88	93.88	19.11
23	1.31	11.86	13.17	95.17	19.65
24	2.00	16.58	18.58	100.58	21.40
25	4.70	30.14	34.84	116.84	28.33
26	1.16	11.68	12.84	94.84	19.63

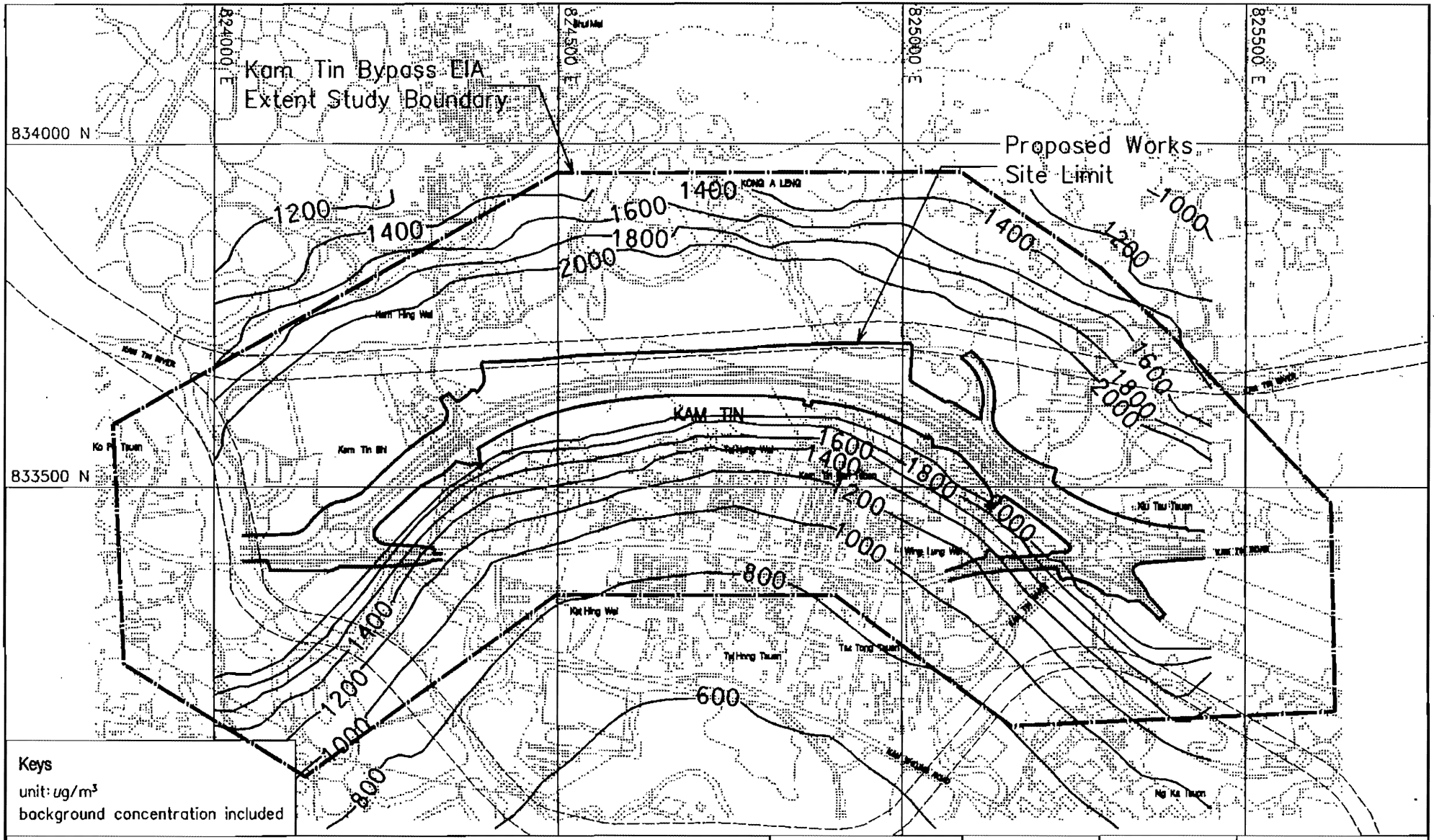
Note :
(1) Total daily impact included emissions due to loading & unloading, top soil removal, wind erosion and stockpiling.
(2) Total daily impact is the sum of all daily impacts including unpaved roads (with 95% reduction).
(3) Cumulative daily impact is the sum of the total daily impact and the background RSP level.
(4) The background RSP level is taken to be 82 $\mu g/m^3$ for daily RSP impacts.
(5) Cumulative yearly impact is the sum of the total yearly impact and the background RSP level.
(6) The background RSP level is taken to be 15 $\mu g/m^3$ for yearly RSP impacts.



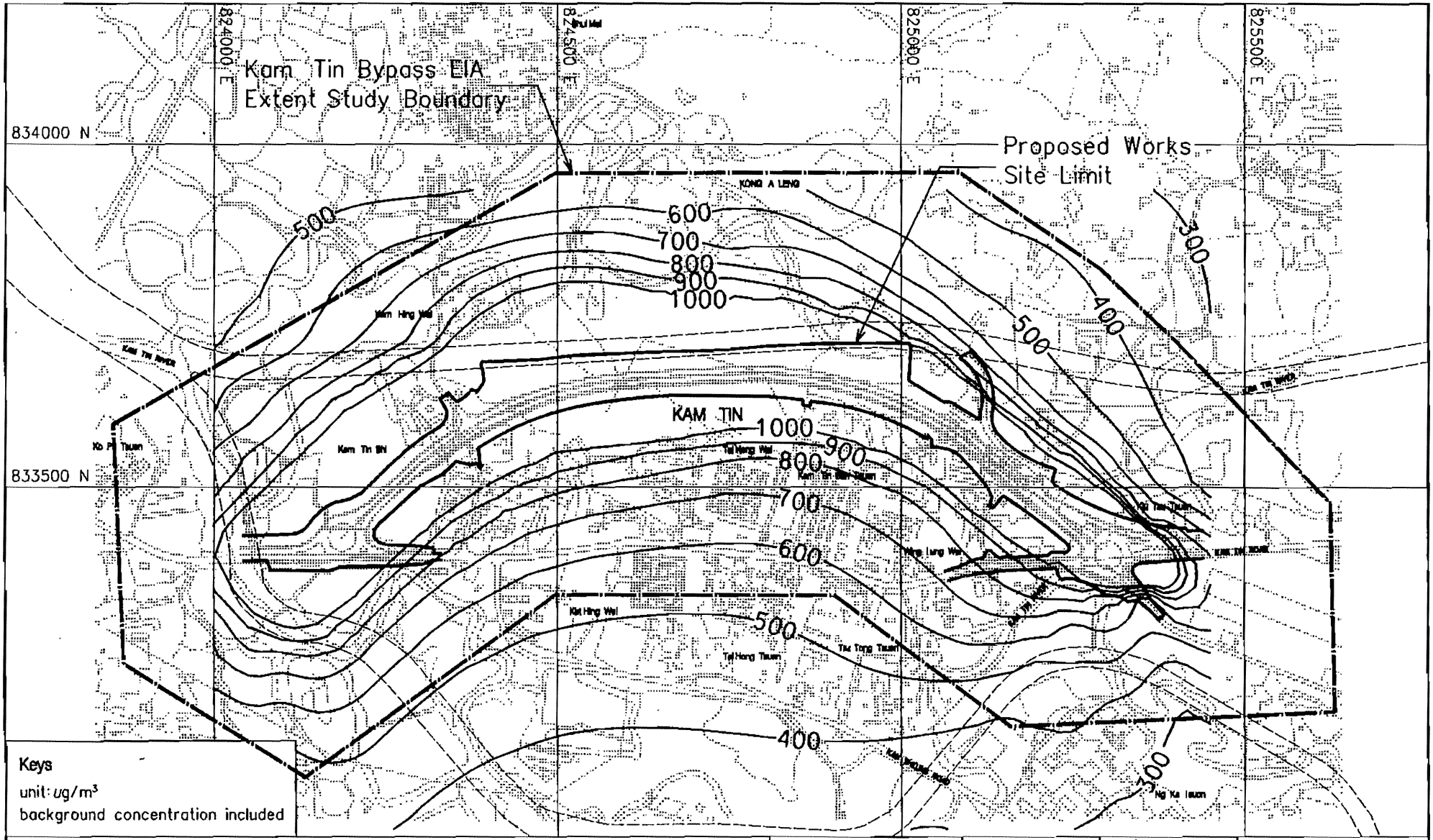
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev. –	Date : SEP. 95	Scale : 1 : 5000
Title : EIA - LOCATION OF AIR SENSITIVE RECEIVERS	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 6.1



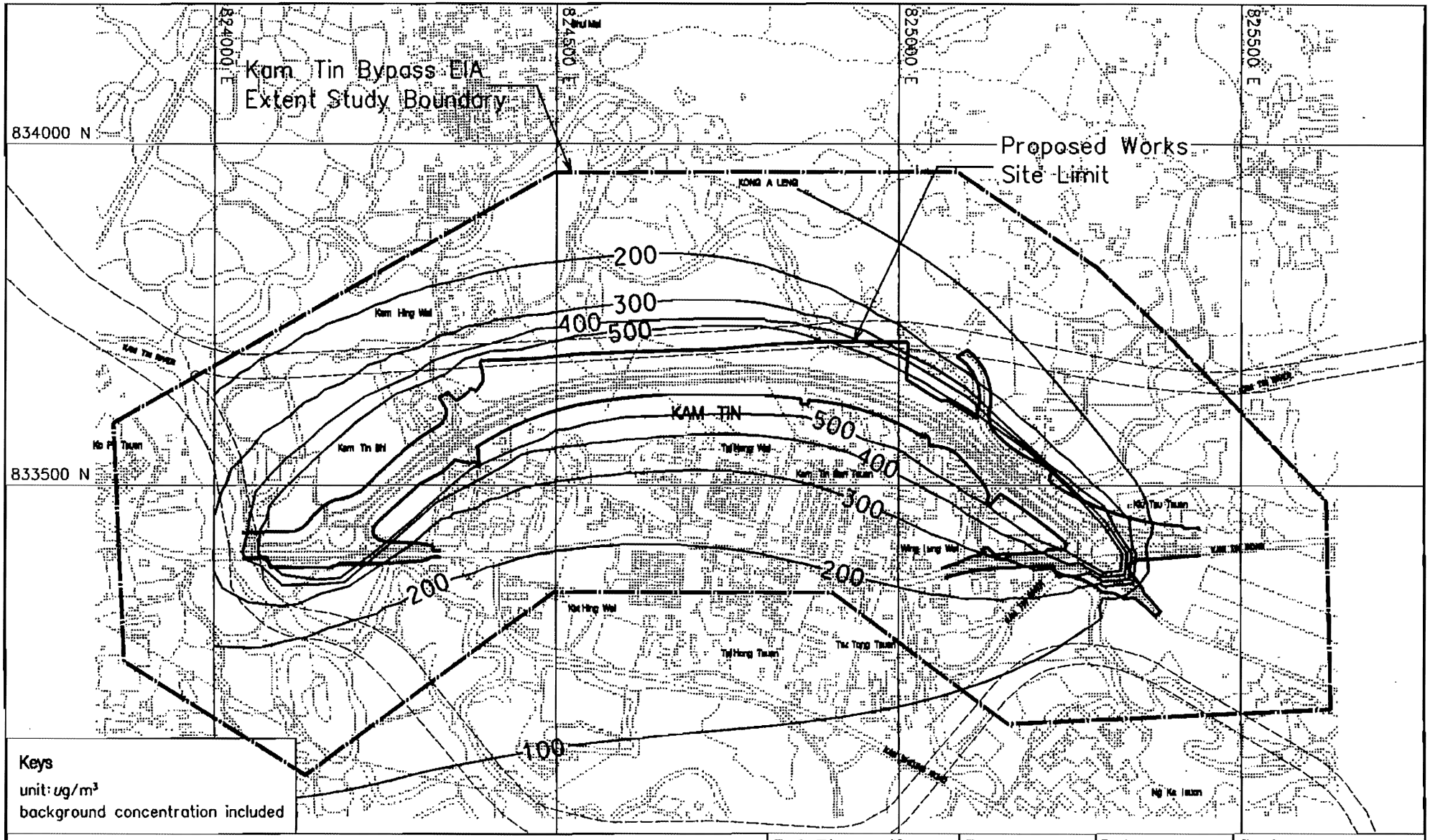
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 5000
Title : EIA - THE LOCATION OF DUST SOURCES	Joint Consultants :	Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)		Figure No. 6.2



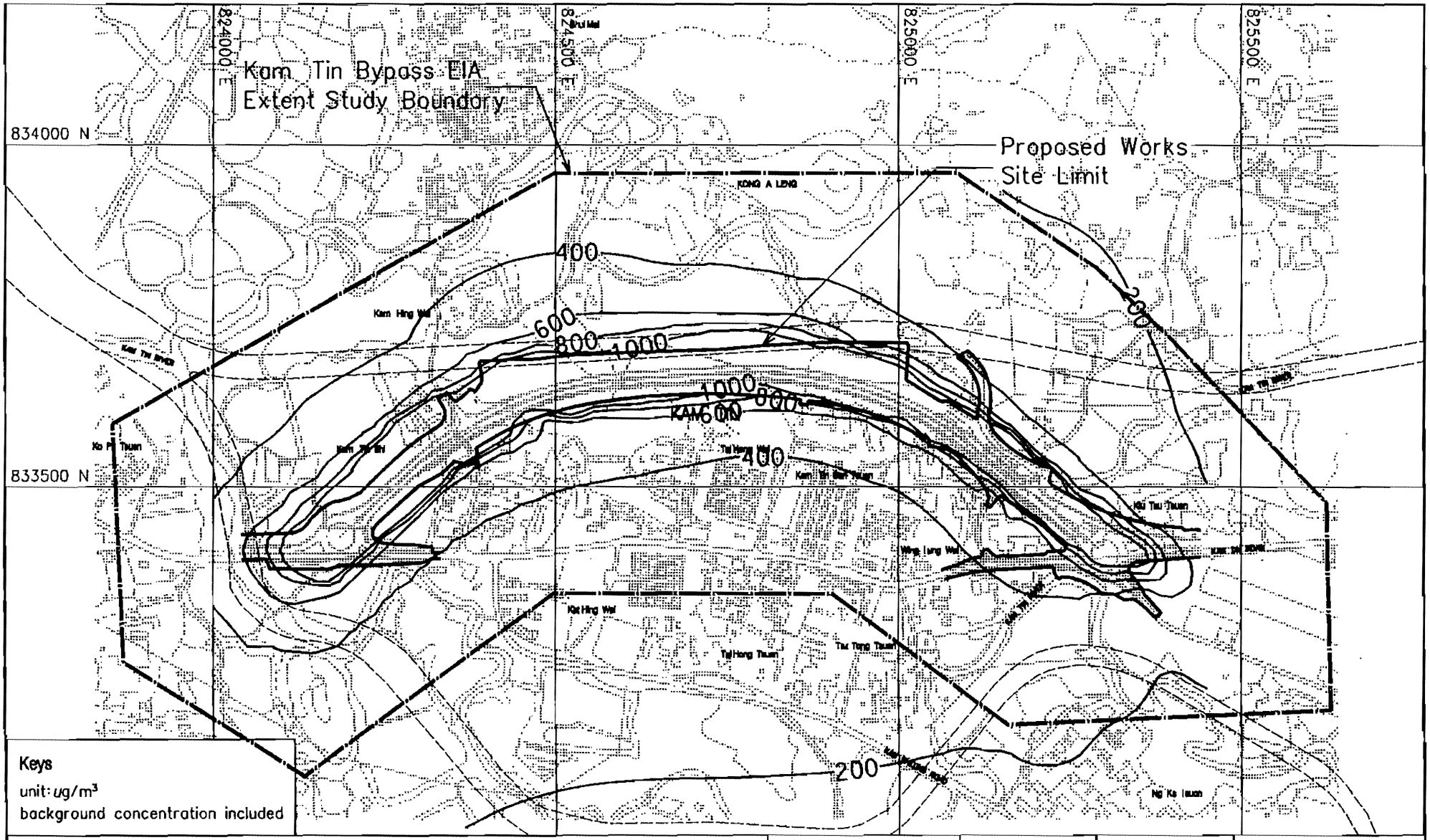
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - 1 HOUR TSP GROUND LEVEL (COMPLETELY UNMITIGATED)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.3



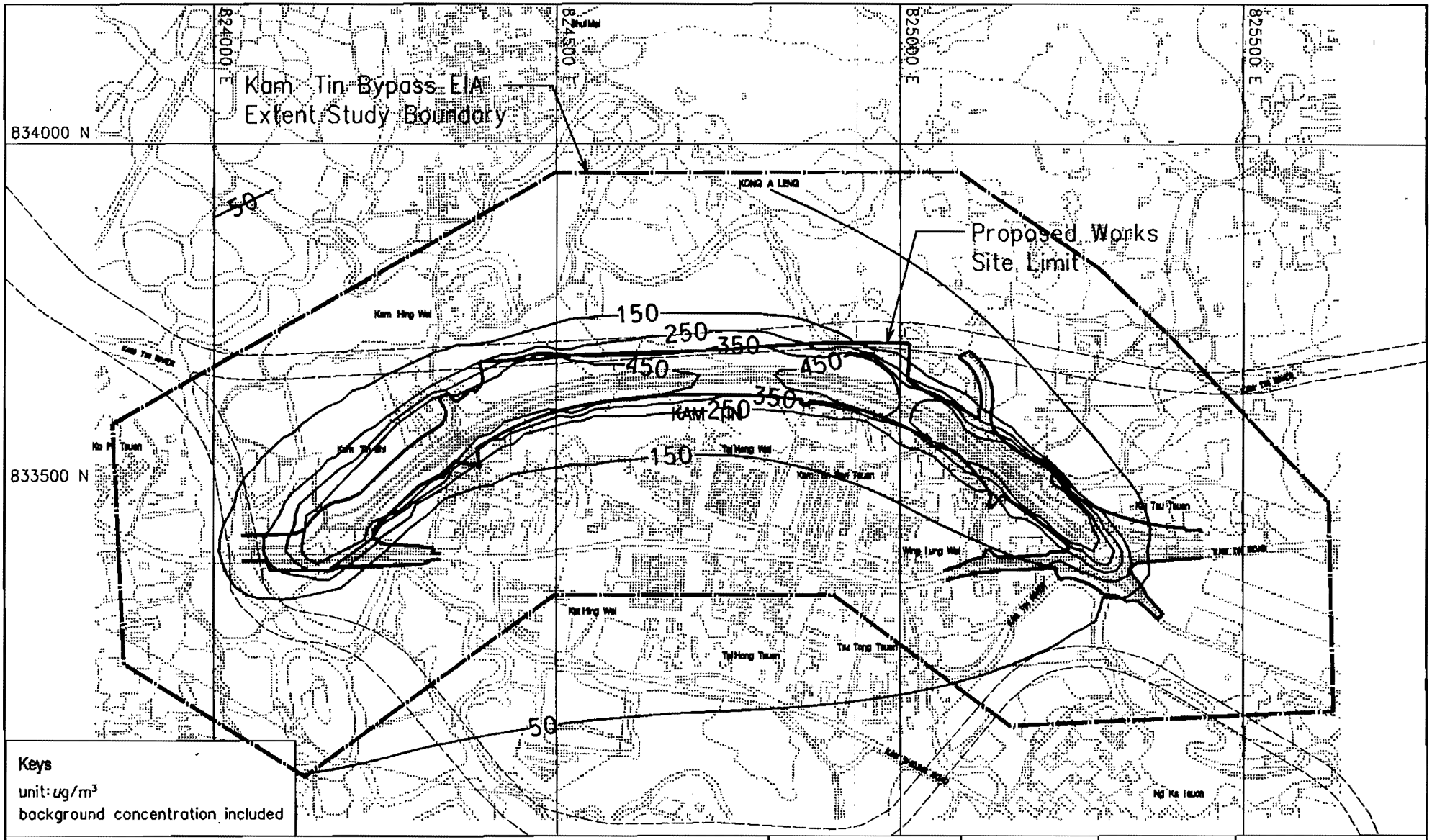
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - 24 HOUR TSP GROUND LEVEL (COMPLETELY UNMITIGATED)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.4



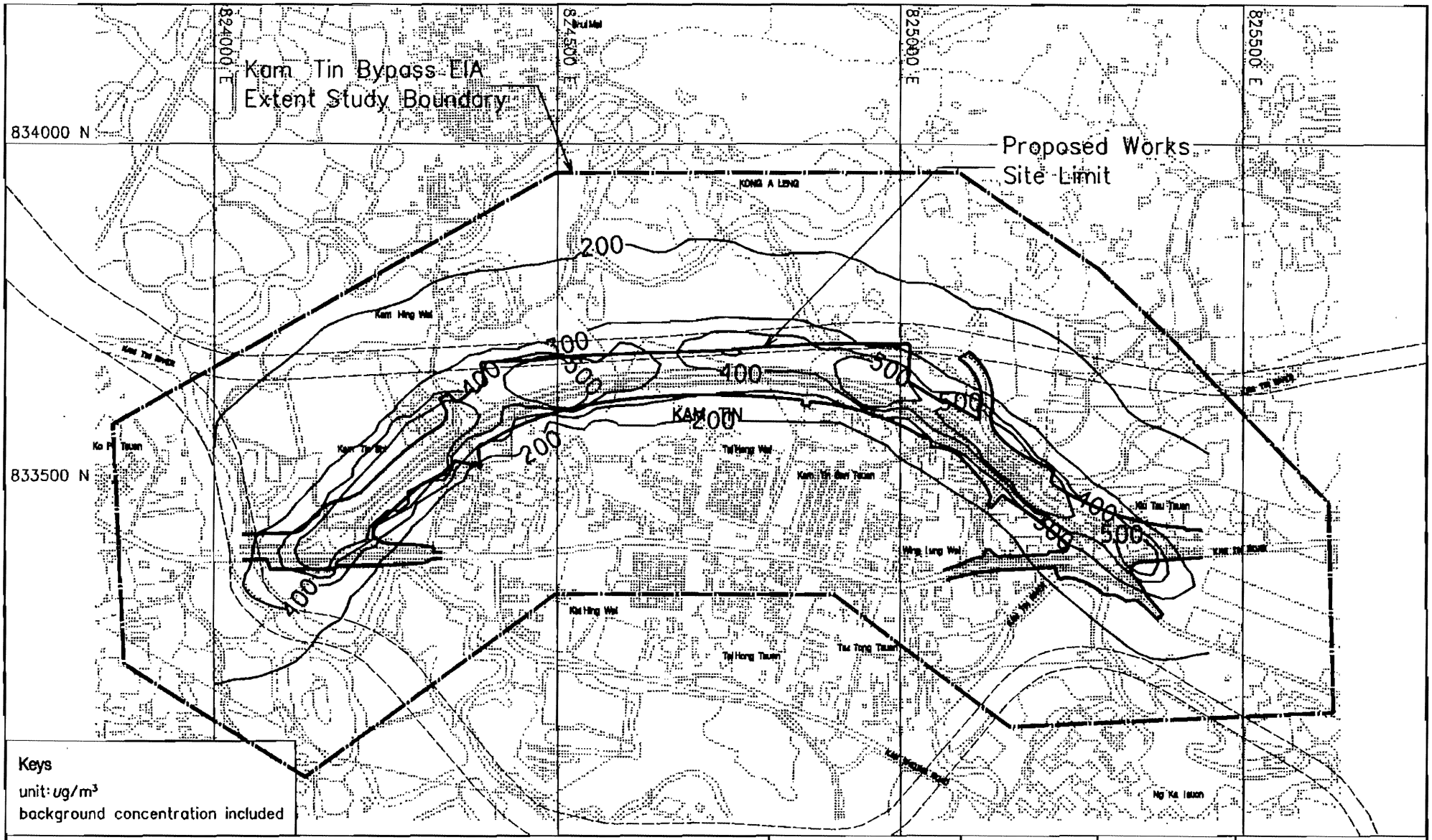
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - ANNUAL TSP GROUND LEVEL (COMPLETELY UNMITIGATED)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.5



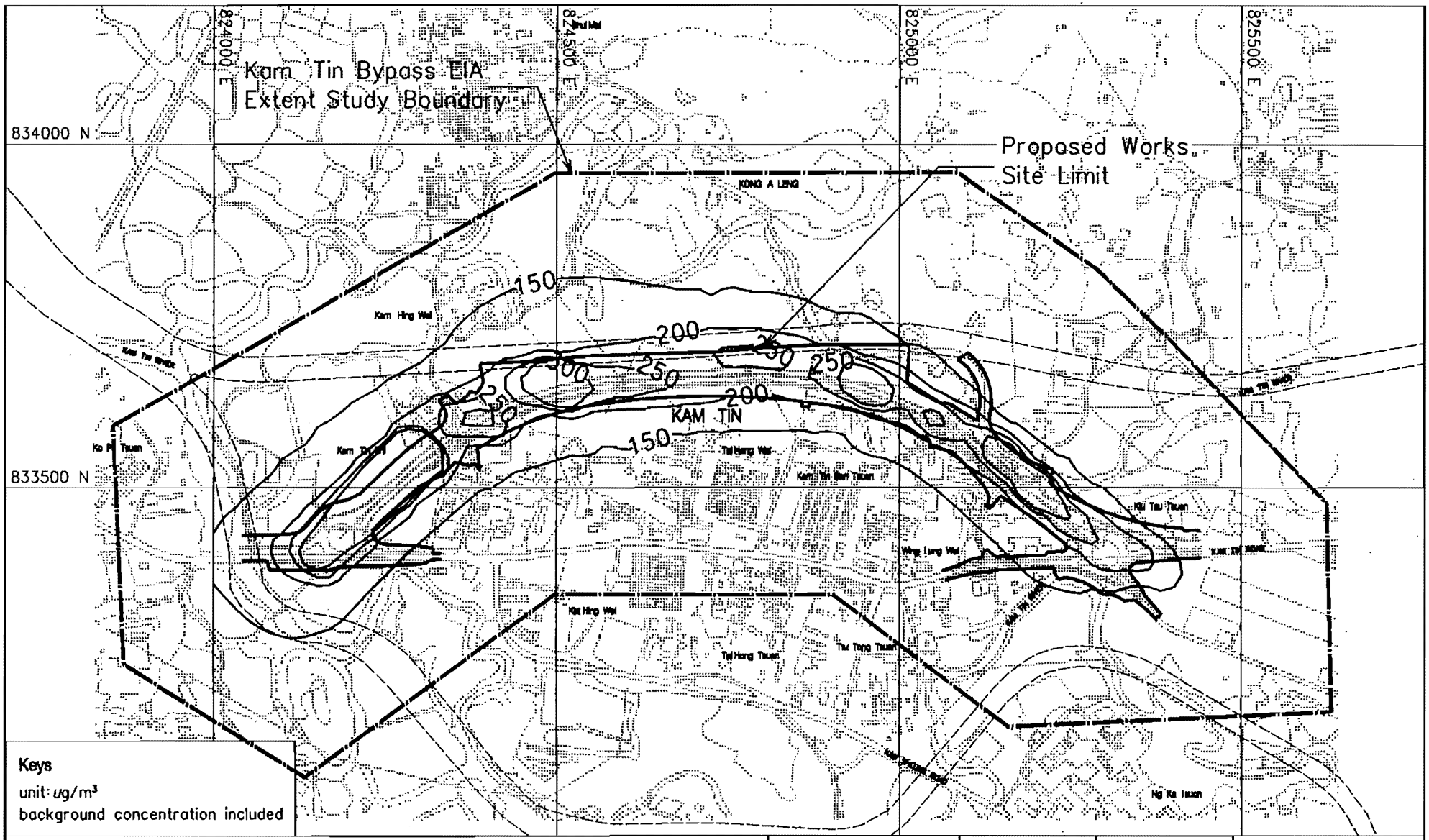
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - 24 HOUR RSP GROUND LEVEL (COMPLETELY UNMITIGATED)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.6



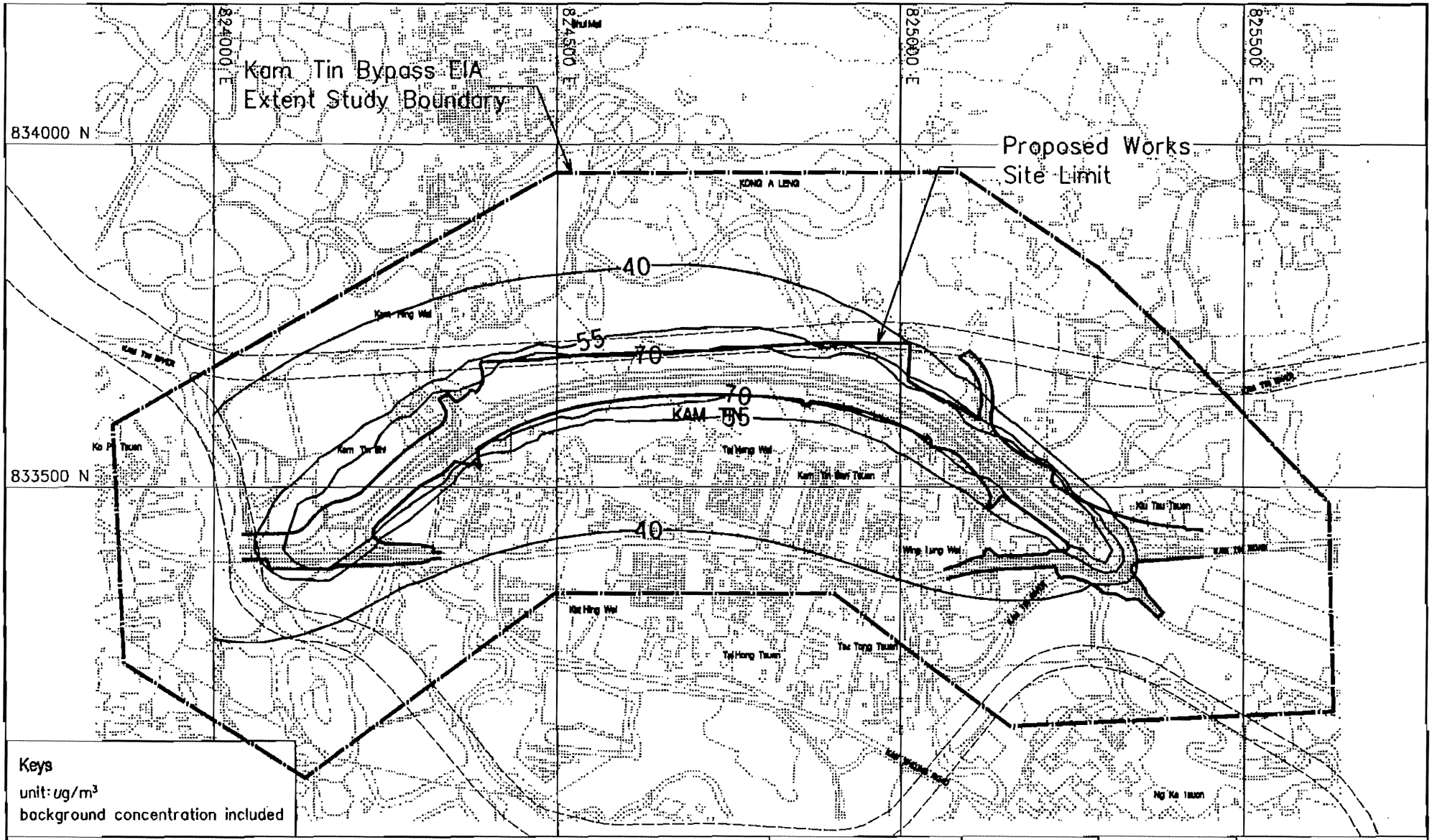
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - ANNUAL RSP GROUND LEVEL (COMPLETELY UNMITIGATED)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.7



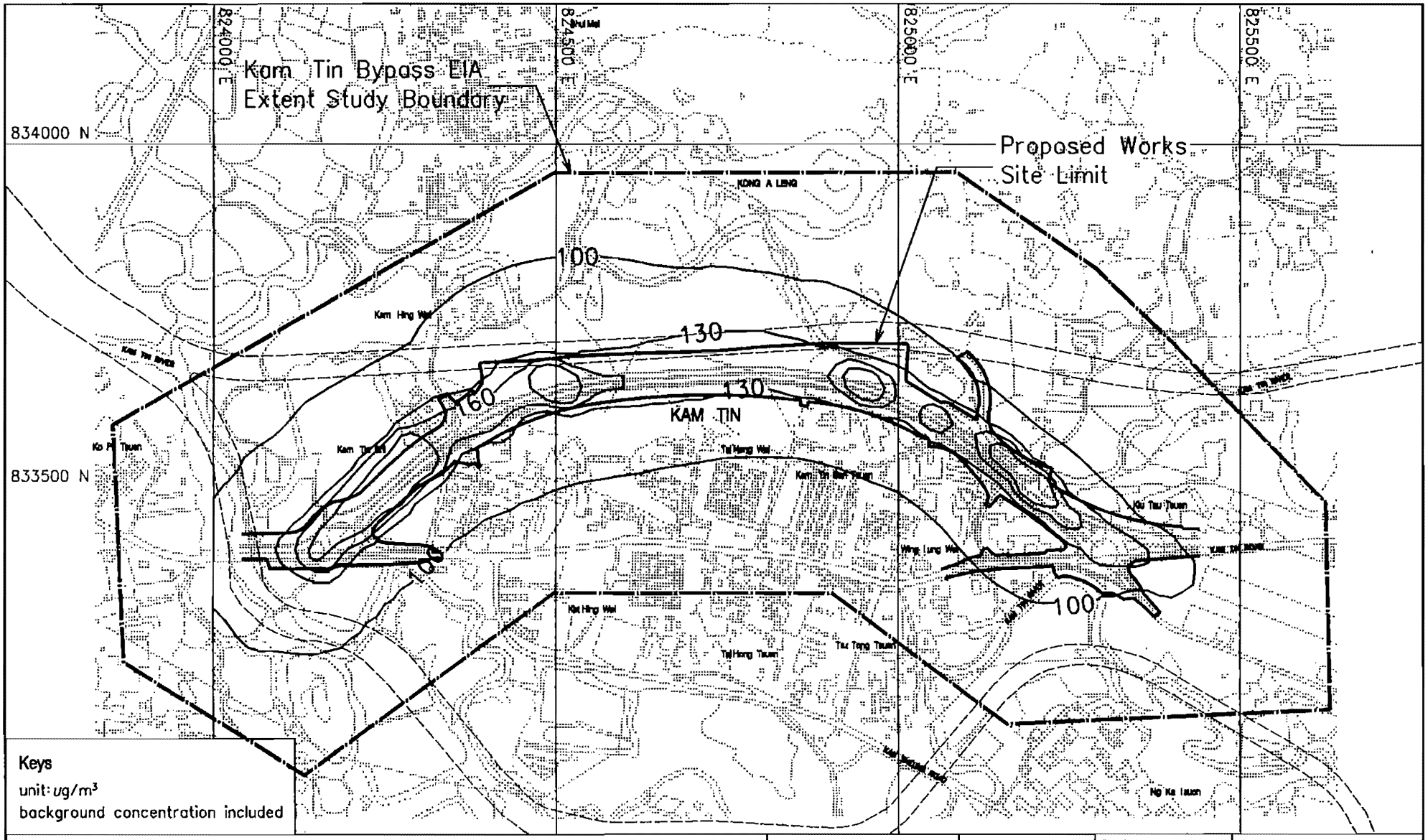
Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - 1 HOUR TSP GROUND LEVEL (95% REDUCTION IN DUST FROM DIRT ROADS)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.8



Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - 24 HOUR TSP GROUND LEVEL (95% REDUCTION IN DUST FROM DIRT ROADS)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.9



Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : 1 : 8000
Title : EIA - ANNUAL TSP GROUND LEVEL (95% REDUCTION IN DUST FROM DIRT ROADS)	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 6.10



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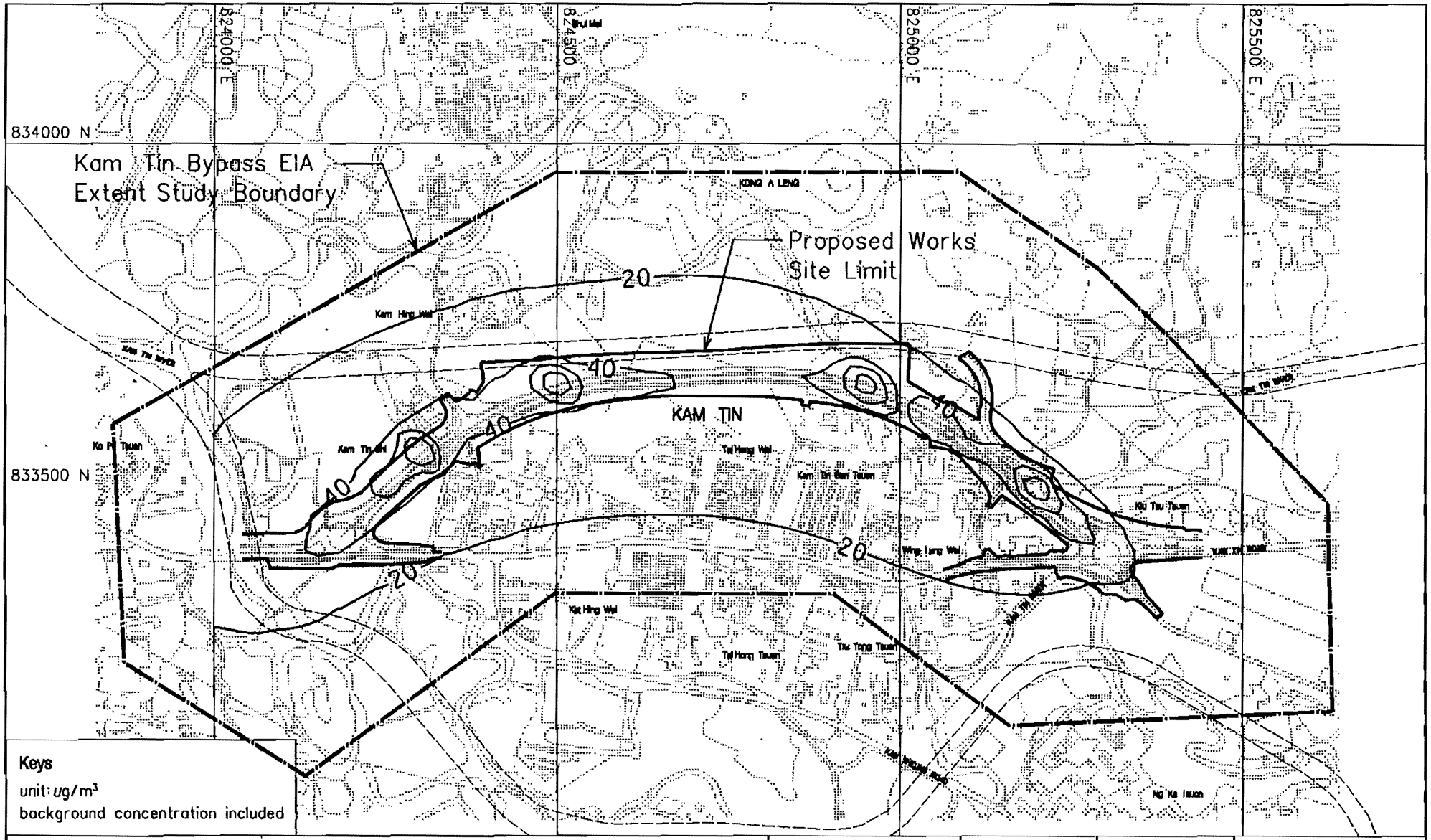
Title : EIA - 24 HOUR RSP GROUND LEVEL (95% REDUCTION IN DUST FROM DIRT ROADS)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.11



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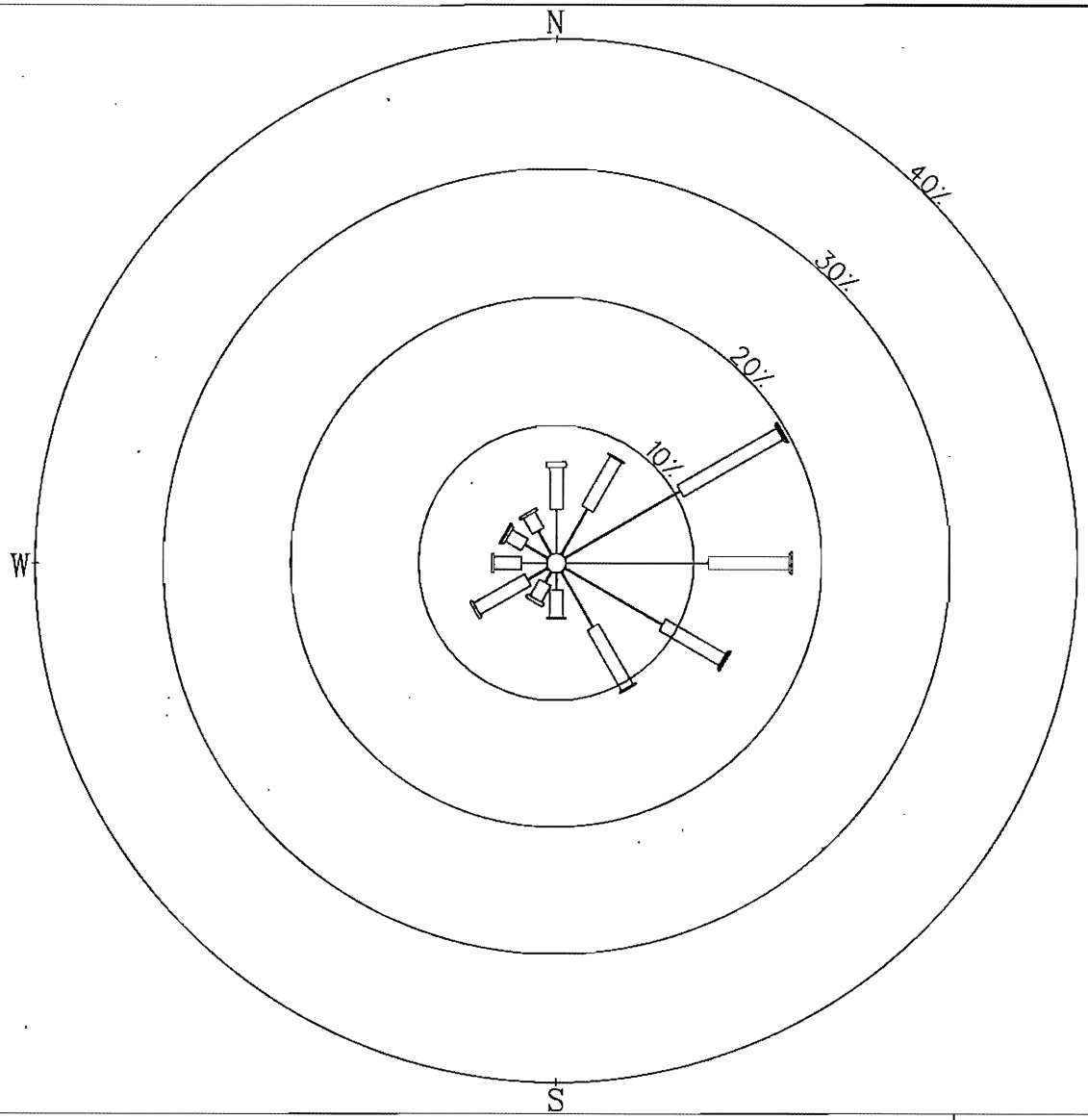
Title : EIA - ANNUAL RSP GROUND LEVEL (95% REDUCTION IN DUST FROM DIRT ROADS)	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.12



JAN 1989 - DEC 1993

No. of observations = 41340

No. of variable winds = 1 (.0%)

No. of calm winds = 162 (.4%)

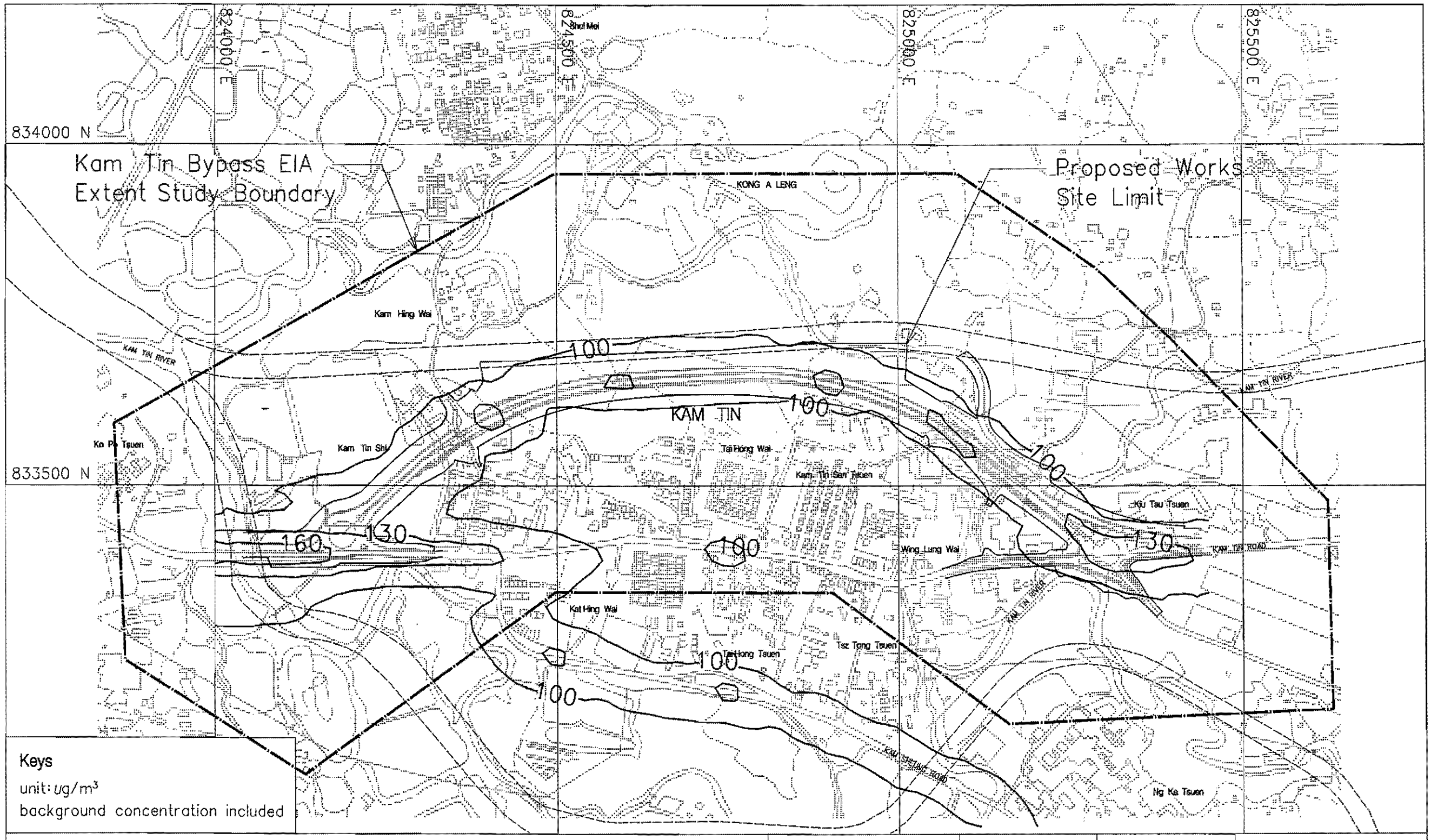
0 10 20 30

Percentage frequency

2-12	13-30	31-51	>51	km/h
0.1-3.2	3.3-8.2	8.3-14.2	>14.2	m/s
1-2	3-4	5-6	>6	Beaufort force

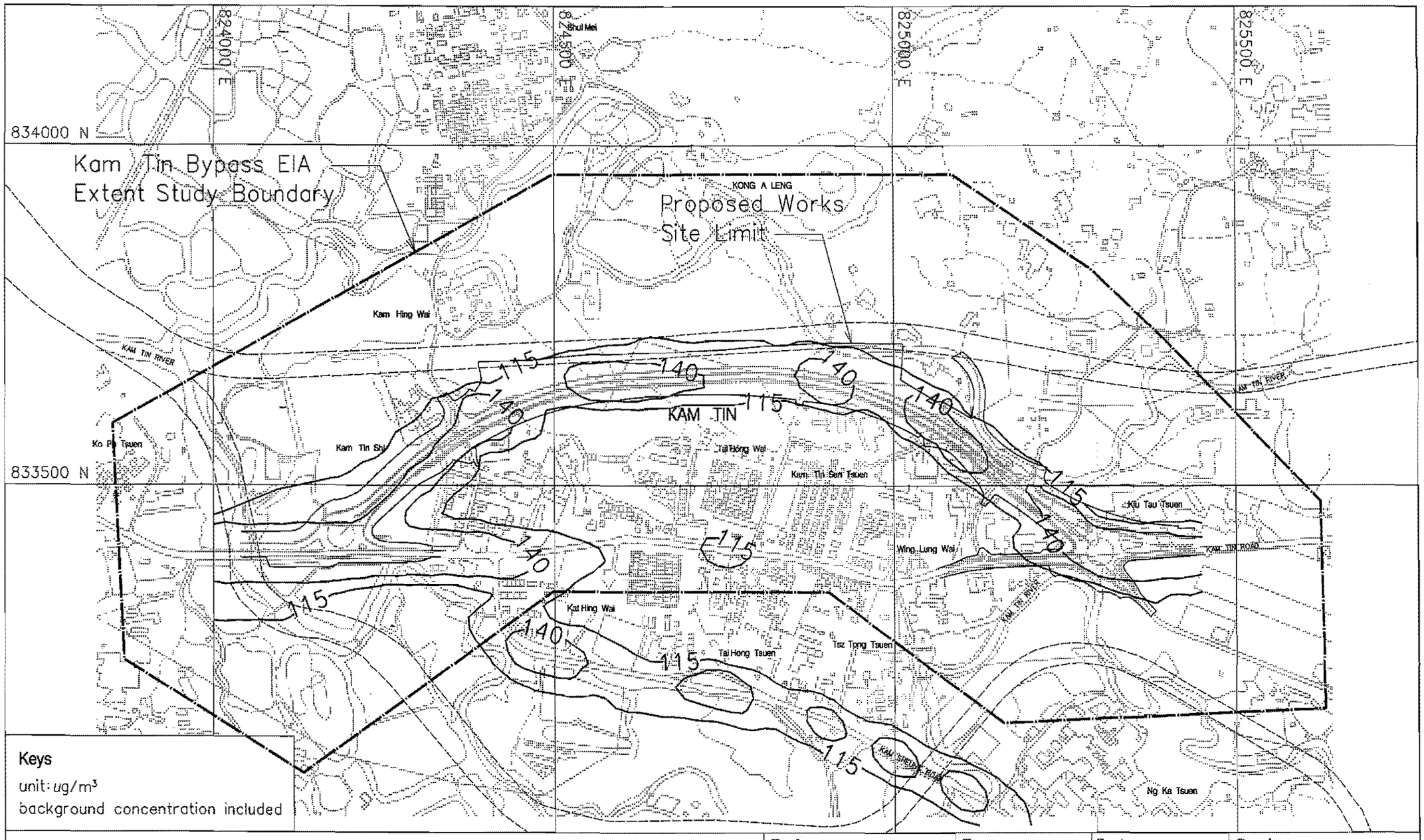
Wind speed

Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : SEP. 95	Scale : -
Title : EIA - WIND ROSE FOR LAU FAU SHAN AWS	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 6.13



Keys
unit: ug/m^3
background concentration included

Agreement No. CE 7/94 Kam Tin Bypass	Reference :	Rev.	Date : JAN. 96 / Scale : 1 : 6000
Title : EIA - OPERATIONAL PHASE 2011 MAXIMUM RSP CONCENTRATIONS AT PEDESTRIAN LEVEL (1.5m above ground): HOURLY AVERAGE	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)		Figure No. 6.14



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Title : EIA - OPERATIONAL PHASE 2011 MAXIMUM NO_2 CONCENTRATIONS AT PEDESTRIAN LEVEL (1.5m above ground): HOURLY AVERAGE	Joint Consultants : Binnie Consultants Limited Wilbur Smith Associates Limited Harris & Sutherland (Far East)			Figure No. 6.15

7 ECOLOGICAL IMPACT

Introduction

7.1 This section examines the existing flora and fauna along the route of the proposed Bypass as well as the surrounding areas (the Study Area), and describes the potential impacts of the project on their ecology.

7.2 Field surveys were conducted on 17 and 23 August 1995 to investigate the existing ecology of the proposed route. Figure 7.1 illustrates the broad vegetation ecotopes occupying or adjacent to the proposed alignment of the Bypass. In addition, studies of the expected ecological impacts of adjacent proposed drainage and road projects[1,2] were reviewed.

7.3 Within the built area of Kam Tin, other than the occasional fruit tree or shading plants, the area is predominantly paved and concreted. Figure 2.3 in Section 2 shows the current extent of the built area, as well as the intended future development and other land uses, as illustrated in the Outline Zoning Plan.

7.4 Legislation relevant to these ecological studies is presented in Section 3 of this report.

Habitats

River channel habitat

7.5 The eastern part of the Bypass, north of Wing Lung Wai, will lie along a small section of the existing Kam Tin River channel. A previous study showed that the Kam Tin River was heavily polluted with agricultural and residential wastes, and that its anoxic condition together with its pollution were responsible for a low species richness and diversity[3].

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1 *Main Drainage Channels for Ngau Tau Mei, Yuen Long and Kam Tin: EIA Study* (1994) ERM Hong Kong for Territory Development Department

2 *Route 3 Country Park Section and Ting Kau Bridge: Preliminary Design Stage 2 - Country Park Section - Tai Lam Tunnel and Yuen Long Approach Road - Volume 3A: Environmental Assessment - Technical Report* (undated) Freeman Fox Maunsell for Highways Department, Western Link Office

3 *Assessment of Effects of Mangrove Removal on Water Quality in Deep Bay* (1992) Binnie Consultants Ltd for Territory Development Department

7.6 Due to the heavy rain in the New Territories a week before the first field visit, the water in the channel was running quite rapidly. The channel water was very turbid and there was a high level of sediment deposition as well as debris accumulation along the channel.

7.7 The grasses *Paspalum longifolium* and *Miscanthus floridulus* were abundant on both sides of the channel.

7.8 Judging by the state of the channel, a diverse aquatic fauna would not be expected. During both site visits, a total of four terrapins were recorded in the channel. These were probably an imported exotic species which had been released into the wild. There were some indications (ripples and other disturbances) of fish activity in the River, but the turbidity of the water prevented identification.

7.9 There is an area of reed beds adjacent to the Kam Tin river north of Kiu Tau Tsuen (this is indicated on Figure 7.1). The reeds (*Phragmites sp.*) are over a metre in height and densely packed. A Shrike and several Bulbuls were observed foraging for insects in this area.

Agricultural habitat

7.10 The middle section of the proposed Bypass will run through currently active agricultural land north of Kam Tin San Tsuen and west of Kam Tin Shi. Approximately 80% of the land is actively cultivated: the remainder has been abandoned. The cultivated land was covered entirely with water spinach *(Ipomoea aquatica)* for commercial production. Two other types of vegetables (Chit kwa and Taro) were also recorded; but these were probably for domestic use and only observed on a small scale. A high abundance of the fresh water snails *Ampullalia* sp were found among the cultivated fields.

Flora

7.11 A total of 40 plant species were recorded in the survey (Table 7.1). The majority of these plants were cultivated species found along roads, footpaths and around residential buildings for shade and wind-break purposes. Fruit trees were especially common around village houses at Kiu Tau Tsuen, Wing Lung Wai, Kam Tin San Tsuen, Tai Hong Wai and Kam Tin Shi. None of the plant species recorded in the survey are listed as rare or endangered.

Table 7.1
Plant Species recorded in Kam Tin Study Area

Trees	Fruit trees
Bauhinia sp	*Annona squamosa* (Sugar apple)
Daphniphyllum glaucescens	*Carica papaya* (Papaya)
Delonix regia	*Citrus grandis* (Pomelo)
Ficus hispida	*Citrus microcarpa*
Ficus microcarpa	*Clausena lansium* (Wampi)
Ficus sp	*Cocos nucifera* (Coconut palm)
Macaranga tanarius	*Euphoria longan* (Longan)
Michelia alba	*Litchi chinesis* (Lychee)
	Mangifera indica (Mango)
Bamboo	*Musa paradisiaca* (Banana)
Bambusa ventricosa McClure	*Psidium guajava* (Guava)
Bambusa sp	*Saccharum officinarum* (Sugar cane)
	Sterculia nobilis (Pun po)
Shrubs & understory	
Alocasia odora	Cultivated vegetables
Juniperus chinesis	*Ipomoea aquatica* (Ung tsoi)
Ipomoea cairica	*Benincasa hispida* (Chit kwa)
Lantana camara	*Colocassia esculenta* (Taro)
Melothria heterophylla	
Nephrolepis cordifolia	
Salix babylonica	
Thevetia peruviana	
Thuja orientalis	
Lygodium japonicum	
Grasses	
Paspalum longifolium	
Miscanthus floridulus	
Eleusine indica	
Phragmites sp.	

Note: Name inside brackets is common name of the species

Invertebrate fauna

7.12 On both visits, the Study Area was found to have a low faunal diversity (Table 7.2). Due to the homogeneity of the habitat, which is composed mainly of monocultured, agricultural fields, the most obvious invertebrate fauna recorded was the insect group. Additionally, general practice in domestic farming involves the application of insecticides on a regular basis. This may account for the low species diversity as well as the low abundance of the observed fauna of the study area.

Table 7.2
Faunal Species recorded in the Study Area

Insects	Abundance
Butterflies	xx
Grasshoppers	xx
Beetles	xx
Gastropods	
Ampullalia sp	xxx
Reptiles	
Terrapin	x
Fish	
Gambusia affinis	x

Note: xxx = abundant, xx = moderate, x = present

Reptiles and amphibians

7.13 Only one reptile species was recorded during both visits to the Study Area. A total of four terrapins were observed in the Kam Tin River, to the north of the Kiu Tau Tsuen area. The species could not be identified on the local reptile checklist[4]. The species is likely to be an imported exotic released into the wild from captivity.

[4] *Hong Kong Amphibians and Reptiles* (1986) S J Karsen, M Wai-neng Lau and A Bogadek for Urban Council

7.14 The majority of reptiles and amphibians are nocturnal. It is, therefore, difficult to observe these animals during a day visit. Nevertheless, there are a few species that are commonly found in similar agricultural habitats and gardens and are potentially inhabitants of the study area. These include the Asian common toad (*Bufo melanostictus*), the Paddy frog (*Rana limnocharis*), Gunther's frog (*Rana guentheri*), the Asiatic painted frog (*Kaloula pulchra pulchra*), the Crested tree lizard (*Calotes versicolor*) and several species of small skinks. It should be noted that all of the above mentioned species are relatively common to these habitats and are not on the rare and endangered species list.

Avifauna

7.15 A total of twelve bird species were recorded during the surveys (Table 7.3). In general, birds were of low abundance in the surveyed areas. Apart from the Chinese Bulbul, the Crested Bulbul and the Magpie Robin which were frequently recorded both in the open fields and around the residential buildings, the other species were only sighted once or twice during the surveys. Among the list of birds, the Long-tailed Shrike was seen foraging around the abandoned fields.

Table 7.3
Bird Species Sighted and their Abundance in Study Area

Common name	Scientific name	Abundance
Chinese/Light-vented Bulbul	*Pycnonotus sinensis*	xx
Crested/Red-whiskered Bulbul	*P. jacosus*	xx
Black-crowned Night-heron	*Nycticorax nycticorax*	x
Cattle Egret	*Bubulcus ibis*	x
Magpie Robin	*Copsychus saularis*	xx
Long-tailed Shrike	*Lanius schach*	x
Spotted Dove	*Streptopelia chinensis*	x
Red Turtle-Dove	*S. tranquebarica*	x
Swallow sp.	*Hirundinidae sp.*	x
Chinese Pond Heron	*Ardeola bacchus*	x
Banded Rail	*Gallirallus striatus*	x
Warbler sp.	*Sylviidae* sp.	x

Note: xxx = abundant, xx = moderate, x = present

7.16 The peak month for migratory or visiting species (resting, feeding and wintering) in the Territory is January with the season spanning from late September to March. It is possible that these species may use the wet agricultural lands for feeding.

7.17 The relatively low floral, and hence, insect diversity and the corresponding reduced variety of available food items in the Study Area, probably contribute to the low number of birds using the area as an intensive foraging ground. In addition, most of the tree species are located around the residential buildings where human disturbance is greatest. This further decreases the usage of these trees as nesting sites by birds. During the surveys, two bird nests were recorded but they appeared to be abandoned or out of seasonal use.

Ecology - Potential Impacts

On-site impact

Loss of agricultural/grass land

7.18 Partial loss of the agricultural habitat is inevitable if the Project is to proceed. According to Agriculture and Fisheries Department's estimation[5], approximately four hectares of agricultural land will be affected. However, this estimation was based on the outline design for a 2-lane single carriageway road: the current design is for a dual two carriageway, and the affected area will be in the region of 5.5 hectares. The abandoned fields probably support a higher diversity and abundance of insects than the actively cultivated fields. Birds using these areas as part of their foraging ground will thus be affected. However only low numbers of birds were sighted.

Loss of vegetation

7.19 Apart from loss of agricultural and fallow land, some large individual trees and some other plants will be lost to the project. A plant species list (excluding fruit trees) of observed vegetation is shown in Table 7.4.

[5] Director of Agriculture & Fisheries' comments on preliminary general layout plans. Letter ref: (14) in AF DVL 14/54 dated 14th October 1994

7.20 Air pollutants from road traffic may affect local habitats and species. Certain ferns and lichens are particularly vulnerable to elements of vehicle emissions. Lead pollution can cause replacement of native communities by lead tolerant species, and more generally, particulates settling on plants can impair photosynthesis[6].

7.21 If the dust mitigation programme outlined in Section 6 is fully implemented, the impacts of dust and particulates should not arise. Leaded petrol is being phased out by the Hong Kong Government.

7.22 Two tree corridors at either end of the middle section of the route of the proposed Bypass will be entirely lost.

Table 7.4
Plant Species susceptible to loss in the Study Area

Trees
Delonix regia
Ficus hispida
Ficus microcarpa
Ficus sp
Macaranga tanarius
Bamboo
Bambusa sp
Shrubs & understory
Alocasia odora
Juniperus chinesis
Ipomoea cairica
Lantana camara
Cultivated vegetables
Ipomoea aquatica (Ung tsoi)

7.23 Road projects can cause severance, creating a barrier and dividing existing habitats or wildlife corridors (eg. hedgerows). Smaller areas of land may be more vulnerable to loss, damage or change, and may be unable to continue to support their original number and diversity of species.

[6] *Design Manual for Roads & Bridges Vol 11: Environmental Assessment* (1993) HMSO, UK

Impacts on fauna

7.24 Creatures may be killed trying to cross a road which cuts across their traditional territory or foraging routes unless prevented from doing so. Some birds, such as owls, are known to hunt along roadside verges and are therefore at risk from traffic. Breeding amphibians may also be vulnerable if the new road separates the animals' day-to-day habitat from their traditional breeding ponds.

Pollution to Kam Tin River channel

7.25 Pollutants from surface runoff and additional sediment loading to the existing channel during the construction phase could further aggravate the already polluted state of the Kam Tin River. The operational phase of the Bypass is likely to lead to road runoff. Polluted runoff from roads can lead to pollution of local water courses through oil, particulates and accidental spillages. The volume of runoff also needs consideration to avoid overloading the capacity of watercourses, particularly during storms. These issues are discussed in the water quality section (Section 8 of this Report), and in the separate Drainage Impact Assessment. Ultimately, the impact of the Main Drainage Channel (MDC) scheme is going to be of greater fundamental significance to the river ecology and hydrology than this project.

Off-site impact

Impacts on fauna

7.26 Due to its proximity to the Project, the Ko Po Village Egretry (to the west of Kam Tin, as shown on Figure 2.1), may be susceptible to a certain degree of noise and dust disturbance during the construction and operation phases. However, the combined impacts of the Route 3 project and the MDC scheme are certain to have a far more significant effect on this ecological resource.

7.27 A grove of trees near the village of Ho Pui, 3 km to the south, supports a breeding colony of herons and egrets. These birds typically forage on lowland or wetland habitats such as those found in the agricultural areas alongside the Kam Tin River.[7] The location of the fishponds between Cheung Chun San Tsuen and Ko Po Tsuen, to the north west of the western end of the Site is a more likely feeding ground than the monocultured, farmed area directly impacted by the Project.

[7] see *Route 3 Country Park, etc - Environmental Assessment*

7.28 Road structures may cause problems for certain birds and mammals. Large waders and flocks of wildfowl, in particular, prefer open expanses for their feeding and roosting sites, as this allows them to see their predators more easily. Structures such as bridges, viaducts or embankments, which reduce visibility may therefore make the site unattractive to these birds.

Mitigation Measures - Ecology

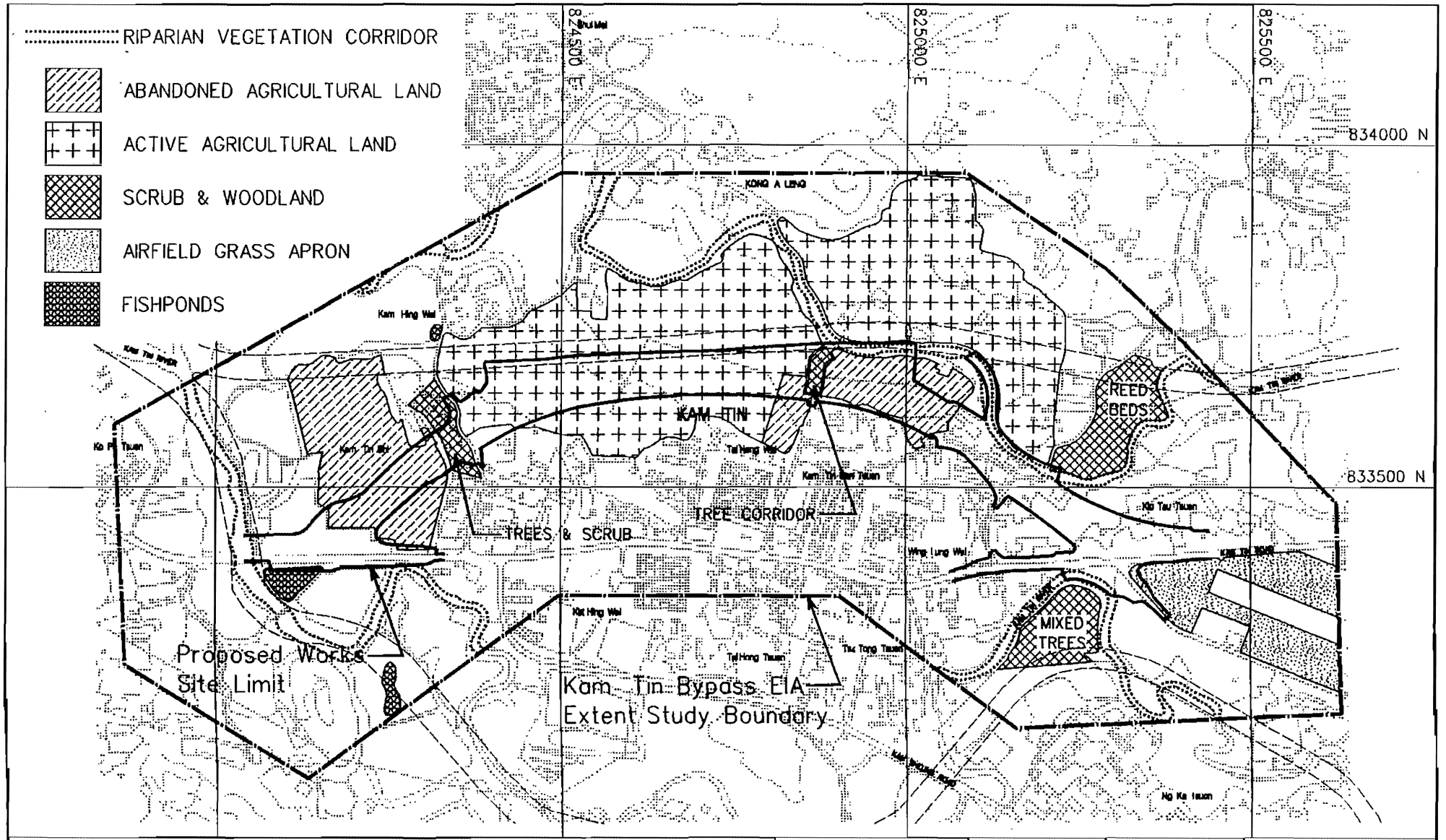
7.29 Mitigation measures recommended for water, air and noise should be sufficient to minimise impacts to the Kam Tin River and the Ko Po Village Egretry from the construction of this Project.

Summary

7.30 None of the animal or plant species recorded in the Study Area are listed in either the *Forests and Countryside Ordinance (Cap 96)* or the *Animals and Plants (Protection of Endangered Species) Ordinance (Cap 187).*

7.31 Existing trees should be preserved if possible. The Regional Services Department (RSD) and AFD will be consulted by the Engineer. Through the Director's Representative, arrangements will be made for the tree felling and, to ascertain if any of the trees to be removed are suitable for replanting, in accordance with WBTC No. 24/94 and any subsequent revisions.

7.32 While two tree corridors, at either end of the middle section of the Site, are to be lost, the subsequent landscaping and replanting with native plant species along the Bypass boundary would improve the visual impact of the Project as well as the ecology of the surrounding area. The replanting and landscaping programmes are opportunities to use plant species which act as a 'sink' to the harmful byproducts of vehicle emissions.



Agreement no. CE 7/94 Kam Tin By-pass	Ref. Figure No.	Rev.	Date : AUG. 95	Scale : 1 : 8000
Title : EIA - VEGETATION ECOTOPES OCCUPYING SITE AREA	Joint Consultants : Binnie Consultants Limited, Wilbur Smith Associates Limited, Harris & Sutherland (Far East)			Figure No. 7.1

8 WATER QUALITY

Introduction

8.1 This section addresses the potential water quality impacts for the construction and operational phases and identifies mitigation measures to ensure minimal impacts to the surrounding environment.

8.2 Construction and operation of Kam Tin Bypass could adversely affect the local surface water system unless appropriate measures are taken. Such impacts would result from uncontrolled construction site runoff and drainage, or direct discharge of sewage, to the streams, adjacent agricultural land or fish ponds during the construction phase. Uncontrolled road surface runoff and drainage discharges are potential sources of contamination to the surface water system and other sensitive receivers during the operational stage.

Water Quality Assessment Criteria

8.3 The Study Area is within the Deep Bay Water Control Zone (WCZ) which was declared in December, 1990. The water quality in Kam Tin River should comply with the Water Quality Objectives (WCO) for the inland waters of Deep Bay WCZ; these are extracted in the following table.

Table 8.1
Water Quality Objectives for Rivers in Deep Bay WCZ

Parameters	WQO Criteria
pH	6.5 - 8.5
Suspended Solids	the annual median shall not exceed 20 mg/L
Dissolved Oxygen	not to be below 4 mg/L
Chemical Oxygen Demand	not to exceed 15 mg/L
Biochemical Oxygen Demand (5 day)	not to exceed 3 mg/L

Water Sensitive Receivers

8.4 The Kam Tin River itself is a sensitive receiver in that it carries water for downstream uses. The other sensitive receivers are the adjacent agricultural land and the downstream fishpond which is located in the western end of the site limit, as shown in Figure 7.1 in Section 7 of this report. This fishpond falls within an area zoned as an open space in the future, as shown in the OZP of the Kam Tin area (see Section 2).

Baseline Conditions

8.5 The Site is currently predominantly agricultural land with scattered villages. Two streams drain the northern and southern parts of the Site and feed into the Kam Tin River. Frequent flooding of this area has been reported with a return period of 1-2 years.

8.6 The water quality of the Kam Tin River was reported in the *Water Quality Assessment - North West New Territories Development: Main Drainage Improvement Works for Yuen Long Creek and Kam Tin River*[1] and is abstracted as follows:

> *The existing conditions of Kam Tin River in 1989 were described in the EPD report as badly polluted by organic wastes. The condition was intensified by the tidal intrusion from Deep Bay weakening the dispersal of the polluted river flows, and causing suspended materials to settle and accumulate on the river beds in the areas intruded by saline waters ...*
>
> *It is stated that more than 500 tonnes of livestock waste were discharged into the rivers in the study area daily, and that the sediments arising from this source exceed those arising from natural erosion, construction waste and tidal borne silt ...*
>
> *It was reported that levels of organic pollution and nutrient content (nitrogen and phosphorus) are very high and anoxic and anaerobic conditions exist in the lower reaches of the watercourses.*

8.7 The Kam Tin River was still ranked "very bad" as described in the latest EPD report *River Water Quality in Hong Kong for 1993*[2]. The annual median dissolved oxygen (DO) value was only 1.1 mg/L which is the lowest median value among all the rivers sampled in Hong Kong. The maximum DO level was less than 3.5 mg/L of the two monitoring sites along the river.

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1 *Water Quality Assessment - North West New Territories Development: Main Drainage Improvement Works for Yuen Long Creek and Kam Tin River* (1990) Environmental Protection Department

2 *River Water Quality in Hong Kong for 1993* (1994) Environmental Protection Department

8.8 Several site surveys were undertaken by our EIA study team to investigate the existing environmental conditions in the Study Area. Large loads of settled sediments were found in the stream courses during the site visits; these obviously reduce the capacity of the river.

Water Quality - Construction Phase

8.9 Potential impacts on surface water quality as a result of the construction activities include:

(i) construction runoff; and
(ii) sewage effluent from construction workforce.

8.10 Construction site runoff has the potential to cause the most damaging effects on the adjacent river by increasing the suspended solids loading and potential for sediment deposition. Construction site runoff also has the potential to cause damaging effects if it is directly drained into the adjoining agricultural land and fish ponds. If unrestrained, site runoff may carry suspended solids containing toxic contaminants such as fuels, oils, lubricants and concrete. Accidental spillage of chemicals and other contaminants may also be carried in surface water runoff. Any adverse impact on the water quality should be avoided.

8.11 Sewage effluent is characterised by higher suspended solids and biochemical oxygen demand (BOD), nutrients and bacterial count than fresh water. Adverse water quality impacts may result from uncontrolled discharges.

Mitigation Measures - Construction Phase

Construction runoff

8.12 It is important that proper site management and practices such as control measures on the runoff and drainage are carried out to ensure that construction activities do not cause high loadings of suspended solids to enter the nearby streams. The control is of particular importance when the construction works are close to the streams.

8.13 To protect surface runoff from possible contamination, it is important that:

(i) sediment traps, drainage channels and bunding are used (drainage channels and bunds must be designed to prevent construction site runoff from directly draining to the agricultural land or fish ponds);
(ii) oil interceptors have a bypass;
(iii) stockpiles or open working areas are minimised;
(iv) surface water is collected and settled; and
(v) solids in the sediment traps, manholes and stream beds are cleared out regularly.

8.14 Discharges from the construction site must be controlled to comply with the standards for effluent discharged into the inland waters as stated in the TM on *Standards for Effluent Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* of the Water Pollution Control Ordinance.

8.15 Advice on the handling and disposal of construction site discharges, including site runoff and contaminated wastewaters, is provided in the ProPECC Paper (PN1/94) on *Construction Site Drainage.*

8.16 The disposal of waste oil and other chemicals is controlled by the Waste Disposal (Chemical Waste) (General) Regulation (Cap 354). Waste oil and other chemicals must be disposed of at the Government Chemical Waste Treatment Centre at Tsing Yi.

8.17 Fuel and lubricating oil leakage from plant and storage sites should be prevented from contaminating the construction site. A spill action plan should be prepared. Suitable clean-up materials should be kept on site. Layers of sawdust, sand or equivalent material should be laid underneath and around any construction plant and equipment that may possibly leak oil. The polluted clean-up materials should be replaced with some clean materials on a regular basis. Any polluted materials should be disposed of in an acceptable and regular manner. Plant and storage sites for fuel and lubricating oil should be formed on bunded and impervious ground. Adequate numbers of oil/petrol interceptors should be provided.

Sewage

8.18 Latrines should be provided within the site office and temporary works area. Sewage generated from toilets, washing facilities and any temporary canteen provided for staff should be separately collected and suitable treatment should be provided before discharge.

8.19 Adequate and suitable temporary arrangements should be implemented such as sufficient chemical toilets and ensuring the waste generated is properly handled. The quantities of domestic waste will be relatively small.

Water Quality - Operational Phase

8.20 Potential impacts on surface water quality as a result of the operation of the road include road surface runoff. The chemical nature of the road surface runoff is highly variable, but the major potential pollutants are listed as follows:

(i) suspended solids - mainly from mud, corrosion, metal particles, grit, tyre organics and road surface wear;

(ii) lead - mainly from petrol, but in decreasing quantities as unleaded petrol is being widely used;

(iii) zinc and cadmium - mainly from the deterioration of the galvanised portions of vehicles, such as exhaust pipes and brake wear respectively (only small quantities);

(v) organics - such as rubber, bitumen, grease and oil (only small quantities); and

(vi) iron - from corrosion (only small quantities).

8.21 Only small quantities of the potential pollutants are expected, because the Kam Tin Bypass will not be regarded as a "busy" road based on the traffic census. The peak traffic flows are estimated to be 2000 - 2500 vehicles per hour. Moreover, the surface runoff impact on water courses can be minimized by drainage systems.

Mitigation Measures - Operational Phase

8.22 To protect surface runoff from possible contamination, surface water should be collected and settled. The road surface runoff will be diverted to the proposed Main Drainage Channels (MDC) for Yuen Long and Kam Tin. The road surface drainage system should be designed so that no runoff will be directly discharged to the adjoining agricultural land and fishponds. Desilting manholes will be installed along the Kam Tin Bypass to filter the overflow water before connecting to the permanent drainage system. Solids in the manholes and stream beds should be cleared out regularly.

Drainage Impact

Kam Tin Bypass

8.23 Kam Tin experiences frequent and extensive flooding on 1-2 year return period basis. In the review of the *Territorial Land Drainage and Flood Control Strategy Study - Phase I* (TELADFLOCCOSS 1)[3], physical change of a flooded area (eg. creation of embayments) may result in changes to water flows or levels which can increase the risk of flooding. The Kam Tin Bypass will be 1-2 m higher than the ground level and is to be situated in the flooding zone. These issues are currently being studied in the Kam Tin Bypass Drainage Impact Assessment.

[3] *Territorial Land Drainage and Flood Control Strategy Study - Phase 1* (1990) Mott Macdonald Hong Kong Ltd for Drainage Services Department

Main Drainage Channels for Yuen Long and Kam Tin

8.24 The problem of regular and repeated severe flooding impacts of the Site can be alleviated and the efficacy of the local drainage system in Kam Tin will be improved significantly by the Main Drainage Channels (MDC) for Yuen Long and Kam Tin Project. The construction of MDC for Yuen Long and Kam Tin will be undertaken concurrently with the Kam Tin Bypass. Section 22CD Phase 1-3 and Section 43CD Phase 3 of the MDC surround the Site and cut through the existing streams in certain parts, as shown in Figure 2.1 in Section 2 of this report.

8.25 The river training works of 43CD involves the construction of new river channel section which extends from the section of the Kam Tin River to the east of the Castle Peak Road and terminates on reaching the Kam Tin Road. Two fabric dams will be installed to act as a barrier to prevent tidal intrusion upstream. Tidal intrusion from Deep Bay currently weakens the dispersal of the polluted river flows, and causes suspended materials to settle and accumulate on the river beds. This situation will be alleviated by construction of the fabric dams.

8.26 Dry weather flow channels will be built upstream of the fabric dams to convey flow during the dry season. The fabric dams will allow sediment to be contained upstream under dry weather flow and low flow conditions, when the fabric dam is raised. Silt traps are to be installed just upstream of the fabric dams and sediments could be removed by regular maintenance when the dam is raised. Silt traps will also be built alongside the channel.

8.27 The 22CD section will complete the main drainage channel construction and the artificial channelisation including deepening, widening and lining of natural meandering streams.

8.28 In the operational phase of the MDC works, the Kam Tin river bed will be dredged frequently to prevent excess sediment accumulation and to maximise the flows and capacity of the river. It is advised that the on-site Environmental Manager will carry out regular checks to ensure that no excessive sediment accumulates in the stream courses.

Summary

8.29 It is not anticipated that there will be any deterioration in surface water quality or contamination of the nearby fish pond due to the construction, provided good site management practice and sensible measures are observed. Any discharges from the site are controlled under the TM on *Standards for Effluents Discharged into Sewerage Systems, Inland and Coastal Waters.*

8.30 No significant road surface runoff is expected if the settled solids in the desilting manholes are cleared out regularly.

8.31 The Kam Tin Bypass should not increase flood problems in the surrounding area. Improvement of drainage facilities and minimization of the flooding hazard are expected after the implementation of the MDC in Kam Tin area.

8.32 The realignment of the Kam Tin River under the MDC works should bring about a beneficial water quality impact on the Kam Tin River. Substantial improvement in the river water quality is expected after the full implementation of the Livestock Waste Control Scheme, Yuen Long and Kam Tin Sewerage Master Plan and the Water Pollution Control Ordinance.

9 CONSTRUCTION WASTE AND SPOIL MANAGEMENT

Introduction

9.1 Wastes will be produced during the construction phase. In order to minimise waste production, the potential for reuse and recycling has been considered in order to achieve good environmental conservation practice.

Site Clearance Phase

9.2 The proposed Kam Tin Bypass site is currently occupied by several residential houses, car stores and active farmlands. The area of abandoned farmland is covered mainly with grass. During the site clearance period, the houses and car stores will be demolished. The active farming will need to be halted in the working area before construction work can commence.

9.3 The materials from the construction site clearance will be sorted on Site into inert and non-inert materials. Non-inert material such as wood, and materials such as glass, steel or other metals will be taken to landfill. It should be noted that at the strategic landfill sites, construction waste must contain no more than 20% inert material by volume. Inert materials such as soil, rock, sand, concrete and debris will be sorted before disposal as much as possible and used at other building sites if this can be arranged. The most appropriate landfill sites for the disposal of vegetative wastes are SENT and NENT landfill sites.

Construction Phase

Municipal Waste

9.4 Solid and liquid wastes will be generated by the construction workers during the construction period. The total number of site staff is estimated to be about 105 persons. If the quantity of municipal waste generated is estimated to be 1.29 kg/employee/day[1], then the total generation will be 135 kg/day. A temporary refuse collection station will be set up by the Contractor. Municipal waste will be collected in black refuse bags and delivered to, and disposed of, at an approved landfill.

[1] *Monitoring of Municipal Solid Waste 1991, 1992* (1993) Environmental Protection Department

Chemical Waste

9.5 The chemical wastes likely to be generated during the construction period are lubricants, oil, paint and solvents. Lubricants and waste oil are likely to be generated from the maintenance of vehicles and mechanical equipment. Used lubricants will be collected and stored in individual containers which are fully labelled. The containers will be stored in a designated secure place. If these chemical wastes cannot be recycled, then they will be treated as Chemical Waste and sent to the Chemical Waste Treatment Centre at Tsing Yi.

9.6 All the empty chemical cans/drums/bottles will be collected for reuse or disposal. Chemical waste will not be allowed to discharge into stream courses and drains either by direct discharge or as contaminants carried in surface water runoff from the construction site.

Sewage

9.7 Domestic sewage generated from site toilets, washing facilities and any temporary canteen provided for construction workers will be collected separately and appropriately treated to comply with Government requirements. Sewage is characterised by high BOD and suspended solids, and is enriched with nutrients and high bacteriological counts.

Wood

9.8 Wooden materials may be used during the construction phase such as wooden boards for formwork. Wooden waste will be sorted out from other waste. On site incineration of wooden waste should be strictly prohibited as this would lead to excessive smoke emission and deposition of ash on local receivers, and would also be a fire hazard on the construction site. In order to minimize waste, the Contractor will be asked to identify wooden waste which can be reused and/or recycled.

Excavated Material

9.9 The volume of material to be excavated on the Site (mostly silt and mud) is estimated to be 2000 m^3. Only the excavated material in the eastern area of the Site is suitable to be reused. Any suitable excavated material will be stockpiled and used for the construction of embankment, barrier mound, etc. Unsuitable excavated material, e.g. mud/organic clay will be disposed of at the Pillar Point Valley Landfill in accordance with EPD's ProPECC PN 3/94. Alternatively, if marine disposal is selected, uncontaminated muds would be disposed of at either South Cheung Chau or East Ninepins; any materials classified as contaminated in accordance with WBTC 22/92 will be disposed of at East Sha Chau.

Fill Material

9.10 Approximately 140,000 m^3 of fill material is required for the road embankment. This Most fill material will be imported from Tai Tong East Borrow Area in Yuen Long, where some 110,000 m^3 of fill material has been reserved for the Project. Mitigation measures for dust associated with the handling and transportation of this material are covered in Section 6.

Concrete Waste

9.11 Of the volume of concrete supplied, it has been assumed that approximately 3% of the concrete used would be lost to waste (see Table 9.1). Dry concrete waste will be sorted out from the other wastes and recycled for reuse or sorted for disposal at the public dump.

Table 9.1
Volume of concrete arising from construction activities

Activity	Total volume of concrete required (m^3)	Total volume of concrete waste (m^3)
U-Channel	360	11
Trapezoidal Channel	1056	32
Subway	282	8
Footpath	240	7
Channel on Slope	600	18

Aqueous Wastes

9.12 All vehicles leaving the construction site should pass through a wheelwash at the Site exit. The wheelwash requires regular cleaning to remove sediment which may also produce a large volume of wastewater. To prevent excess sedimentation, and possibly contamination of local streams and water courses, these wastewaters could be directed into settlement lagoons. The wastewater can then be reused on site.

Summary

9.13 Waste will be produced during the construction period. The waste should be minimised and materials should be recycled as far as practicable to minimize the disposal requirement.

9.14 Provided that there is strict control of wastes from construction works and all arisings are stored, transported and disposed of using approved methods as described previously, no significant adverse environmental impacts are predicted. Thus, it is not anticipated that waste will have any serious impact.

10 IMPACTS SUMMARY AND RECOMMENDATIONS

Introduction

EIA Study Requirements

10.1 The requirements for the Kam Tin Bypass EIA Study are detailed in Section 6.1.1 'Environmental Study Brief' of the Consultancy Brief. The purpose of this EIA Study Report is detailed in Section 1 and can be summarised as to:

(i) provide an assessment and evaluation of the environmental impacts and cumulative effects arising from the proposed Project;

(ii) define measurable environmental parameters and environmental features likely to be affected by the proposed Project and identify baseline, construction and operational phase environmental monitoring programmes;

(iii) define the environmental audit requirements for compliance and post-project audits.

Detailed Environmental Studies

10.2 The scope of this EIA Study Report incorporates the results of detailed investigations of all key issues, namely: landscape and visual impact; construction and operational phase noise; construction and operational phase air quality; ecological impact; construction and operational phase water quality impact; construction waste and spoil management.

10.3 Background studies to identify, collect and analyse existing information relevant to the EIA Study have been undertaken. Where necessary, environmental surveys, site investigations and baseline monitoring have been carried out on site.

10.4 Potential short- and long-term impacts of the Project on sensitive receivers have been predicted and quantified, using mathematical models where appropriate, and assessed relative to the Hong Kong Planning Standards and Guidelines and other statutory requirements.

10.5 Practicable, effective and enforceable methods, measures and standards to mitigate adverse impacts to acceptable levels have been proposed.

10.6 An Environmental Monitoring & Audit Manual has been developed. This Manual is to be used as a guideline for environmental monitoring and audit during the construction and post-project operational phases.

Purpose of Impacts Summary

10.7 This Section summarises the findings of the detailed EIA Study. The summary is intended to provide an overall appreciation of the key issues associated with the Project. The potential impacts identified during the EIA Study have been presented in approximate order of relative importance.

Noise

10.8 The noise impact assessment has identified Noise Sensitive Receivers (NSRs) within the Study Area. Predicted noise levels at houses and schools representative of both existing and future NSRs have been calculated for both the construction and operational phases of the Project. The choice of both representative NSRs, potential baseline monitoring locations and modelling techniques have been agreed with EPD.

Construction Impacts

10.9 For assessment purposes it has been assumed that construction of the Bypass will be carried out in 100 m segments. Construction noise calculations have been based on the worst case scenario for each NSR, ie. when the nearest section of the Bypass to that NSR undergoes construction.

10.10 The noise calculations indicate that exceedances of EPD's recommended construction noise levels at NSRs could occur when construction activities are within 100 m of those NSRs.

10.11 Provided that the substantial temporary noise barriers and quiet working methods outlined below are diligently implemented, noise levels can be maintained below 75 dB(A) at houses during the daytime and below 70 dB(A) at schools. Particular care will be needed during school examination periods.

Impact Mitigation - Recommendations

10.12 In order to avoid exceedance of the recommended construction noise levels, we recommend that substantial acoustic protection in the form of temporary noise barriers is provided throughout the main construction period for the potentially most severely impacted NSRs.

10:13 In addition, we recommend that all equipment such as pneumatic breakers, which may be used for very short periods of time early in the construction programme, are sound-reduced by the use of silencers or similar means and acoustically screened. All equipment should be properly maintained and operated, and used no more often than is necessary.

10.14 We recommend that noisy equipment and activities are sited as far from close-proximity sensitive receivers as is practical. Prolonged operation of noisy equipment close to houses should be avoided.

10.15 We recommend that noisy activities are scheduled to minimise exposure of nearby sensitive receivers to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours).

10.16 Construction activities should also be planned so that parallel operation of several sets of equipment close to a given receiver is avoided. The number of items of powered mechanical equipment operating at any one time should be minimised. Idle equipment should be turned off or throttled down.

Operational Impacts

10.17 Traffic noise is the only significant source of noise for the operation of Kam Tin Bypass. Future traffic noise has been calculated at one metre away from the nearest facade and other selected facades of existing and planned sensitive receivers.

Impact Mitigation - Recommendations

10.18 Since the earliest studies for the Kam Tin Bypass, it has been recognised that construction of some form of noise barrier to protect the adjacent sensitive receivers is inevitable.

10.19 Noise calculations have confirmed that the construction of substantial permanent noise barriers is essential to protect existing and future residents of Kam Tin and the surrounding areas from the impact of traffic noise.

Protection of NSRs to the north of the Bypass

10.20 Future sensitive receivers, that is sensitive land uses allowing further dwelling construction, are fully protected to the north of the Bypass by the direct mitigation measures.

10.21 Construction of the drainage channel and associated embankments and service roads adjacent to the northern side of the Bypass will buffer most of the northern NSRs from traffic noise, without the need for any additional protection.

10.22 Three sections of 1 m and 2 m high acoustic barriers will be built to protect both existing and future NSRs located in areas between the drainage channel and the Bypass and just north of the drainage channel.

10.23 Future construction of 3 storey houses up to the northern boundary of the drainage channel will necessitate construction of a 1 m noise barrier along the full length of the northern side of the Bypass. This 1 m barrier will also protect houses built on the north eastern side of the Bypass. On the western end the land is zoned for agriculture.

Protection of NSRs to the south of the Bypass

10.24 In order to protect both existing and future NSRs to the south of the Bypass, it will be necessary to construct a continuous noise barrier along the southern boundary of the Bypass broken only at the intersections and extending a little distance along the intersecting roads.

10.25 Most NSRs can be adequately protected by a 2 m barrier on top of the 1.5 m earth bund to be constructed alongside the Bypass (ie. total 'barrier' height along this section is 3.5 m above road level). Some short sections of the barrier will need to be 3.5-5.5 m high on top of the bund (ie. total height is 5-7 m).

10.26 Protection of NSR 3 from excessive traffic noise necessitates the construction of the only section of 5.5 m high cantilever type noise barrier on top of a 1.5 m high earth bund. The proposed cantilever type noise barrier consists of a 3.5 m high vertical section with a 2 m high barrier above bending 30 degrees towards the carriageway side. This barrier would not overhang the carriageway. It is illustrated in Figure 5.15.

10.27 In order to fully protect NSR 3 and all other current sensitive receivers nearest NSR 3, two stretches of barrier 3.5 m high (i.e. 5 m above road level), are required. This fully protects all future sensitive receivers within the RC(1) zone near the Bypass. An area at the eastern end of Bypass is currently occupied by non-sensitive uses (vehicle storage) with NSR 3 in the northwestern corner. The calculation point 30 was placed at the worst case position within this area. It is not possible to fully protect a future sensitive receiver at calculation point 30. Partial protection is offered to future development in the area between NSR 3 and NSR 30. It is recommended that the practice of non-sensitive use be continued. If future residential development is undertaken between NSR 3 and the roundabout corner, then the necessity for noise mitigative design would need to be assessed case by case.

10.28 The Kam Tin Mung Yeung Public School (NSR 18) has been the subject of intensive assessment. This school had been provided with air conditioning under NAMISP, a programme to provide noise abatement measures to schools affected by excessive noise. However, only 7 of the 9 classrooms were found to be air-conditioned. The upper storey was relatively noise non-sensitive on the facades facing Kam Tin Road or the Bypass. Only an office, with air conditioning, faces Kam Tin Road and a corridor separates classrooms from the facade facing the Bypass. Barriers have been designed to bring future noise levels down to 75 or 65 dB(A) depending on the presence or absence of air-conditioning at noise sensitive facades. The ground floor of the facade facing Kam Tin Road has offices and non-sensitive walls at its eastern end. Classrooms at the eastern end are sheltered by the barrier wall. Noise levels shown in Table 5.16 have been calculated at the least protected end of the classrooms.

Noise - Operational Phase - Conclusions

10.29 Road traffic noise levels experienced by NSRs close to the existing Kam Tin Road and Kam Sheung Road are expected to be higher than the standards of the HKPSG. Current noise levels are already considerable and can exceed the HKPSG standards.

Summary

10.30 In order to fully protect all existing and virtually all future noise sensitive receivers, that is all currently planned land uses sensitive to traffic noise, the following mitigation measures will be implemented:

(i) construction of the planned 1.5 m high earth bund;

(ii) construction of extensive noise barriers both on the earth bund and extending beyond the bund and to the north of the Bypass as shown on Figure 5.14. HK$7 million to provide for 2½ km of barriers;

(iii) application and maintenance of friction course to the central section of the Bypass shown on Figure 5.13. It will cost at today's prices about HK$0.6 million to apply the friction course. The friction course will need to be repaved about every four years.

10.31 Without any direct technical remedies such as friction course or barriers, about 160 dwellings and 3 schools would suffer from traffic noise level above the HKPSG criteria after completion of the roadworks. Without direct technical remedies such as bunds or barriers but with friction course applied to the entire Bypass about 130 dwellings and 3 schools would exceed the HKPSG criteria.

10.32 After completion of the works including the implementation of the direct technical remedies as shown in Figures 5.13 and 5.14, that is the earth bunds, about 2½ km of barriers and a section of friction course, 5 dwellings and 1 school will still exceed the HKPSG criteria. However, in every case the exceedance is due to Kam Tin Road. The school, Kam Tin Dragon Kindergarten, is air-conditioned.

10.33 No dwelling meets the "eligibility criteria" for indirect technical remedies.

Air Quality

10.34 The air quality impact assessment has identified Air Sensitive Receivers (ASRs) within the Study Area. Construction dust contours for the Study Area predicted using the Fugitive Dust Model (FDM) have been plotted to assess the air quality impact on both existing and future ASRs; the impact on sensitive receivers of traffic emissions has been calculated using CALINE4 and plotted on contour diagrams which show peak hour average pollution contours at pedestrian level. The modelling techniques and parameters have been agreed with EPD.

Construction Impacts

10.35 Kam Tin is located in the Deep Bay Airshed which has a low dust dispersion potential.

10.36 Dust measurements are made in terms of Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP).

10.37 The 'worst case scenario' for construction dust generation is embankment formation. This construction scenario includes the following concurrent activities: movement of vehicles and fill materials on-site on unpaved roads and haul routes; unloading and compaction of fill materials; stockpiling; and wind erosion of the whole exposed area.

10.38 Movement of vehicles on the haul road will generate the greatest quantities of dust.

Impact Mitigation - Recommendations

10.39 The construction of Kam Tin Bypass is not expected to cause any significant dust impacts in relation to the AQO standard, providing that good site practices designed to minimise the generation of construction dust are fully implemented. The regular watering of haul roads is of particular importance.

10.40 We recommend that construction working areas should be restricted to a minimum practicable size, and that areas within the Site where there is a regular movement of vehicles should have an approved hard surface and be kept clear of loose surface material. We also recommend that the speed of vehicles on roads within the Site is limited to 20 kph, and that haulage and delivery vehicles are confined to designated roadways within the Site.

10.41 We recommend that regular watering of unpaved areas, access roads, construction areas and dusty stockpiles is undertaken at least twice daily during dry and windy weather. Watering the haul road once every three hours during the working day may be required in particularly dry or windy conditions.

10.42 We recommend that stockpiles of sand, aggregate or other dusty materials greater than 20 m^3 are enclosed on three sides with walls extending above and beyond the pile and that, where possible, stockpiles are stored in sheltered areas.

10.43 Wheel washing facilities should be provided at the exits to the Site. All vehicles leaving the Site should be compelled to use the wheel washes. The wheel washes should be regularly maintained.

10.44 We recommend that plant and vehicles are regularly inspected to ensure that they are operating efficiently and that exhaust emissions are not causing a nuisance. All site vehicle exhausts should be directed vertically upwards or away from the ground.

Operational Impacts

10.45 The major source of operational phase air pollution will be vehicular emissions from traffic on Kam Tin Bypass and Kam Sheung Road. Traffic air pollution is mainly from nitrogen dioxide (NO_2) and RSP.

10.46 Predicted maximum cumulative NO_2 levels fall well within the hourly AQO maximum of 300 $\mu g/m^3$. Peak hour RSP concentrations are well below the 24 hour RSP maximum concentration in the AQO.

10.47 All future air sensitive receivers in the study area will have predicted air quality levels well below the AQO. No buffer distance from the boundary of the Bypass is necessary.

Impact Mitigation - Recommendations

10.48 Pollution levels due to operational phase traffic emissions are expected to be acceptable, consequently no mitigation measures are considered necessary to reduce their impact.

Landscape and Visual Impact

10.49 The landscape and visual assessment has evaluated the existing landscape and visual quality in the Study Area, identified representative sensitive receivers, analysed the impacts of the Project on the area and proposed effective mitigation measures.

Construction Impacts

10.50 The imposition of a major Bypass on a traditional farmland environment will inevitably impinge adversely on the area's visual quality. However, any definition of the extent of this adverse effect must be assessed in relation of the positive benefits it creates elsewhere. This is the situation for the Kam Tin Bypass.

10.51 The Bypass carriageway is raised approximately 2 metres above the existing ground level for flood prevention reasons. On the southern side of the Bypass, a continuous earth mound of between 1.5 and 2.0 m higher than the carriageway is proposed. An additional noise barrier is needed on top of the earth mound which, for the purposes of the visual assessment has been estimated to be 2.5 m high.

10.52 The movement of vehicles, installation of vertical lighting poles, any overhead signage required and night-time illumination will exacerbate the visual impact.

10.53 Without mitigation, the Bypass will severely degrade the existing visual quality.

Impact Mitigation - Recommendations

10.54 The perspective views presented in the landscape and visual impact assessment demonstrate the effectiveness of a comprehensive landscape and tree planting programme.

10.55 To avoid accentuating the severe horizontal effect of the basic engineering requirements on the southern side of the noise barrier, a curvilinear barrier is proposed, supported by free-form, wavy structure of planting 'boxes'. This will create a more 'organic' form, allowing for variety in the shape and form of the

lower mound while providing structural support for the main noise barrier. Planting should be in irregular groups and extend, as far as space and other constraints permit, beyond the toe of the mound.

10.56 Extensive tree planting should be provided, within practical operational requirements, on the carriageway side of the barrier, with climbing species introduced to cover the barrier.

10.57 In the area between the Bypass and the drainage channel, it is recommended that substantial tree planting and ground cover vegetation is provided. At points indicated in the landscape and visual impact section, the existing tree cover should be protected and supplemented with extra trees and shrubs.

Ecological Impact

10.58 Field investigations have been undertaken in the Study Area to assess the overall conservation importance and general wildlife interest of the area. None of the animal and plant species recorded in the Study Area are listed in either the *Forests and Countryside Ordinance (Cap 96)* or in the *Animals and Plants (Protection of Endangered Species) Ordinance (Cap 197).*

10.59 Areas potentially affected by the Project include agricultural land, the Kam Tin River and associated reedbeds, fishponds and the Ko Po Village Egretry.

Construction Impacts

10.60 Construction of the Bypass will necessitate the loss of around 5 hectares of agricultural land currently used for commercial production of water spinach (*Ipomoea aquatica*).

10.61 In addition, some large individual trees and other plants will be lost.

10.62 The fishponds and reedbeds are located outside of the Works boundary and are not expected to be affected by this Project: greater impacts are anticipated from construction of the Main Drainage Channels.

Impact Mitigation - Recommendations

10.63 Mitigation measures recommended for water, air and noise should be sufficient to minimise impacts to the Kam Tin River and the Ko Po Village Egretry from the construction of the Bypass.

10.64 Although two tree corridors, at either end of the middle section of the Site, are to be lost, the subsequent landscaping and replanting with native plant species along the Bypass boundary would improve the visual impact of the Project as well as the ecology of the area.

Water Quality

10.65 The water quality impact has identified sensitive receivers and assessed potential impacts on water quality in the Study Area.

10.66 Kam Tin is located within the Deep Bay Water Control Zone. In view of the existing highly unsatisfactory water quality in Deep Bay, stringent requirements for effluent discharges into waters within the Deep Bay WCZ are laid out in the relevant legislation.

10.67 The water quality of Kam Tin River itself was still regarded as 'very bad' in the latest report on *River Water Quality in Hong Kong* published in 1994.

10.68 Construction and operation of Kam Tin Bypass could adversely affect the local surface water system, unless appropriate measures are taken. Such impacts would result from uncontrolled construction site runoff and drainage, or direct discharge of sewage, to the streams, adjacent agricultural land or fishponds during the construction phase.

Construction Impacts

10.69 Uncontrolled road surface runoff and drainage discharges are potential sources of contamination to the surface water system and other sensitive receivers during the construction stage.

Impact Mitigation - Recommendations

10.70 We do not anticipate that there will be any deterioration in surface water quality or contamination of any agricultural land or fishpond due to the construction of the Kam Tin Bypass, provided that good site management practice and sensible measures are observed.

10.71 It is important that proper site management and practices are carried out to ensure that construction activities prevent site runoff with high loadings of suspended solids or other contaminants from entering nearby streams.

10.72 We recommend that the advice on the handing and disposal of construction site discharges is provided in the ProPECC Paper (PN 1/94) on *Construction Site Drainage* is followed.

10.73 To protect surface runoff from possible contamination, we recommend that:

(i) surface runoff is collected via a system of drainage channels and bunds, and that the runoff is settled and passes through appropriate, well maintained sediment traps (drainage channels and bunds must be designed to prevent construction site runoff from directly draining onto the agricultural land or fishponds);

(ii) oil interceptors should have a bypass;

(iii) stockpiles and open working areas should be minimised;

(iv) solids in sediment traps and stream beds should be cleared out regularly.

Operational Impacts

10.74 Uncontrolled road surface runoff and drainage discharges to streams are potential sources of contamination during the operational phase.

Impact Mitigation - Recommendations

10.75 No significant road surface runoff is expected if the settled solids in the desilting manholes are cleaned out regularly.

Drainage Impacts

10.76 All issues relating to the impact of the Project on drainage in the Study Area, which is currently subject to regular and frequent flooding on a 1-2 year return period basis, are covered in the Drainage Impact Assessment.

Construction Waste & Spoil Management

10.77 Wastes will be generated during the site clearance and construction of the Kam Tin Bypass. In order to minimise unnecessary wastage, we have considered potential for reuse and recycling of construction materials.

Construction Impacts

10.78 Wastes produced during site clearance will include: glass, steel, concrete and wood from demolition of houses and car stores; trees and other vegetation, soil and rock.

10.79 During construction, wastes will include municipal waste (eg. packaging), chemicals and chemical waste, concrete, wood, 'unsuitable' excavated material and sewage from the workforce.

10.80 Approximately 140,000 m^3 of fill material is required for the road embankment. Most fill material will be imported from the Tai Tong East Borrow Area in Yuen Long, where some 110,000 m^3 of material has been reserved for the Project. The remainder of the fill will be reused material excavated from the Site.

Impact Mitigation - Recommendations

10.81 Provided that there is strict control of wastes from construction works and that all arisings are stored, transported and disposed of using approved methods, no significant adverse environmental impacts are anticipated.

10.82 We recommend that wastes are sorted into inert and non-inert materials and reused or disposed of to other building sites or landfill. Any materials contaminated with chemicals such as lubricants, oil, paint and solvents should be treated as chemical waste and sent to the Chemical Waste Treatment Centre at Tsing Yi.

10.83 We recommend that municipal waste is collected in black refuse bags and delivered to and, disposed of at, an approved landfill.

10.84 Used lubricants and waste oil should be collected and stored in suitable, fully labelled containers. These containers should be stored in a designated secure place. If the chemicals cannot be reused, they should be treated as chemical waste.

10.85 Dry concrete waste should be sorted out from other waste and recycled for reuse or sorted for disposal at the public dump.

10.86 Wood should be reused and recycled where possible. Under no circumstances should burning of wooden waste on site be permitted.

10.87 Excavated material which is unsuitable for reuse in road embankment and barrier mound formation or landscaping should be tested for contamination in accordance with ProPECC 3/94 and WBTC 22/92 and disposed of to landfill or marine mud pits, as appropriate.

10.88 Sewage from the site toilets, washing facilities and any temporary canteen should be treated and disposed of appropriately to Government standards.

10.89 Mitigation measures associated with the importation and handling of fill material are outlined above under the air quality impact assessment.

Environmental Monitoring & Audit

10.90 It is inevitable that construction of the Kam Tin Bypass will impact on the existing environment. Where potential adverse impacts from the construction and operation of the Project have been identified in the EIA, a series of mitigation measures have been set out to prevent these impacts, or at least to reduce them to an acceptable level. Most of these mitigation measures are what may be termed 'good construction practice'.

10.91 An Environmental Monitoring & Audit Manual has been developed as part of the EIA Report to ensure that good construction practice and monitoring of environmental effects is carried out systematically. The manual also provides a schedule of post project evaluation to allow the identification of unforeseen detrimental impacts.

Conclusion

10.92 The Kam Tin Bypass is an integral and essential part of Highways Department's development of the road network in the North West New Territories. Highways Department is committed to constructing and operating the new road in a manner which minimises adverse environmental impacts on the existing and future residents of the Kam Tin area.

10.93 Provided that the requirements of this report and the Environmental Monitoring & Audit Manual are carried out diligently, particularly with respect to:

Construction Phase

(i) erection of appropriate temporary acoustic barriers near the most affected NSRs during the construction phase;

(ii) use of quiet working methods;

(iii) frequent watering of haul roads, exposed areas and dusty stockpiles;

(iv) proper installation, use and maintenance of wheel washes at Site exits;

(v) adequate management of Site runoff;

Operational Phase

(vi) construction of the permanent noise barriers and application of friction course along the Bypass;

(vii) appropriate and well-maintained landscaping and tree planting,

the Project can be constructed and operated with a minimum of impact on the environment, to the benefit of both current and future residents in the Study Area and users of the new Kam Tin Bypass.

APPENDIX A

DETAILED NOISE CALCULATIONS

Kam Tin Bypass

1 Site Clearance/Formation

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
Backhoe	081	112	1	112.0	1.58E+11	119.9
Dump truck	067	117	1	117.0	5.01E+11	
Bulldozer	030	115	1	115.0	3.16E+11	
Air compressor	002	100	1	100.0	1.00E+10	

2 Removal of Unsuitable Material

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
Backhoe	081	112	1	112.0	1.58E+11	115.0
Lorry Tipper	141	112	1	112.0	1.58E+11	

3 Backfill for Road Embankment

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
Backhoe	081	112	2	115.0	3.17E+11	122.0
Dump truck	067	117	2	120.0	1.00E+12	
Compaction roller	185	108	1	108.0	6.31E+10	
Grader	104	113	1	113.0	2.00E+11	

4 Slope and Drainage Work

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
Backhoe	081	112	2	115.0	3.17E+11	119.7
Baby roller	185	108	1	108.0	6.31E+10	
40T crane truck	048	112	2	115.0	3.17E+11	
Lorry tipper	141	112	1	112.0	1.58E+11	
Concrete truck	044	109	1	109.0	7.94E+10	

5 Roadwork (Flexible Pavement)

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
Baby roller	185	108	1	108.0	6.31E+10	115.6
40T crane truck	048	112	1	112.0	1.58E+11	
Milling machine	184	111	1	111.0	1.26E+11	
Suction sweeper	-	101	1	101.0	1.26E+10	

6 Roadwork (Rigid Pavement)

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
40T crane truck	048	112	1	112.0	1.58E+11	120.5
Concrete truck	044	109	2	112.0	1.59E+11	
Air compressor	002	100	1	100.0	1.00E+10	
Vibrating plate/poker	170	113	4	119.0	7.98E+11	

7 Temporary Drainage Diversion

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
Generator	102	100	1	100.0	1.00E+10	100.8
Water pump	283	85	6	92.8	1.90E+09	

8 Structural Work (Subway)

Type of PME	CNP code	SWL (T.M.)	No. of units	SWL	Summation of SWL	T.SWL
40T crane truck	048	112	1	112.0	1.58E+11	119.5
Lorry tipper	141	112	1	112.0	1.58E+11	
Concrete truck	044	109	2	112.0	1.59E+11	
Generator	102	100	1	100.0	1.00E+10	
Air compressor	002	100	1	100.0	1.00E+10	
Vibrating plate/poker	170	113	2	116.0	3.99E+11	

Table A.1 Equipment List and the Sound Power Levels

Kam Tin Bypass SCENARIO I

NSR	Activity	T.SWL dB(A)	Source	Hori. Dist. (m)	Vert. Dist. (m)	Actual Dist. (m)	Distance Correction dB(A)	CNL 1 dB(A)	Summation of CNL 1	Unmitigated CNL dB(A)	Barrier Correction dB(A)	CNL 2 dB(A)	Summation of CNL 2 dB(A)	Barriered CNL dB(A)
1	1	119.9	A	60	1.5	60	43.6	79.4	8.65E+07	79.7	-10	69.4	8.65E+06	69.7
	2	115.0	B	114	1.5	114	49.1	68.9	7.71E+06		-10	58.9	7.71E+05	
	7	100.8	C	225	1.5	225	55.0	48.8	7.51E+04		-10	38.8	7.51E+03	
2	1	119.9	A	115	1.5	115	49.2	73.7	2.36E+07	74.9	-10	63.7	2.36E+06	64.9
	2	115.0	B	116	1.5	116	49.3	68.7	7.45E+06		-10	58.7	7.45E+05	
	7	100.8	C	198	1.5	198	53.9	49.9	9.70E+04		-10	39.9	9.70E+03	
3	1	119.9	A	123	1.5	123	49.8	73.1	2.06E+07	83.2	-10	63.1	2.06E+06	73.2
	2	115.0	B	23	1.5	23	35.3	82.8	1.89E+08		-10	72.8	1.89E+07	
	7	100.8	C	110	1.5	110	48.8	55.0	3.14E+05		-10	45.0	3.14E+04	
4	1	119.9	A	185	1.5	185	53.3	69.6	9.11E+06	72.9	-10	59.6	9.11E+05	62.9
	2	115.0	B	99	1.5	99	47.9	70.1	1.02E+07		-10	60.1	1.02E+06	
	7	100.8	C	113	1.5	113	49.1	54.7	2.98E+05		-10	44.7	2.98E+04	
5	1	119.9	A	273	1.5	273	56.7	66.2	4.18E+06	69.6	-10	56.2	4.18E+05	59.6
	2	115.0	B	164	1.5	164	52.3	65.7	3.73E+06		-10	55.7	3.73E+05	
	7	100.8	C	57	1.5	57	43.1	60.7	1.17E+06		-10	50.7	1.17E+05	
6	1	119.9	A	319	1.5	319	58.1	64.9	3.06E+06	67.6	-10	54.9	3.06E+05	57.6
	2	115.0	B	210	1.5	210	54.4	63.6	2.27E+06		-10	53.6	2.27E+05	
	7	100.8	C	102	1.5	102	48.2	55.6	3.65E+05		-10	45.6	3.65E+04	
7	1	119.9	A	240	1.5	240	55.6	67.3	5.41E+06	69.7	-10	57.3	5.41E+05	59.7
	2	115.0	B	165	1.5	165	52.4	65.7	3.68E+06		-10	55.7	3.68E+05	
	7	100.8	C	142	1.5	142	51.0	52.8	1.89E+05		-10	42.8	1.89E+04	
8	1	119.9	D	87	1.5	87	46.8	76.1	4.12E+07	76.9	-10	66.1	4.12E+06	66.9
	2	115.0	E	111	1.5	111	48.9	69.1	8.13E+06		-10	59.1	8.13E+05	
	7	100.8	F	210	1.5	210	54.4	49.4	8.62E+04		-10	39.4	8.62E+03	
9	1	119.9	D	98	1.5	98	47.8	75.1	3.25E+07	76.6	-10	65.1	3.25E+06	66.6
	2	115.0	E	86	1.5	86	46.7	71.3	1.35E+07		-10	61.3	1.35E+06	
	7	100.8	F	173	1.5	173	52.8	51.0	1.27E+05		-10	41.0	1.27E+04	
10	1	119.9	D	207	1.5	207	54.3	68.6	7.28E+06	71.9	-10	58.6	7.28E+05	61.9
	2	115.0	E	119	1.5	119	49.5	68.5	7.08E+06		-10	58.5	7.08E+05	
	7	100.8	F	62	1.5	62	43.9	59.9	9.88E+05		-10	49.9	9.88E+04	
11	1	119.9	G	172	1.5	172	52.7	70.2	1.05E+07	70.7	-10	60.2	1.05E+06	60.7
	2	115.0	H	300	1.5	300	57.5	60.5	1.11E+06		-10	50.5	1.11E+05	
	7	100.8	J	427	1.5	427	60.6	43.2	2.09E+04		-10	33.2	2.09E+03	
12	1	119.9	G	130	1.5	130	50.3	72.7	1.84E+07	73.3	-10	62.7	1.84E+06	63.3
	2	115.0	H	194	1.5	194	53.8	64.3	2.66E+06		-10	54.3	2.66E+05	
	7	100.8	J	312	1.5	312	57.9	45.9	3.91E+04		-10	35.9	3.91E+03	
13	1	119.9	G	174	1.5	174	52.8	70.1	1.03E+07	74.2	-10	60.1	1.03E+06	64.2
	2	115.0	H	80	1.5	80	46.1	71.9	1.57E+07		-10	61.9	1.57E+06	
	7	100.8	J	150	1.5	150	51.5	52.3	1.69E+05		-10	42.3	1.69E+04	
14	1	119.9	G	149	1.5	149	51.5	71.5	1.40E+07	76.2	-10	61.5	1.40E+06	66.2
	2	115.0	H	60	1.5	60	43.6	74.4	2.78E+07		-10	64.4	2.78E+06	
	7	100.8	J	154	1.5	154	51.8	52.0	1.60E+05		-10	42.0	1.60E+04	
15	1	119.9	G	140	1.5	140	50.9	72.0	1.59E+07	84.7	-10	62.0	1.59E+06	74.7
	2	115.0	H	19	1.5	19	33.6	84.4	2.76E+08		-10	74.4	2.76E+07	
	7	100.8	J	125	1.5	125	49.9	53.9	2.43E+05		-10	43.9	2.43E+04	
16	1	119.9	G	114	1.5	114	49.1	73.8	2.40E+07	77.1	-10	63.8	2.40E+06	67.1
	2	115.0	H	61	1.5	61	43.7	74.3	2.69E+07		-10	64.3	2.69E+06	
	7	100.8	J	164	1.5	164	52.3	51.5	1.41E+05		-10	41.5	1.41E+04	
17	1	119.9	G	157	1.5	157	51.9	71.0	1.26E+07	79.3	-10	61.0	1.26E+06	69.3
	2	115.0	H	37	1.5	37	39.4	78.6	7.31E+07		-10	68.6	7.31E+06	
	7	100.8	J	111	1.5	111	48.9	54.9	3.09E+05		-10	44.9	3.09E+04	
18	1	119.9	G	209	1.5	209	54.4	68.5	7.14E+06	72.4	-10	58.5	7.14E+05	62.4
	2	115.0	H	101	1.5	101	48.1	69.9	9.82E+06		-10	59.9	9.82E+05	
	7	100.8	J	92	1.5	92	47.3	56.5	4.49E+05		-10	46.5	4.49E+04	
19	1	119.9	G	277	1.5	277	56.8	66.1	4.06E+06	68.8	-10	56.1	4.06E+05	58.8
	2	115.0	H	175	1.5	175	52.9	65.1	3.27E+06		-10	55.1	3.27E+05	
	7	100.8	J	122	1.5	122	49.7	54.1	2.55E+05		-10	44.1	2.55E+04	
20	1	119.9	G	195	1.5	195	53.8	69.1	8.20E+06	70.0	-10	59.1	8.20E+05	60.0
	2	115.0	H	233	1.5	233	56.3	62.7	1.85E+06		-10	52.7	1.85E+05	
	7	100.8	J	307	1.5	307	57.7	46.1	4.03E+04		-10	36.1	4.03E+03	
21	1	119.9	D	355	1.5	355	59.0	63.9	2.47E+06	65.6	-10	53.9	2.47E+05	55.6
	2	115.0	E	300	1.5	300	57.5	60.5	1.11E+06		-10	50.5	1.11E+05	
	7	100.8	F	260	1.5	260	56.3	47.5	5.62E+04		-10	37.5	5.62E+03	
22	1	119.9	D	294	1.5	294	57.4	65.6	3.61E+06	67.1	-10	55.6	3.61E+05	57.1
	2	115.0	E	262	1.5	262	56.4	61.6	1.46E+06		-10	51.6	1.46E+05	
	7	100.8	F	261	1.5	261	56.3	47.5	5.58E+04		-10	37.5	5.58E+03	
23	1	119.9	A	288	1.5	288	57.2	65.8	3.76E+06	67.6	-10	55.8	3.76E+05	57.6
	2	115.0	B	232	1.5	232	55.3	62.7	1.86E+06		-10	52.7	1.86E+05	
	7	100.8	C	216	1.5	216	54.7	49.1	8.15E+04		-10	39.1	8.15E+03	
24	1	119.9	G	132	1.5	132	50.4	72.5	1.79E+07	73.4	-10	62.5	1.79E+06	63.4
	2	115.0	H	158	1.5	158	52.0	66.0	4.01E+06		-10	56.0	4.01E+05	
	7	100.8	J	244	1.5	244	55.7	48.1	6.39E+04		-10	38.1	6.39E+03	

Table A.2 The Predicted Construction Noise Levels during Scenario 1

Kam Tin Bypass SCENARIO IIa

NSR	Activity	T.SWL dB(A)	Source	Hori. Dist. (m)	Vert. Dist. (m)	Actual Dist. (m)	Distance Correction dB(A)	CNL 1 dB(A)	Summation of CNL 1	Unmitigated CNL dB(A)	Barrier Correcton dB(A)	CNL 2 dB(A)	Summation of CNL 2 dB(A)	Barriered CNL dB(A)
1	3	122.0	A	50	1.5	50	43.6	81.4	1.39E+08	82.1	-10	71.4	1.39E+07	72.1
	4	119.7	B	114	1.5	114	49.1	73.6	2.27E+07		-10	63.6	2.27E+06	
2	3	122.0	A	115	1.5	115	49.2	75.8	3.79E+07	77.8	-10	65.8	3.79E+06	67.8
	4	119.7	B	116	1.5	116	49.3	73.4	2.20E+07		-10	63.4	2.20E+06	
3	3	122.0	A	123	1.5	123	49.8	75.2	3.31E+07	87.7	-10	65.2	3.31E+06	77.7
	4	119.7	B	23	1.5	23	35.3	87.5	5.57E+08		-10	77.5	5.57E+07	
4	3	122.0	A	185	1.5	185	53.3	71.7	1.46E+07	76.5	-10	61.7	1.46E+06	66.5
	4	119.7	B	99	1.5	99	47.9	74.8	3.02E+07		-10	64.8	3.02E+06	
5	3	122.0	A	273	1.5	273	56.7	68.3	6.72E+06	72.5	-10	58.3	6.72E+05	62.5
	4	119.7	B	164	1.5	164	52.3	70.4	1.10E+07		-10	60.4	1.10E+06	
6	3	122.0	A	319	1.5	319	58.1	66.9	4.93E+06	70.7	-10	56.9	4.93E+05	60.7
	4	119.7	B	210	1.5	210	54.4	68.3	6.70E+06		-10	58.3	6.70E+05	
7	3	122.0	A	240	1.5	240	55.6	69.4	8.70E+06	72.9	-10	59.4	8.70E+05	62.9
	4	119.7	B	165	1.5	165	52.4	70.4	1.09E+07		-10	60.4	1.09E+06	
8	3	122.0	D	87	1.5	87	48.8	78.2	6.62E+07	79.6	-10	68.2	6.62E+06	69.6
	4	119.7	E	111	1.5	111	48.9	73.8	2.40E+07		-10	63.8	2.40E+06	
9	3	122.0	D	98	1.5	98	47.8	77.2	5.22E+07	79.6	-10	67.2	5.22E+06	69.6
	4	119.7	E	86	1.5	86	46.7	76.0	4.00E+07		-10	66.0	4.00E+06	
10	3	122.0	D	207	1.5	207	54.3	70.7	1.17E+07	75.1	-10	60.7	1.17E+06	65.1
	4	119.7	E	119	1.5	119	49.5	73.2	2.09E+07		-10	63.2	2.09E+06	
11	3	122.0	G	172	1.5	172	52.7	72.3	1.69E+07	73.1	-10	62.3	1.69E+06	63.1
	4	119.7	H	300	1.5	300	57.5	65.2	3.29E+06		-10	55.2	3.29E+05	
12	3	122.0	G	130	1.5	130	50.3	74.7	2.97E+07	75.7	-10	64.7	2.97E+06	65.7
	4	119.7	H	194	1.5	194	53.8	69.0	7.86E+06		-10	59.0	7.86E+05	
13	3	122.0	G	174	1.5	174	52.8	72.2	1.66E+07	78.0	-10	62.2	1.66E+06	68.0
	4	119.7	H	80	1.5	80	46.1	78.8	4.82E+07		-10	68.8	4.82E+06	
14	3	122.0	G	149	1.5	149	51.5	73.5	2.26E+07	80.2	-10	63.5	2.26E+06	70.2
	4	119.7	H	60	1.5	60	43.8	79.1	8.21E+07		-10	69.1	8.21E+06	
15	3	122.0	G	140	1.5	140	50.9	74.1	2.56E+07	89.2	-10	64.1	2.56E+06	79.2
	4	119.7	H	19	1.5	19	33.6	89.1	8.14E+08		-10	79.1	8.14E+07	
16	3	122.0	G	114	1.5	114	49.1	75.9	3.86E+07	80.7	-10	65.9	3.86E+06	70.7
	4	119.7	H	61	1.5	61	43.7	79.0	7.94E+07		-10	69.0	7.94E+06	
17	3	122.0	G	157	1.5	157	51.9	73.1	2.03E+07	83.7	-10	63.1	2.03E+06	73.7
	4	119.7	H	37	1.5	37	39.4	83.3	2.16E+08		-10	73.3	2.16E+07	
18	3	122.0	G	209	1.5	209	54.4	70.6	1.15E+07	76.1	-10	60.6	1.15E+06	66.1
	4	119.7	H	101	1.5	101	48.1	74.6	2.90E+07		-10	64.6	2.90E+06	
19	3	122.0	G	277	1.5	277	56.8	68.2	6.53E+06	72.1	-10	58.2	6.53E+05	62.1
	4	119.7	H	175	1.5	175	52.9	69.8	9.65E+06		-10	59.8	9.65E+05	
20	3	122.0	G	195	1.5	195	53.8	71.2	1.32E+07	72.7	-10	61.2	1.32E+06	62.7
	4	119.7	H	233	1.5	233	55.3	67.4	5.45E+06		-10	57.4	5.45E+05	
21	3	122.0	D	355	1.5	355	59.0	68.0	3.98E+06	68.8	-10	58.0	3.98E+05	58.8
	4	119.7	E	300	1.5	300	57.5	65.2	3.29E+06		-10	55.2	3.29E+05	
22	3	122.0	D	294	1.5	294	57.4	67.6	5.80E+06	70.0	-10	57.6	5.80E+05	60.0
	4	119.7	E	262	1.5	262	56.4	66.3	4.31E+06		-10	56.3	4.31E+05	
23	3	122.0	A	288	1.5	288	57.2	67.8	6.04E+06	70.6	-10	57.8	6.04E+05	60.6
	4	119.7	B	232	1.5	232	55.3	67.4	5.49E+06		-10	57.4	5.49E+05	
24	3	122.0	G	132	1.5	132	50.4	74.6	2.88E+07	76.1	-10	64.6	2.88E+06	66.1
	4	119.7	H	158	1.5	158	52.0	70.7	1.18E+07		-10	60.7	1.18E+06	

Table A.3a The Predicted Construction Noise Levels during Scenario 2

Kam Tin Bypass SCENARIO IIb

NSR	Activity	T.SWL dB(A)	Source	Hori. Dist. (m)	Vert. Dist. (m)	Actual Dist. (m)	Distance Correction dB(A)	CNL 1 dB(A)	Summation of CNL 1	Unmitigated CNL dB(A)	Barrier Correction dB(A)	CNL 2 dB(A)	Summation of CNL 2 dB(A)	Barriered CNL dB(A)
1	3	122.0	A	60	1.5	60	43.6	81.4	1.39E+08	82.1	-10	71.4	1.39E+07	72.1
	4	119.7	B	114	1.5	114	49.1	73.6	2.27E+07		-10	63.6	2.27E+06	
2	3	122.0	A	115	1.5	115	49.2	75.8	3.79E+07	77.8	-10	65.8	3.79E+06	67.8
	4	119.7	B	118	1.5	118	49.3	73.4	2.20E+07		-10	63.4	2.20E+06	
3	3	122.0	A	123	1.5	123	49.8	75.2	3.31E+07	87.7	-10	65.2	3.31E+06	77.7
	4	119.7	B	23	1.5	23	35.3	87.5	5.67E+08		-10	77.5	5.67E+07	
4	3	122.0	A	185	1.5	185	53.3	71.7	1.46E+07	76.5	-10	61.7	1.46E+06	66.5
	4	119.7	B	99	1.5	99	47.9	74.8	3.02E+07		-10	64.8	3.02E+06	
5	3	122.0	A	273	1.5	273	56.7	68.3	6.72E+06	74.3	-10	58.3	6.72E+05	64.3
	4	119.7	B	184	1.5	184	52.3	70.4	1.10E+07		-10	60.4	1.10E+06	
	8	119.5	K	175	1.5	175	52.9	69.6	9.20E+06		-10	59.6	9.20E+05	
6	3	122.0	A	319	1.5	319	58.1	68.9	4.93E+06	72.6	-10	58.9	4.93E+05	62.6
	4	119.7	B	210	1.5	210	54.4	68.3	6.70E+06		-10	58.3	6.70E+05	
	8	119.5	K	205	1.5	205	54.2	68.3	6.71E+06		-10	58.3	6.71E+05	
7	3	122.0	A	240	1.5	240	55.6	69.4	8.70E+06	72.9	-10	59.4	8.70E+05	62.9
	4	119.7	B	165	1.5	165	52.4	70.4	1.09E+07		-10	60.4	1.09E+06	
8	3	122.0	D	97	1.5	97	46.8	78.2	6.62E+07	81.1	-10	68.2	6.62E+06	71.1
	4	119.7	E	111	1.5	111	48.9	73.6	2.40E+07		-10	63.6	2.40E+06	
	8	119.5	K	85	1.5	85	48.6	75.9	3.90E+07		-10	65.9	3.90E+06	
9	3	122.0	D	98	1.5	98	47.8	77.2	5.22E+07	82.0	-10	67.2	5.22E+06	72.0
	4	119.7	E	88	1.5	88	46.7	76.0	4.00E+07		-10	66.0	4.00E+06	
	8	119.5	K	65	1.5	65	44.3	78.2	6.67E+07		-10	68.2	6.67E+06	
10	3	122.0	D	207	1.5	207	54.3	70.7	1.17E+07	76.8	-10	60.7	1.17E+06	66.8
	4	119.7	E	119	1.5	119	49.5	73.2	2.09E+07		-10	63.2	2.09E+06	
	8	119.5	K	135	1.5	135	50.8	71.9	1.55E+07		-10	61.9	1.55E+06	
11	3	122.0	G	172	1.5	172	52.7	72.3	1.69E+07	73.6	-10	62.3	1.69E+06	63.6
	4	119.7	H	300	1.5	300	57.5	65.2	3.29E+06		-10	55.2	3.29E+05	
	8	119.5	K	335	1.5	335	58.5	64.0	2.51E+06		-10	54.0	2.51E+05	
12	3	122.0	G	130	1.5	130	50.3	74.7	2.97E+07	75.7	-10	64.7	2.97E+06	65.7
	4	119.7	H	194	1.5	194	53.8	69.0	7.86E+06		-10	59.0	7.86E+05	
13	3	122.0	G	174	1.5	174	52.8	72.2	1.66E+07	78.0	-10	62.2	1.66E+06	68.0
	4	119.7	H	80	1.5	80	48.1	78.6	4.62E+07		-10	68.6	4.62E+06	
14	3	122.0	G	149	1.5	149	51.5	73.5	2.26E+07	80.2	-10	63.5	2.26E+06	70.2
	4	119.7	H	60	1.5	60	43.6	79.1	8.21E+07		-10	69.1	8.21E+06	
15	3	122.0	G	140	1.5	140	50.9	74.1	2.56E+07	89.2	-10	64.1	2.56E+06	79.2
	4	119.7	H	19	1.5	19	33.6	89.1	8.14E+08		-10	79.1	8.14E+07	
16	3	122.0	G	114	1.5	114	49.1	75.9	3.86E+07	80.7	-10	65.9	3.86E+06	70.7
	4	119.7	H	61	1.5	61	43.7	79.0	7.94E+07		-10	69.0	7.94E+06	
17	3	122.0	G	157	1.5	157	51.9	73.1	2.03E+07	83.7	-10	63.1	2.03E+06	73.7
	4	119.7	H	37	1.5	37	39.4	83.3	2.16E+08		-10	73.3	2.16E+07	
18	3	122.0	G	209	1.5	209	54.4	70.6	1.15E+07	76.1	-10	60.6	1.15E+06	66.1
	4	119.7	H	101	1.5	101	48.1	74.8	2.90E+07		-10	64.8	2.90E+06	
19	3	122.0	G	277	1.5	277	56.8	68.2	6.53E+06	72.1	-10	58.2	6.53E+05	62.1
	4	119.7	H	175	1.5	175	52.9	69.8	9.65E+06		-10	59.8	9.65E+05	
20	3	122.0	G	195	1.5	195	53.8	71.2	1.32E+07	72.7	-10	61.2	1.32E+06	62.7
	4	119.7	H	233	1.5	233	55.3	67.4	5.45E+06		-10	57.4	5.45E+05	
21	3	122.0	D	355	1.5	355	59.0	68.0	3.98E+06	68.8	-10	58.0	3.98E+05	58.8
	4	119.7	E	300	1.5	300	57.5	65.2	3.29E+06		-10	55.2	3.29E+05	
22	3	122.0	D	294	1.5	294	57.4	67.8	5.80E+06	70.0	-10	57.8	5.80E+05	60.0
	4	119.7	E	262	1.5	262	56.4	66.3	4.31E+06		-10	56.3	4.31E+05	
23	3	122.0	A	288	1.5	288	57.2	67.8	6.04E+06	70.8	-10	57.8	6.04E+05	60.8
	4	119.7	B	232	1.5	232	55.3	67.4	5.49E+06		-10	57.4	5.49E+05	
24	3	122.0	G	132	1.5	132	50.4	74.6	2.88E+07	76.1	-10	64.6	2.88E+06	66.1
	4	119.7	H	158	1.5	158	52.0	70.7	1.18E+07		-10	60.7	1.18E+06	

Table A.3b The Predicted Construction Noise Levels during Scenario 2

Kam Tin Bypass SCENARIO III

NSR	Activity	T.SWL dB(A)	Source	Hori. Dist. (m)	Vert. Dist. (m)	Actual Dist. (m)	Distance Correction dB(A)	CNL 1 dB(A)	Summation of CNL 1	Unmitigated CNL dB(A)	Barrier Correction dB(A)	CNL 2 dB(A)	Summation of CNL 2 dB(A)	Mitigated CNL dB(A)
1	5	115.6	A	60	1.5	60	43.6	75.0	3.19E+07	77.7	-10	65.0	3.19E+06	67.7
	6	120.5	B	114	1.5	114	49.1	74.4	2.73E+07		-10	64.4	2.73E+06	
2	5	115.6	A	115	1.5	115	49.2	69.4	8.68E+06	75.4	-10	59.4	8.68E+05	65.4
	6	120.5	B	116	1.5	116	49.3	74.2	2.64E+07		-10	64.2	2.64E+06	
3	5	115.6	A	123	1.5	123	49.8	68.8	7.59E+06	86.3	-10	58.8	7.59E+05	76.3
	6	120.5	B	23	1.5	23	35.3	86.2	6.68E+08		-10	76.2	6.68E+07	
4	5	115.6	A	185	1.5	185	53.3	65.3	3.35E+06	76.0	-10	55.3	3.35E+05	66.0
	6	120.5	B	99	1.5	99	47.9	75.6	3.62E+07		-10	65.6	3.62E+06	
5	5	115.6	A	273	1.5	273	56.7	61.9	1.54E+06	71.7	-10	51.9	1.54E+05	61.7
	6	120.5	B	164	1.5	164	52.3	71.2	1.32E+07		-10	61.2	1.32E+06	
6	5	115.6	A	319	1.5	319	58.1	60.5	1.13E+06	69.6	-10	50.5	1.13E+05	59.6
	6	120.5	B	210	1.5	210	54.4	69.1	8.05E+06		-10	59.1	8.05E+05	
7	5	115.6	A	240	1.5	240	55.6	63.0	1.99E+06	71.8	-10	53.0	1.99E+05	61.8
	6	120.5	B	165	1.5	165	52.4	71.1	1.30E+07		-10	61.1	1.30E+06	
8	5	115.6	D	87	1.5	87	46.8	71.8	1.52E+07	78.4	-10	61.8	1.52E+06	68.4
	6	120.5	E	111	1.5	111	48.9	74.8	2.88E+07		-10	64.8	2.88E+06	
9	5	115.6	D	98	1.5	98	47.8	70.8	1.20E+07	77.8	-10	60.8	1.20E+06	67.8
	6	120.5	E	86	1.5	86	46.7	76.8	4.80E+07		-10	66.8	4.80E+06	
10	5	115.6	D	207	1.5	207	54.3	64.3	2.68E+06	74.4	-10	54.3	2.68E+05	64.4
	6	120.5	E	119	1.5	119	49.5	74.0	2.51E+07		-10	64.0	2.51E+06	
11	5	115.6	G	172	1.5	172	52.7	65.9	3.88E+06	68.9	-10	55.9	3.88E+05	58.9
	6	120.5	H	300	1.5	300	57.5	66.0	3.94E+06		-10	56.0	3.94E+05	
12	5	115.6	G	130	1.5	130	50.3	68.3	6.79E+06	72.1	-10	58.3	6.79E+05	62.1
	6	120.5	H	194	1.5	194	53.8	69.7	9.43E+06		-10	59.7	9.43E+05	
13	5	115.6	G	174	1.5	174	52.8	65.8	3.79E+06	77.7	-10	55.8	3.79E+05	67.7
	6	120.5	H	80	1.5	80	46.1	77.4	5.54E+07		-10	67.4	5.54E+06	
14	5	115.6	G	149	1.5	149	51.5	67.1	5.17E+06	80.2	-10	57.1	5.17E+05	70.2
	6	120.5	H	60	1.5	60	43.6	79.9	9.85E+07		-10	69.9	9.85E+06	
15	5	115.6	G	140	1.5	140	50.9	67.7	5.86E+06	89.9	-10	57.7	5.86E+05	79.9
	6	120.5	H	19	1.5	19	33.6	89.9	9.77E+08		-10	79.9	9.77E+07	
16	5	115.6	G	114	1.5	114	49.1	69.5	8.83E+06	80.2	-10	59.5	8.83E+05	70.2
	6	120.5	H	61	1.5	61	43.7	79.8	9.53E+07		-10	69.8	9.53E+06	
17	5	115.6	G	157	1.5	157	51.9	66.7	4.66E+06	84.2	-10	56.7	4.66E+05	74.2
	6	120.5	H	37	1.5	37	39.4	84.1	2.59E+08		-10	74.1	2.59E+07	
18	5	115.6	G	209	1.5	209	54.4	64.2	2.63E+06	75.7	-10	54.2	2.63E+05	65.7
	6	120.5	H	101	1.5	101	48.1	75.4	3.48E+07		-10	65.4	3.48E+06	
19	5	115.6	G	277	1.5	277	56.8	61.8	1.50E+06	71.2	-10	51.8	1.50E+05	61.2
	6	120.5	H	175	1.5	175	52.9	70.6	1.16E+07		-10	60.6	1.16E+06	
20	5	115.6	G	195	1.5	195	53.8	64.8	3.02E+06	69.8	-10	54.8	3.02E+05	59.8
	6	120.5	H	233	1.5	233	55.3	68.2	6.54E+06		-10	58.2	6.54E+05	
21	5	115.6	D	355	1.5	355	59.0	59.8	9.11E+05	68.9	-10	49.8	9.11E+04	58.9
	6	120.5	E	300	1.5	300	57.5	68.0	3.94E+06		-10	58.0	3.94E+05	
22	5	115.6	D	294	1.5	294	57.4	61.2	1.33E+06	68.1	-10	51.2	1.33E+05	58.1
	6	120.5	E	262	1.5	262	56.4	67.1	5.17E+06		-10	57.1	5.17E+05	
23	5	115.6	A	288	1.5	288	57.2	61.4	1.38E+06	69.0	-10	51.4	1.38E+05	59.0
	6	120.5	B	232	1.5	232	55.3	68.2	6.59E+06		-10	58.2	6.59E+05	
24	5	115.6	G	132	1.5	132	50.4	68.2	6.59E+06	73.2	-10	58.2	6.59E+05	63.2
	6	120.5	H	158	1.5	158	52.0	71.5	1.42E+07		-10	61.5	1.42E+06	

Table A.4 The Predicted Construction Noise Levels during Scenario 3

Kam Tin Bypass **Haul Road Traffic Calculation**

			Option 1 West to East		Option 2 Through Kam Tin		Option 3 Two routes	
NSR	Activity	T.SWL dB(A)	Hori. Dist. (m)	LAeq dB(A)	Hori. Dist. (m)	LAeq dB(A)	Hori. Dist. (m)	LAeq dB(A)
1	haul road traffic	113.0	105	63.2	13	72.3	13	69.6
2	haul road traffic	113.0	210	60.2	10	73.4	10	70.8
3	haul road traffic	113.0	45	66.9	45	66.9	45	64.2
4	haul road traffic	113.0	85	64.1	85	64.1	85	61.5
5	haul road traffic	113.0	51	66.3	51	66.3	51	63.7
6	haul road traffic	113.0	63	65.4	63	65.4	63	62.8
7	haul road traffic	113.0	169	61.1	80	64.4	80	61.8
8	haul road traffic	113.0	107	63.1	107	63.1	107	60.5
9	haul road traffic	113.0	106	63.2	106	63.2	106	60.5
10	haul road traffic	113.0	87	64.0	87	64.0	87	61.4
11	haul road traffic	113.0	104	63.2	104	63.2	104	59.8
12	haul road traffic	113.0	106	63.2	106	63.2	106	59.7
13	haul road traffic	113.0	60	65.6	60	65.6	60	62.2
14	haul road traffic	113.0	40	67.4	40	67.4	40	64.0
15	haul road traffic	113.0	48	66.6	48	66.6	48	63.2
16	haul road traffic	113.0	100	63.4	100	63.4	100	60.0
17	haul road traffic	113.0	65	65.3	65	65.3	65	61.9
18	haul road traffic	113.0	112	62.9	27	69.1	27	66.5
19	haul road traffic	113.0	170	61.1	15	71.7	15	69.0
20	haul road traffic	113.0	225	59.9	19	70.6	19	68.0
21	haul road traffic	113.0	275	59.0	23	69.8	23	67.2
22	haul road traffic	113.0	285	58.9	12	72.6	12	70.0
23	haul road traffic	113.0	240	59.6	10	73.4	10	70.8
24	haul road traffic	113.0	185	60.7	72	64.8	72	62.2

Note : Haul road traffic calculation based on dump truck travelling at speed 20km/hr, SWL of 113dB(A).
The option 1 and 2 has 22 trips/hr. Option 3 is split into two routes , the route from west to east along Kam Tin Bypass has 10 trips/hr and the route passing through Kam Tin Road has 12 trips/hr.

Table A.5 Haul Road Calculation during Construction

Kam Tin Bypass **STRUCTURAL WORK (SUBWAY)**

NSR	Activity	T.SWL dB(A)	Source	Hori. Dist. (m)	Vert. Dist. (m)	Actual Dist. (m)	Distance Correction dB(A)	CNL 1 dB(A)	Unmitigated CNL dB(A)	Barrier Correction dB(A)	CNL 2 dB(A)	Barriered CNL dB(A)
5	subway	119.5	K	175	1.5	175	52.9	69.6	69.6	-10	59.6	59.6
6	subway	119.5	K	205	1.5	205	54.2	68.3	68.3	-10	58.3	58.3
8	subway	119.5	K	85	1.5	85	46.6	75.9	75.9	-10	65.9	65.9
9	subway	119.5	K	65	1.5	65	44.3	78.2	78.2	-10	68.2	68.2
10	subway	119.5	K	135	1.5	135	50.6	71.9	71.9	-10	61.9	61.9
11	subway	119.5	K	335	1.5	335	58.5	64.0	64.0	-10	54.0	54.0

Table A.6 The Predicted Construction Noise Levels during Subway Structural Work

APPENDIX B

AIR QUALITY ASSESSMENT DETAILS

Appendix B1 Log Wind Profile

To estimate the mean wind speed as a function of height z, we use a logarithmic relationship (log wind profile) as following:

$$U = \frac{U_*}{k} \ln \frac{z}{z_o} \quad \ldots\ldots\ldots\ldots (A.1)$$

where U* = friction velocity,
k = von Karman constant, 0.4 (dimensionless),
z_o = roughness length (10cm).

The friction velocity can be recalculated from equation (A.1) by substituting U = 5.4 m/s, z = 10 m in equation (A.1). The friction velocity is thus 0.46 m/s.

For example, if the pile height is 5 metre, then the mean velocity is thus 4.49 m/s. Hence, the conversion factor is (4.49/5.4)x100%= 83%. This conversion factor will be used to convert the percentage provided by Royal Observatory to the value (f) used in pile height.

Appendix B2 Calculation of Emission Rates

Loading & Unloading

	TSP	RSP
Particle size multiplier, k	0.74	0.35
Mean wind speed (m/s), U	1	1
Material moisture content (%), M	2	2
Unadjusted emission rate (kg/T), Qo	4.25E-04	2.01E-04
Volume of material (m3)	140000	140000
Density of material (kg/m3)	1987	1987
Days of work	280	280
Working hours	9	9
Unadjusted emission rate (g/s)	1.30E-02	6.16E-03
Surface area (m2)	40573	40573
Unadjusted emission rate (g/s/m2)	3.21E-07	1.52E-07

Unpaved Road and Haul Route

	TSP	RSP
Particle size multiplier, k	0.8	0.36
Silt content of road surface material (%), s	16	16
Mean vehicle speed (km/hr), S	20	20
Mean vehicle weight (T), W	24	24
Mean number of wheels, w	10	10
Number of days with at least 0.254 mm rainfall per year, p	100	100
Number of vehicle roundtrips per hr	22	22
E (kg/VKT)	4.00E+00	1.80E+00
E (g/s/m)	2.45E-02	1.10E-02

Stock Piling (Aggregate Storage)

Silt content of aggregate (%), s	1.6
% of time with wind speed > 5.4 m/s at mean pile height	7
Number of days with at least 0.254 mm rainfall per year, p	100
E (kg/day/hectare)	1.066515
E (g/s/m2) for TSP	1.23E-06
E (g/s/m2) for RSP	6.17E-07

Top Soil Removal

Depth of top soil (m)	0.2
Surface area (m2)	10000
Density of material (kg/m3)	1987
Mass of material (T)	3974
Days of work	150
Working hours	9
Rate of removal (T/hr)	2.943704
E (g/s) for TSP	1.64E-02
E (g/s) for RSP	8.18E-03
E (g/s/m2) for TSP	1.64E-06
E (g/s/m2) for RSP	8.18E-07

Wind Erosion

E (g/s/m2) for TSP	2.70E-06
E (g/s/m2) for RSP	1.35E-06

APPENDIX B3

PREDICTED ROAD TRAFFIC

Traffic flows for 2011 AM peaks have been predicted by Wilbur Smith Associates Limited. The total vehicle and the percentage heavy are the combined addition of the east and west bound traffic for the major roads and the access roads (see Figure A3.1). The decomposition of the vehicle mix are provided only for the major road and they are shown in Table A2.1. For the access roads, it is assumed that the light vehicles are evenly distributed while only heavy vehicle are considered.

Table B3. Predicted AM Traffic Flows (2011)

Road Segment	Total Vehicle (Veh/hr) (AM)	% P.Car	% Taxi	% PrBus	% PuLB	% LGV	% Medium	% heavy (AM)	RSP (g/km)	NO_2 (g/km)
Kam Tin Bypass	2396-2479	25.6	1.5	1.4	0.0	36.4	12.3	22.8	3.52	32.79
Kam Sheung Road	2695	40.7	1.3	2.3	3.9	30.5	8.4	12.9	2.76	26.25
West of Kam Tin Bypass	4209	32.3	3.2	2.0	6.6	30.7	9.0	16.2	3.08	28.21
East of Kam Tin Bypass	2968	24.3	1.4	1.2	11.9	31.2	11.1	18.9	3.44	30.35

Note: P.Car is private car
PrBus is private bus such as school bus
PuLB is public light bus
LGV is light goods vehicle
Medium is medium good vehicle
Heavy is heavy goods vehicle

APPENDIX C

COMMENTS AND RESPONSES

Agreement No. CE 7/94
Kam Tin Bypass
Responses to Comments on Draft Environmental Impact Assessment Report

Binnie Consultants Limited circulated on 22nd September 1995 to various Government departments for comments on the Draft Environmental Impact Assessment Report. Comments were received as follows:

Department/Division	Reference Number	Date
Agriculture and Fisheries Department, Conservation Division	(17) in AF DVL 14/54 II	10/10/95
CP (CSP Traffic) Traffic Management Bureau Traffic Wing, Royal Hong Kong Police Force	(38) in CP/T/TMB	6/10/95
District Office/Yuen Long Yuen Long District Office Building	(9) in YL 131/6/18 III	4/10/95
Chief Engineer/Mainland North Drainage Services Department	( ) in MN 7/4/18	10/10/95
Chief Highway Engineer/Structures, Highways Department	(46) in STR 5/30/246(1)	9/10/95
Chief Highway Engineer (D&M)/NT	( ) in HNT/602/YL/3	30/9/95
Senior Landscape Architect, Highways Department	HYDT 12/7/38	16/10/95
District Planning Office/TM&YL, Yuen Long Section, Planning Department (Attn: Miss C.H. Yau)	PD3L 2/10/7	12/10/95
Civil Aviation Department	(2) in AS/WKS/644 IV	11/10/95
Principal Government Geotechnical Engineering/Planning, Civil Engineering Department	GCP 1/10/407	6/10/95
Environmental Protection Department	EP2/N6/23 IV	12/10/95
Regional Highway Engineer/NT, Highways Department	(43) in HNT 54/42 XV	11/10/95
Chief Engineering/Mainland North West, Water Supplies Department	(2) in WWO/M891/1744/85 II TJ(2)	13/10/95
Western Harbour Link and Route 3 Country Park Section Office, Highways Department	( ) in CPS/INT/103	13/10/95
Fire Services Department	(24) in FSD 8/7596/85 II	13/10/95
Assistant Director/Major Works (Major Works Project Management Office), Highways Department	( ) in HyD MWPMO 246TH/ ENV	19/10/95
District Lands Office/Yuen Long	(3) in DLOYL 207/YRN/60A IV	17/10/95
Project Manager/New Territories North, Territory Development Department	(4) in NTN RU 2/10/7	20/10/95
Regional Services Department/Yuen Long	(11) in RSD YHQ 752/85(9) II	19/10/95
Assistant Commissioner for Transport, NT Regional Office	( ) in NR 183/161/PWP/-246TH	19/10/95
Environmental Protection Department	EP2/N6/23 IV	30/10/95
Environmental Protection Department	EP2/N6/23 IV	6/11/95

Comments	Responses
Agriculture & Fisheries Department, Conservation Division Regarding the loss of agricultural habitats and facilities, I would like to draw your attention to our previous comments on this aspect. Copies of the relevant correspondence are attached for your easy reference.	Thank you for drawing our attention to the issue of reprovisioning agricultural infrastructure. This issue is being dealt with by the engineering design team.
CP (CSP Traffic), Traffic Management Bureau Traffic Wing, Royal Hong Kong Police Force I refer to your letters dated 22.9.95 and take this opportunity to advise you that I have no comments to make in respect to the above captioned impact assessments.	Noted with thanks.
District Office/Yuen Long, Yuen Long District Office Building This office has no comment on the captioned Report.	Noted with thanks.
Chief Engineer/Mainland North Drainage Services Department As the subject EIA is outside our purview, we will not comment on the submission.	Noted with thanks.
Chief Highway Engineer/Structures, Highways Department I refer to the letter from Binnie Consultants Limited ref. LSL/HCW/0960/D01/11.1 dated 22.9.95 enclosing the draft Environmental Impact Assessment for the captioned project. I have no comment.	Noted with thanks.
Chief Highway Engineer (D&M)/NT As extensive noise barrier of height varying from 0.5 m to 5.5 m are required to adopt as noise mitigation measures, details of which should be submitted to this Region for comments/agreement should they be erected on ground and to our Structure Division for those erected on elevated structure.	Thank you for your comments, which we have noted.
Senior Landscape Architect, Highways Department I have no comment on the above report.	Noted with thanks.

Comments	Responses
District Planning Office/TM&YL, Yuen Long Section, Planning Department (Attn: Miss C.H. Yau)	
I refer to your above letter and the attached draft EIA. I have the following comments on the draft EIA. General Comments	Thank you for your detailed comments on the Draft EIA Report.
(a) Despite in the NWNT Base Strategy Study, Kam Tin has been designated as a rural centre, it has never been known as a town of any nature. In order not to confuse the reader, I suggest that the term "Kam Tin" be used to refer to the general area of this locality while Kam Tin central area refer to the area around the market and the surrounding five walled villages.	We have amended the text of paras. 1.3 & 2.6 in the Final EIA Report in accordance with your suggestion, to read: *Kam Tin Bypass is a proposed new route ... running to the north of Kam Tin and connecting onto Kam Tin Road to the east and west of the rural centre ... The main objective of the Kam Tin Bypass Project is to ... relieve the section of Kam Tin Road through the central area of Kam Tin of traffic so that a comprehensive environmental and traffic improvement scheme can be implemented there in future.* *Kam Tin, with its five walled villages, is a place of historical and cultural importance ... Kam Tin is designated as a Rural Centre in the NWNT Base Strategy Study.*
(b) The Kam Tin Layout Plan No. L/YL-KT/1E was adopted by Government in 1985 to guide the detailed development of the planned area. Site reserved for different uses have been earmarked on the plan. However, as the implementation of the proposed uses proceeded, many changes have been taken place which rendered amendment of the layout plan necessary. The proposed rail link and associated rail station and public transport interchange shown on the layout plan would be amended as the proposed alignment of the WCR will fall outside the layout plan area in accordance to the administrative route protection plan which is recently circulated by CE/R, HyD. The rural housing estate will also not be pursued further by the Housing Society and Housing Department. For the purpose of this study, please assume that the railway alignment and the associated transport facilities and the rural public housing reserved on the layout plan are non-existent.	We have amended the last sentence in para. 2.26 as follows: *The District Planning Officer (Tuen Mun & Yuen Long) has advised that the proposed alignment of the WCR will fall outside the layout plan area in accordance with the administrative route protection plan recently circulated by the Chief Engineer/Railways, Highways Department. As suggested, for the purpose of the EIA Study, we will assume that the railway alignment and the associated transport facilities are non-existent.*

Comments	Responses
Specific Comments Para 2.12 Please note that there are two sub paras of 2.12, 2.13 and 2.14. The land use zonings for Kam Tin Area should be referred to the draft Kam Tin North OZP No. S/YL-KTN/1 and the draft Kam Tin South OZP No. S/YL-KTS/1.	We have amended the paragraph numbering and references to the two draft OZPs in the final EIA Report.
Para 2.13 The planning application no. DPA/YL-KTN/31 is granted with temporary planning permission up to 12.96. The use of the site for storage of new vehicles would be terminated when the construction of the Bypass commence unless the approval is renewed. The temporary nature of this planning approval should be spelt out.	We have amended the test of para. 2.14 to read: *Figure 2.3 also shows a number of small, mainly non-sensitive, developments for which planning applications have been made: ...* *(iii) Application for Storage of New Vehicles (Temporary planning approval up to December 1996)*
Para 2.13 Please explain the term 'Site' found in line 1 of the second para of 2.13 and in the 2nd last line of the second sub para of 2.14.	The term 'Site' refers to the proposed Works Site Limit, as indicated in Figure 2.2. The text will be clarified in the Final EIA Report.
Para 2.14 The words 'Village Type' should read 'Village Type Development'.	We have amended the text in para. 2.14 of the Final EIA Report.
Para 2.17 I understand that Stage 2 of the Kam Tin Road Improvement works covers the section between the eastern roundabout of Kam Tin Road near Shek Kong Military Camp and Route Twisk.	We have amended the text as suggested.
Para 2.25 The Western Corridor Railway (WCR) was one of the many strategic routes that had been identified under the Railway Development Study. The detailed feasibility study of the WCR is being undertaken by KCRC. CE/Railway, HyD would be in a better position to advise on the latest progress of the study.	We have amended the text of para. 2.25 as follows: *The Western Corridor Railway (WCR) is one of several strategic routes that have been identified under the Railway Development Study, which is being managed by the Railway Division of Highways Department. The detailed feasibility of the WCR is being undertaken by the Kowloon-Canton Railway Corporation ....*

Comments	Responses
Para 4.5 During the informal meeting between the consultant of this study and the staff from this office, it had been emphasised that the EIA should take into consideration not only the planned and committed developments but also the long-term planning for the area adjacent to the Bypass. The list of s.16 approval cases are provided for the consultant to facilitate the identification of committed developments where the physical works have not yet been constructed. The draft Kam Tin North and Kam Tin South OZPs showing the long-term planning of the Kam Tin Area were given to the consultants. The EIA should take into consideration of the land use zonings on the OZP and the possible impacts of the Bypass on the future developments that will take place in this area, even though the actual implementation of the development is yet to take place. It is considered necessary to incorporate appropriate mitigation measures into the Bypass to reduce its adverse impacts so as to avoid sterilizing the surrounding areas for future development.	As required by the Brief, we have undertaken the EIA Study, including development of measures to minimise any potential environmental impacts, taking into consideration both the existing and committed future land uses in the Study Area as indicated on the OZPs. We have deleted para. 4.27 in the Final EIA Report, and modified para. 4.5 to read: *Future development proposals will need to respond to the new Bypass as an existing constraint. This applies to all areas of environmental impacts and mitigation measures.*
Para 4.8 I suppose the 'existing village' in line 2 refers to the 'existing villages' found within the study area.	We have amended the text as suggested.
Para 4.12 There is no such place as Kam Tin Village. Please clarify.	The text has been amended to read: *... the tree-line is replaced by the built up edge of Kam Tin.*
Para 4.19 Please add 'in Kam Tin Shi' after 'residential development' at the end of the second line. Most of the existing developments at the eastern end of the Bypass along Kam Tin Road are rural industrial establishments mix with some residential use. Please explain in more detail why you conclude that they are non-sensitive users.	We have added 'in Kam Tin Shi' to the text as suggested. We have amended the 3rd sentence to read: *At the eastern end, most of the existing developments are rural industrial establishments mixed with some residential use.*
Para 4.21 The development cluster No. 3 is not close to the eastern end of the Bypass. Please clarify which cluster you refer to.	We have amended the text to refer to development cluster No. 4.

Comments	Responses
Para 4.24 A large piece of land zoned 'V' on the draft Kam Tin OZPs has not been formed or serviced with infrastructural facilities. At present, they have not been taken up for the building of small houses. However, it is anticipated that the land will eventually be occupied by small houses once it is formed and serviced.	We have added your comments to the text of para. 4.24, to read: *... This allows for village type housing up to 3 storeys (8.23 m). The area has not been formed or serviced with infrastructural facilities. It is anticipated that after the area has been formed and serviced, planning applications to build up to 1,680 houses will be received.*
Para 4.27 It will be more cost effective if the environmental nuisance could be mitigated at sources rather than at receivers. It is suggested that the EIA should take into account of the proposed land use of the surrounding area when assessing the possible impacts of the Bypass and the mitigation measures required to redress the nuisance.	Agreed. The mitigation plan at the end of Section 4 takes these points into account.
Para 4.49 Please indicate which plan this paragraph is referred to.	Para. 4.49 has been amended as follows: *Where pedestrian crossings are proposed, access to these is incorporated in a tangential way up the mound to avoid noise and visual penetration. Figure 4.6 indicates the locations of a central underpass (A) and two pedestrian crossing as at grade (B).*
Para 4.53 What is the purpose of having the "*" marked on this para,.?	The (*) refers to an asterisk inadvertently missed off Figure 4.6. The figure will be amended in the Final EIA Report.
Para 5.3 Figure 2.2 & 2.3 do not refer to sensitive receivers.	All residences and schools, etc. occurring within the Study Area are shown in Figure 2.2: these are current sensitive receivers. The OZPs in Figure 2.3 define the locations of all future sensitive receivers.
Table 2.2 On the draft Kam Tin south OZP, there is an 'R(C)' zone which permits a maximum number of 4 storeys and a maximum height of 12 m. The 'R(C)' zone should indicate on Table 2.2.	We have added details of 'R(C)' to Table 2.2, as suggested.
Figure 2.3 I suggest that the reference to the S.16 application should simplified as the main purpose for having them shown is to indicate the location of the application site. As a matter of fact, the proposed use of these applications are mostly non-sensitive.	We have deleted details of the planning applications, apart from the one for a school, from the final version of Figure 2.3.

Comments	Responses
Figures 5.9, 5.10 & 5.11 I will assume that the noise contour line of 70 dB(A) will run all the way along Kam Tin Road which is a very busy road. However the contour lines shown on these figures have different pattern particularly near Kam Tin Shi. Please explain why you findings.	As outlined in paras. 5.83-5.86, noise contours on Figures 5.9, 5.10 & 5.11 give an indication of traffic noise levels in 2011 within the vicinity of the Kam Tin Bypass. The model includes noise generated on the existing Kam Tin Road and Kam Sheung Road and the proposed Kam Tin Bypass within the Study Area.
Civil Aviation Department Thank you for your Draft Environmental and Draft Drainage Impact Assessment reports on the captioned project. I would like to advise you that we have comment on these reports.	Noted with thanks.
Principal Government Geotechnical Engineer/Planning, Civil Engineering Department It is not clear what proportion of the 2000 m^3 of excavated material is contaminated mud. The means of disposal of this material should be addressed at an early stage. The report only states that unsuitable material will be disposed of at 'the Government dump site'. Where will that be? If marine disposal is being considered, the procedure laid down in WBTC 22/92 will need to be followed.	Thank you for your comments. While the excavated muds and clays may be 'contaminated' with organic materials, they are unlikely to be contaminated according to the classifications detailed in ProPECC 3/94 and WBTC 22/92. However, prior to disposal, muds and organic clays will be tested for contamination in accordance with EPD's recommendations. Uncontaminated mud/organic clay would be disposed of at the East Ninepins or South Cheung Chau sites; any contaminated muds would be disposed of at Pillar Point Valley Landfill or East Sha Chau.
Environmental Protection Department I refer to your above quoted letter dated 22.9.95 and have the following comments on the Draft EIA:- (I) **Water Quality** (a) S.8.2 - Apart from the streams, the adjacent active agricultural land and the fish ponds are also sensitive receivers (as indicated in Fig. 7.1). The design of the drainage system should ensure that the construction site runoff or operational road runoff will not drain into these adjoining sensitive receivers.	Thank you for your detailed comments on the Draft EIA Report. We have amended para. 8.2 of the Final EIA Report to read: *Construction and operation of Kam Tin Bypass could adversely affect the local surface water system, unless appropriate measures are taken. Such impacts would result from uncontrolled construction site runoff and drainage, or direct discharge of sewage, to the streams, adjacent active agricultural land or fishponds. Uncontrolled road surface runoff and drainage discharges are potential sources of contamination to the surface water system and other sensitive receivers during the operational phase.*

Comments	Responses
(b) S.8.10 - As mentioned in para (a) above, construction site runoff also has the potential to cause damaging effects if it is directly drained into the adjoining agricultural land and fish ponds.	We have included your comments into para. 8.10, which now reads as follows: *Construction site runoff has the potential to cause the most damaging effects on the adjacent river by increasing the suspended solids loading and potential for sediment deposition. Construction site runoff also has the potential to cause damaging effects if it is directly drained into the adjoining agricultural land and fishponds ...*
(c) S.8.13 (i) - It should be specified that the drainage channels and bunding must be designed to prevent the construction site runoff from directly draining onto the agricultural land or fish ponds.	We have added the following to para. 8.13 (i): *... (drainage channels and bunds must be designed to prevent the construction site runoff from directly draining onto the agricultural land or fishponds);*
(d) S.8.22 - Similar to the construction site runoff as referred above, the road surface drainage system should also be designed so that no runoff will be directly discharged to the adjoining agricultural land and fish ponds.	Para 8.22 in the Final EIA Report now reads: *... The road surface runoff will be diverted to the proposed Main Drainage Channels (MDC) for Yuen Long and Kam Tin. The road surface drainage system should be designed so that no runoff will be directly discharged to the adjoining agricultural land and fishponds.*
(II) **Waste**	
(a) S.3.38 - As the Draft EIA report does not state the relationship between the proposed amendment of the Waste Disposal Ordinance (WDO) and this project, this section is suggested to be deleted and replaced by the following :- "Construction waste generated during the construction phase should be sorted on site into insert and non-inert fraction for reuse and recycling as far as practical. Non-inert fraction containing no more than 20% by volume of inert content can be disposed of at landfills, whilst the inert fraction should be delivered to public dumps or other reclamation sites. Inert material means soil, rock, asphalt, concrete, brick, cement plaster/mortar, building debris, aggregates etc."	We have amended para. 3.38 in accordance with your suggestion.
(b) S.3.39 - The design of oil/fuel storage installation is covered by the "Code of Practice for Oil Storage Installations 1992" issued by the Building Authority.	We have amended para.3.39 as follows: *The design of oil/fuel storage installations is covered by the 'Code of Practice for Oil Storage Installations 1992' issued by the Building Authority. Handling of chemical spillages on land is regulated by the Fire Services Department.*

Comments	Responses
(c) S.3.40 - The statement "Waste Disposal Ordinance covers disposal of contaminated land to landfill" is wrong. There is a guideline ProPECC PN 3/94 " Contaminated Land Assessment and Remediation" prepared by this department specifically for the contaminated land issue.	We have amended para. 3.40 to read: *The ProPECC guideline PN3/94 on 'Contaminated Land Assessment and Remediation' prepared by EPD covers the disposal of contaminated soil to landfill.*
(d) S.9.9 and S.10.80 - The unsuitable contaminated mud excavated should not be disposed of at public dump. Contaminated mud may be delivered to the Pillar Point Valley Landfill before its closure.	We have altered paras. 9.9 and 10.80 in accordance with your comments, as follows: Para. 9.9 *Any suitable material will be stockpiled and used for the construction of embankment, barrier mound, etc. Unsuitable excavated material, e.g. mud/organic clay will be disposed of at the Pillar Point Valley Landfill in accordance with EPD's ProPECC PN 3/94. Alternatively, if marine disposal is selected, uncontaminated muds would be disposed of at either South Cheung Chau or East Ninepins; any materials classified as contaminated in accordance with WBTC 22/92 will be disposed of at East Sha Chau.* Para.10.80 *Excavated material which is unsuitable for reuse in road embankment and barrier mound formation or landscaping should be tested for contamination in accordance with ProPECC 3/94 and WBTC 22/92 and disposed of the landfill or marine mud pits, as appropriate.*
(e) S.9.11 and S.10.78 Concrete waste is better to be recycled for reuse or sorted for disposal at public dumps.	We have amended the text as follows: Para 9.11 *... Dry concrete waste will be sorted out from other waste and recycled for reuse or sorted for disposal at the public dump.* Para 10.78 *Dry concrete waste should be sorted out from other waste and recycled for reuse or sorted for disposal at the public dump.*
(III) **Air Quality**	
(a) S.6.3 and Table 6.2 - Please advise whether the distance from Kam Tin Bypass is measured from the boundary or from the centre line of the proposed road. Please also state the above clearly in the respective column of Table 6.2.	The distances shown on the Table 6.2 is measured perpendicularly from the sensitive receivers to the proposed haul road.

Comments	Responses
(b) S.6.6 - We do not agree to make reference of some informal conversations with an EPD officer over the phone and subsequently to quote this in an EIA report. The information we provided for some previous projects might not be appropriate to other projects of different nature. Please use your expertise to judge the suitability of information being used.	We have revised the text in the Final EIA Report as follows: *Because of the rural nature of the project area, the background level of the annual TSP level is not expected to be significant. The background annual TSP level has been approximated to 30 $\mu g/m^3$. Taking 50% of the TSP level as an approximation of the RSP level gives an annual background RSP level of 15 $\mu g/m^3$.* As the values of annual TSP and RSP levels are same as before, the values in the Table 6.7 to Table 6.8 are unchanged.
(c) S.6.50 - Please justify the assumed 95% reduction of dust level concentration if watering four times a day is exercised.	We have noted your comments and revised the text as follows: *... Experience shows that if watering is done at least once every three hours during the day, it is possible to attain invisible dust emission levels. It is thus interpolated that the emission rate associated with the dirt road would be dramatically reduced (95% is assumed) if the watering on the dirt road would be conducted as often as possible...*
(d) S.6.52(i) - Please incorporate the practice of regular watering of haul roads four times a day in the "Mitigation Measures - Construction Phase" as this watering practice has been used in the modelling assessment for achieving the assumed 95% dust suppression efficiency as stated in Section 6.50.	As watering four times a day is not mentioned in the text, the statement of S.6.52(i) is appropriate.
(e) S.6.60 and 10.40 - Please advise the buffer distances from Kam Tin Bypass required to ameliorate the potential vehicular emission impacts on the future sensitive receivers for future landuse planning purposes.	Future houses built next to the site boundary of Kam Tin Bypass will have air quality which meets the AQOs. No buffer distance is required additional to that between the Bypass itself and its site boundary.

Comments	Responses
(f) As there are 1.5 m high earth bund and extensive .... barrier proposed to be built both on the earth bund and to the north of the Bypass, please advise if these barriers would cause adverse air quality impacts to the air sensitive receivers and whether there will be any AQO exceedance at the sensitive receivers.	As detailed in Section 5: Noise, without appropriate noise mitigation, traffic levels on the Bypass are high enough to generate road traffic noise levels in 2011 higher than the standards recommended in the HKPSG. In order to fully protect both existing and future noise sensitive receivers, it will be necessary to build extensive noise barriers on both sides of the Bypass. Deterioration of air quality at sensitive receivers due to noise barriers construction is not expected, for the following reasons: Assuming flat ground, CALINE4 shows that the air quality during the operation of Kam Tin Bypass will not exceed the AQO standard. Topographical effect does have an influence on the flow pattern, thereby impacting the air quality. This is because eddies are likely to be generated at the bottom of the earth bund, depending on the stability of the atmosphere and the strength of wind[1,2]. In physical terms, for strong winds and neutral stability (ie. Froude number[3] approaches infinity) near the top of the earth bund, the streamlines which represent the flow pattern are packed together, causing a speed up of the wind. Immediately downwind of the bund in a strong wind (greater than 11.0 m/s) situation, there is often found a cavity (eddies) associated with boundary layer separation[4]. These eddies are the convergent zones where air pollutants will be potentially accumulated or trapped. The Wind Rose from Lau Fau Shan station shows the dominant easterly wind. Based on the information from Royal Observatory, the occurrence of eddy generation is rare in this area because only 0.5% of wind in a year is classified as strong wind (greater than 11.0 m/s).

1 *An Introduction to Boundary Layer Meteorology* (1988) BS Roland, Kluwer Academic Publishers

2 *Handbook of Air Pollution Technology, Chapter 34 Atmospheric Dispersion* (1984) S Calvert and H M England

3 In simple terms, Froude number can be interpreted as a ratio between the depth of the column that the wind flows from the hill and the height of the hill.

4 *Separation features of boundary-layer flow over valleys.* Boun. layer Meteor., 40 (1987) pp 295-308 F Tampieri

Comments	Responses
(IV) **EM&A Manual** Please ensure the EM&A Manual complies with the following guidelines :- (a) "Engineer's Guidelines for Implementation of EM&A Programmes"; (b) "Standard Air, Water and Noise Monitoring Requirements"; (c) "Typical Event and Action Plan for Air, Water and Noise Monitoring during Construction"; and (d) "Guidelines for Dust Monitoring". The above comments should be incorporated in Chapter 10 - Impacts Summary and Recommendations, as appropriate. Provisions should be made in the relevant contract documents to ensure contractors compliance with the environmental mitigation measures and recommendations as detailed in this EIA, especially the section on impacts summary and recommendations.	We have noted your requirements for the EM&A Manual and incorporate your comments into the Impacts Summary and Recommendations.
Regional Highway Engineer/NT, Highways Department Draft EIA Report (i) Para. 2.17 : The tentative implementation programme of "Improvement to Kam Tin Road, Stage 2" will be from early 2002 to early 2005. (ii) Para. 5.26 & 5.35 : My comments on the use of Kam Tin Road as a haul route have been given vide my earlier letters to you in the same series dated 14 & 15.9.95. (iii) EM & A Manual : It appears that the EM & A Manual only deals with the construction phase. It should cover the operational phase as well.	We have amended para 2.17 to read: *Stage 2 of the road improvements covers the section between the eastern roundabout of Kam Tin Bypass near Shek Kong Military Camp and Route Twisk. The tentative implementation plan for this project is from early 2002 to early 2005.* We note that you do not support the use of Kam Tin Road (section between Au Tau Roundabout and Kam Tin River) as a haul route for Kam Tin Bypass. We have considered this issue in detail during the preparation of the EM&A Manual. We recommend post project auditing. However, post project and operational monitoring is not necessary.

Comments	Responses
Chief Engineer/Mainland North West, Water Supplies Department I refer to your letter ref. LSL/HGW/0960/D01/11.1 dated 22nd September 1995 and wish to advise that I have no comment on your Draft Environmental Impact Assessment Report.	Noted with thanks.
Western Harbour Link and Route 3 Country Park Section Office, Highways Department I should be grateful if you would take note that the Detailed EIA and DIA Reports for the Northern Section of the Route 3 Country Park Section are now expected to be finalized by the Route 3 Contractors Consortium (R3CC) within a few weeks' time. This office will be happy to ask R3CC to provide you with a copy of the above reports in due course, should they be useful for you to check whether the conclusions you have made about the cumulative impacts are still valid.	Thank you for your response. We have received a copy of the EIA: however, the Kam Tin Bypass Study Area falls outside the Route 3 Study Area.
Fire Services Department As regard the noise mitigation measures during Construction Phase and Operational Phase, please be advised that the existing vehicular access, if any, to nearby villages should not be obstructed by the erection of noise barriers. In addition, these barriers may affect the effective operation of street fire hydrants which is designed to serve both sides of the bypass. It is, therefore, additional fire hydrant would be required.	We have noted your comments, which will be taken into account in the design of the Project.

Comments	Responses
Assistant Director/Major works (Major Works Project Management Office)	
(a) Table 2.1	
Consideration should be given to complete the western road junction in advance for early handover to the Improvement to Kam Tin Road - Stage I project (560TH) to facilitate an early completion of the improvement works of Kam Tin Road between Route 3 slip road junction and Kam Tin Bypass.	Thank you for your detailed comments on our Draft EIA Report. We have noted your comment.
(b) Para. 2.26	
The 3rd line should read "The rail link runs west of the Study Area...."	Further to your comments and those received from DPO/YL, we have amended the last sentence in para. 2.26 as follows: *The rail link runs west of the Study Area and the proposed station is located south of the proposed western roundabout. The District Planning Officer (Tuen Mun & Yuen Long) has advised that the proposed alignment of the WCR will fall outside the layout plan area in accordance with the administrative route protection plan recently circulated by the Chief Engineer/Railways, Highways Department. For the purpose of the EIA Study, we will assume that the railway alignment and the associated transport facilities are non-existent.*
(c) Para. 3.14 & 3.15	
Please clarify the current status of the Technical Memoranda mentioned to be being drafted for enactment in mid-1995.	The Technical Memorandum on Noise from Construction within a Designated Area will not be finalized prior to the beginning of 1996 at the earliest. The amendment to the TM on Noise from Percussive Piling is still in the process of public consultation.
(d) Para. 4.51	
Should point 2 mentioned in this paragraph be point 1 on Figure no. 4.6?	We have corrected the text to refer to point 1.
(e) Figure no. 4.7	
Will there be any significant difference in the construction cost for the alternatives as compared with the normal solution for the noise barrier arrangement?	The construction cost for the alternatives will inevitably be greater than the normal solution for the noise barrier arrangement. The details of the landscaping proposals and costings will be developed during the Preliminary design/cost estimate phase (December 1995).

Comments	Responses
(f) Para. 5.15 & Table 5.3 The peak flow and not the average flow should be considered for the number of truck movements.	From Table 5.5, it can be seen that excavation of spoil, backfilling and concreting are unlikely to be carried out at the same time. The figure of 11 vehicles per hour already assumes all these activities are concurrent; thus the flow represents the worst case which could happen at any time.
(g) Para. 5.19 Please clarify and explain why 100 m segments are chosen for assessment purposes.	*During the construction phase, activities will take place concurrently. However, each activity will be separated. In order to predict the worst case situations without over-estimating construction noise at any point, concurrent activites have been centred at 100 metre distances from each other for assessment purposes. For example during the earchworks each layer for each section of the work must be completed before the next stage can be started. In practice, these segments are 100 metres or more in length.*
(h) Para. 5.59 Please advise if the use of friction course is appropriate for the type of road as Kam Tin Bypass. You should also seek the advice of the R&D Division of this Department regarding this issue.	Noted.
(i) Para. 5.96 & Table 5.16 As the total noise level for future NSR 32 is also higher than acceptable standard, what further mitigation measures are recommended?	The landscaping proposal has included plans for planting dense vegetation along the barrier to enhance its appearance. This will serve to effectively reduce the marginal exceedance to an acceptable level. Only a reduction of 0.1 dB(A) is needed.
(j) Para. 5.105 Indirect remedies such as air conditioning should only be considered if all direct mitigation measures have been proved to be not feasible.	Air conditioning was only proposed to protect NSR3 as an alternative should the construction of a 7 metre barrier prove impractical.
(k) Para. 5.106 What will be the additional noise protection measures required to protect the village houses built in the area referred to in paragraph 5.105? Will these measures be required to be provided as part of the Kam Tin Bypass project as mitigation measures for planned development?	These measures are described in para. 5.96. The text has been modified to make this cross-reference.

Comments	Responses
(l) Para. 10.21 The two short sections of 0.5-2 m high barrier are shown on figure no. 5.13 to protect only the existing NSRs and not the future NSRs. Please clarify.	The text of 5.101, 5.102 and the parallel text of 10.21 and 10.2 have been altered to make our meaning clearer.
(m) Para. 10.22 Will the 1 m noise barrier be required to be constructed under the Kam Tin Bypass project?	The one metre noise barrier will be constructed under the Kam Tin Bypass project.
(n) Para. 10.25 Same comment as in (j) above for paragraph 5.105.	See response for Para. 5.105.
(o) Para. 10.48 Same comment as in (e) above for figure no. 4.7.	See response for Para. 4.7.
(p) Para. 10.84 & Appendix A It seems that the Environmental Monitoring & Audit Manual in Appendix A does not include issues in the post project or operational phase.	We have considered this issue in detail during the preparation of the EM&A Manual. We recommend post-project auditing. However, post project and operational monitoring are not necessary.
District Lands Office/Yuen Long I have no comment on the draft Environmental Impact Assessment in connection with Kam tin Bypass.	Noted, with thanks.
Project Manager/New Territories North, Territory Development Department My comments on the report are as follows:- (l) Chapter 4 The content of the chapter is generally acceptable. In order to make the various alternations practicable to reduce the visual impacts of the proposed noise barriers and the earth mound of the carriage, sufficient space on both sides of road is essential. Instead of the "standard" gradient slope of 1:1.5, a more gentle slope is needed for tree planting. Especially for alternative 1 & 2 ample space on both sides of the noise barrier is needed.	Your comments have been noted.

Comments	Responses
(2) Para. 4.20 The level of the embankments of the new drainage channel (43CD) is in general the same as the platform levels of the developments. It is the earth mound/noise barrier (see para. 4.29) of Kam Tin Bypass that blocks the unobstructed view of the development. The sentence regarding our drainage channel should be deleted.	We have amended the text as suggested.
(3) Fig 4.6 I understand that the channel embankment of 43CD have not been designed to cater for the loading from the stockpiled areas of HyD's road. Please request HyD to contact CE/DP, DSD for comments.	The stockpiled areas of the Bypass lie to the south of the channel embankment of the 43CD works. Please note that the Draft EIA Report has already been submitted to CE/DP, DSD for comment.
(4) General No footbridge across the by-pass was proposed. The visual impacts of any footbridge, 6-7m above the road surface, and its massive ramps require detail evaluation. Of course, the requirement for such elevated pedestrian link should be assessed in the first instance.	As no elevated footbridge across the Bypass has been proposed, we have not included the visual impact assessment of such a structure in our EIA Study.
Regional Services Department/Yuen Long A. Draft Environmental Impact Assessment Regarding Para. 9.4 and 10.76, municipal waste generated during the construction shall be delivered to and disposed of at an approved landfill rather than to the nearby Refuse Collection Point(s) of RSD.	We have amended para. 9.4 in the Final EIA Report to read: *... Municipal waste will be collected in black refuse bags and delivered to, and disposed of at, an approved landfill.* We have amended para 10.76 to read: *We recommend that municipal waste will be collected in black refuse bags and delivered to, and disposed of at, an approved landfill.*
Assistant Commissioner for Transport/NT I refer to your above letter dated 22/9/95 and have no comment please.	Noted with thanks.

Comments	Responses
Director of Environmental Protection Further to our comments on the above Draft EIA which were sent to you on 12.10.95, I would like to advise that as stated in the study brief (S.6.11 B, D & E), the EIA should address the cumulative impacts arising from other projects in the surrounding area on the sensitive receivers (including Ko Po Egretry). In particular, it should take into full and accurate account the following projects and their EIA reports:- (a) Main Drainage Channels for Ngau Tam Mei, Yuen Long and Kam Tin : EIA Study for Kam Tin Section (43CD) and Village Flood Protection Works (30CD). (b) Route 3 - Country Park Section : Detailed EIA. Please contact PM/NTN (for item a) and HyD (for item b) should you require a copy of the above EIA reports.	Thank you for your additional comments. Our Draft EIA Report has already taken into account the results of the Main Drainage Channels EIAs. We have also reviewed the Route 3 - Country Park DEIA. The Route 3 Study Area is outside the Study Area for Kam Tin Bypass.

Comments	Responses
Director of Environmental Protection	
Further to our letters dated 12.10.95 and 30.10.95, we have the following comments on the noise section of the Draft EIA:-	
(a) Page 5-2 Table 5.1 - The title is more appropriate to be reworded as "Representative Noise Sensitive Receivers". For residential dwellings, please state the no. of dwelling (i.e. residential unit) affected by the proposed road at each NSR.	We have amended the title as suggested.
(b) Page 5-23 s5.77 - Please confirm whether the traffic data used for the noise modelling have been endorsed by Transport Department.	The traffic data was circulated to EPD, Transport Department and Highways Department before the model was run.
(c) Page 5-27 s5.105 - Window insulation should be viewed as a last resort after all practicable direct technical remedies have been implemented.	Indirect technical remedies were proposed to protect NSR3 as an alternative should the construction of a 7 metre barrier prove unacceptable. The text has been changed.
(d) Page 5-27 s5.106 - The direct technical remedy package should be designed to protect existing as well as planned NSRs. The village development area concerned should be provided with direct technical remedies wherever practicable. Where direct technical remedies are not practicable, specific reasons should be given.	The appropriate measures are described in para. 5.96. The barriers that will be implemented under this project are shown in Figure 5.14.
(e) I would like to draw you attention to the EIA for Route 3 - Country Park Section. Please note that HyD is committed to implement at least 1m high kerbside barriers/planters along Kam Tin Road and it was used as one of hue assumptions for the noise assessment of Route 3. Please clarify whether the above will be included in the recommendation of this EIA as parts of Kam Tin Road is also within the works limit of this road project.	As mentioned previously, the Study Area for Kam Tin Bypass EIA falls outside the Study Area for Route 3 - Country Park Section. The location of noise barriers is indicated in Figure 5.14. Kerbside barriers along Kam Tin Road have not been recommended in the Kam Tin Bypass EIA. The barriers to be constructed along Kam Tin Road fall under another EIA which will soon be commissioned.
(f) Page 5-27 s5.109 - Please confirm and clarify that the recommended noise barrier configurations shown on Figure 5.14 are for the protection of both existing and future NSRs. It is advised in s5.59 that Kam Tin Bypass will have friction course road surfaced. Please make clear in the conclusion that this is one of the direct technical remedies recommended.	We have clarified the text as follows: *In order to fully protect both existing and future noise sensitive receivers, we recommend:* *(i) constructing both the planned 1.5 m high earth bund and extensive noise barriers both on the earth bund and extending beyond the bund and to the north of the Bypass as shown in Figure 5.14;* *(ii) constructing the Kam Tin Bypass with a friction course road surface.*

	Comments	Responses
(g)	Page 5-27 Conclusion - For completeness, please state the following statistics in the report:	New text has been added to the 5-27 Conclusion.
	i) no. of dwellings and other NSRs exceeding the HKPSG criteria after completion of the road works but without the implementation of any direct technical remedies.	About 130 dwellings and 3 schools would suffer from noise levels above the HKPSG criteria.
	ii) no. of dwellings and other NSRs exceeding the HKPSG criteria after completion of the road works within the implementation of recommended direct technical remedies.	5 dwellings and 2 schools will still exceed the HKPSG criteria. However, in every case the exceedence is due to Kam Tin Road. Kam Tin Bypass increases the noise levels by only a fraction of a decibel. Both schools are air-conditioned.
	iii) no. of dwellings, if any, meeting the "eligibility criteria" for indirect technical remedies.	None.
	iv) cost estimate on the recommended direct technical remedies, i.e. the noise barriers and friction course road surface.	The noise barriers will cost approximately HK$6 million for over 2 km of barriers. The friction course would cost about 0.9 million. A table has been added to the text.
(h)	Figure 5.14 - The proposed noise barriers appear to cut across some run-ins/road junctions. Please clarify and provide drawings of a large scale to indicate the detail locations of the proposed noise barriers.	Figure 5.14 has been improved in line with your comments. There are two road junctions.

Agreement No. CE 7/94
Kam Tin Bypass
Second Round of Responses to Comments on Draft Environmental Impact Assessment Report

Binnie Consultants Limited circulated the first round of comments on the Draft Initial Assessment Report on 14th November 1995 to various Government departments. Comments were received as follows:

Department/Division	Reference Number	Date
Agriculture & Fisheries Department	(25) in AF DVL 14/54 II	30/11/95
CP (CSP Traffic) Traffic Management Bureau - Traffic Wing, Royal Hong Kong Police Force	(4) in CP/T/TMB 216/672C Pt.II	27/11/95
District Office/Yuen Long Yuen Long District Office Building	(21) in YL 131/6/18 Pt III	23/11/95
Assistant Commissioner for Transport/N.T., Transport Department	( ) NR 183/161/PWP-246TH	17/11/95
Chief Engineer/Mainland North Drainage Services Department	( ) in MN 7/4/18	17/11/95
Chief Highways Engineer/Structures, Highways Department	(1) in STR 5/30/246(1)	23/11/95
District Planning Office/TM&YL, Yuen Long Section, Planning Department (Attn. Ms C.H. Yau)	(16) in PDYL 2/10/7 II	20/11/95
Civil Aviation Department	(4) in AS/WKS/644 IV	20/11/95
Geotechnical Engineering Office, Civil Engineering Department	GCP 1/10/407	23/11/95
Chief Engineer/Mainland North West, Water Supplies Department	(3) in WWO/M891/1744/85II TJ(1)	23/11/95
Fire Services Department	(27) in FSD 18/7596/85 II	23/11/95
Chief Engineer/Major Works (NT) Major Works Project Management Office, Highways Department	( ) in HyD MWPMO 246TH/ENV	21/11/95
Regional Highway Engineer/NT Highways Department	( ) in HNT 54/42 XV	20/11/95
Chief Highway Engineer/NT Highways Department	( ) in HNT/602/YL/3	21/11/95
Regional Services Department/Sha Tin	(14) in RSD 1/HQ 752/85(9) II	23/11/95
Environmental Protection Department	EP 2/N6/23 IV	29/11/95
Chief Engineer/Drainage Projects, Drainage Services Department	DP/8/7043CD/DC9406	1/12/95
Chief Highways Engineer / R&D	HRD 14/246TH	1/12/95
Transport Department/N.T. Region	( ) in NR 183/161/PWP-246TH	4/12/95
Project Manager/N.T. North, Territory Development Department	( ) in NTN RU 2/10/7 (III)	14/12/95

Comments	Responses
Agriculture & Fisheries Department Please be advised that I have no comment on your responses to our previous comments	Noted, with thanks.
Royal Hong Kong Police Traffic HQ Please be advised that I have no further comments to make in respect to the EIA.	Noted, with thanks.
District Office/Yuen Long, Yuen Long District Office Building I have no comment on the captioned Report.	Noted, with thanks.
Chief Engineer/Mainland North, Drainage Services Department I have no comment on your response to the comments on the draft EIA Report.	Noted, with thanks.
Assistant Commissioner for Transport/N.T., Transport Department Thank you for your letter of 14 November 1995. I have no comments on your responses.	Noted, with thanks.
Chief Highway Engineer/Structures, Highways Department Please note that I have no comments.	Noted, with thanks.
District Planning Office/TM&YL, Yuen Long Section, Planning Department (Attn: Ms C.H. Yau) I have the following comment on your summary of Responses. Para 2.26 I suggested that the whole paragraph should be [rewritten] with similar wordings such as: "The Kam Tin Layout Plan No. L/YL-KT/1E which was approved by Government on 11.7.95 indicates an alignment for the proposed rail link and location of the associated rail station and public transport interchange. Based on the administrative route protection plan recently circulated by Chief Engineer/Railways, HyD, the proposed alignment of the WCR and the associated rail station will fall outside the layout plan area. For the purpose of the EIA Study, it is assumed that the future alignment of the railway follow the administrative protective route of the WCR."	We have amended the text as suggested.

Comments	Responses
Para 4.5 I suggested that para.4.5 be deleted and the following be added in para.4.4: (iii) to take into account of the long-term land use planning as shown on the draft Kam Tin North OZP and comments, where appropriate, on possible impacts on the future land use. Para 4.49 I understand that there may be an additional pedestrian underpass to be provided in the Kam Tin By-pass project (your letter ref. LSL/KFT/0960/D01/125 dated 27.10.95 is referred). If it will be the case, this paragraph should be updated accordingly to reflect the latest development.	We have amended the text in accordance with your suggestion Yes, there will now be two pedestrian underpasses. The text has been changed.
Civil Aviation Department I refer to your letter dated 14 November 1995 and wish to advise you that I have no comment on your responses to the comments made on the captioned report.	Noted, with thanks.
Geotechnical Engineering Office, Civil Engineering Department. In general we are satisfied with your response. However you should note that it would be unwise to make any assumptions about the locations of marine disposal sites at this stage. You will need to liaise with the Secretary of the Fill Management Committee on which sites are likely [to] be actually available at the time of disposal.	At the appropriate time, consultation will be made with the Secretary of the Fill Management Committee.
Water Supplies Department I refer to your letter ref. LSL/HCW/0960/D01/11.1 dated 14 November 1995 and wish to advise our acceptance of your response to our comments on your Draft Environmental Impact Assessment Report.	Noted, with thanks.
Fire Services Department Please be informed that your responses to comments are acceptable to this Department.	Noted, with thanks.

Comments	Responses
Major Works Project Management Office, Highways Department	
As discussed, please confirm the construction of the one metre noise barrier, which has been taken into consideration the long term planning of the adjacent area, along the northern side of the Bypass is to the satisfaction of EPD and DPO/TM&YL, PlanD.	The one metre barrier to the north is necessary to ensure sensitive land uses are not adversely affected. The text has been changed with clear conclusions. Friction course can only be applied to part of the Bypass. The mitigation and the text has been amended to reflect this decision.
Please also confirm with R&D Division and CHE(D&M)/NT of this office whether the use of friction course is appropriate for the type of road.	
Regional Highway Engineer/N.T. Highways Department	
I refer to your above letter dated 14.11.96 enclosing your responses to comments on the draft environment impact assessment report.	
Referring to your response to RHE/NT's comment (ii) shown on page 12 of your letter, I note that you do not mention any haul route as an alternative to using Kam Tin Road. Is there any suggestion in respect to this?	We have passed your comments to the Engineers, and they have given it detailed consideration. At this time there seems to be no alternative.
I have no other comments on your responses.	Thank you.
Chief Highway Engineer/N.T.	
I refer to your letter of 10.11.95.	
Please be advised that friction course is considered acceptable as a standard for high speed roads with speed limit over 70 kph. As I notice that you have copied your letter to our Research and Development Division, I believe that CHE/R&D will provide you with comments on the suitability of using friction course as a noise mitigation measure.	Noted, and mitigation is planned taking this letter and further discussions into account.
Regional Services Department/Sha Tin	
It is noted that our comments have already been incorporated. I have no further remark to add. Thank you for your attention.	Noted, with thanks.
Environmental Protection Department	
I refer to your letter dated 22/11/95 and have the following comments on the above submissions:-	
i) The proposed amendments should be incorporated in the EIA Study which is being undertaken by your team. Any potential environmental impacts arising from these proposed amendments should be clearly identified and mitigated to comply with the HKPSG.	Noted, see the attached text.

Comments	Responses
ii) The locations of each type of Noise Barrier should clearly indicated in the General Layouts.	Noted, see the attached text.
iii) The type of paving (ie. friction course surface) should also be shown on the General Layouts.	Noted, see the attached text.
iv) With reference to telephone conversations with your Pamela Sanders on 27/11/95 and 28/11/95, I understand that there would still be additional changes to the design of the Kam Tin Bypass (such as the use of friction course surface, traffic speed, traffic lights, etc.). These changes should be incorporated in the proposed layouts and the EIA Study in due course.	Noted, see the attached text. The use of friction course and the speed limits have been discussed and agreed. The mitigation text reflects these refinements.
Drainage Projects, Drainage Services Department I have no particular comment on your responses to the comments on the Draft EIA report but would like to remind you that your proposed works on Kam Tin Bypass must be designed such that there are no disruption whatsoever to the progress of 43CD drainage channel works. In addition, you need to seek agreement from this office on the details of your proposed works to be carried out in close vicinity of the works site of 43CD drainage channel. Please note that construction of 43CD drainage has been in progress since 27.10.1995 and is targeted for completion in mid 1998. For your information, I enclose herewith one print each of five drawings (Nos. DDN/43CD/3001 - 3005) showing the detailed layout of the works on 43CD drainage channel.	Noted. Your comments are being thoroughly investigated by the Engineering team. There should not be any overlap in the works.
Chief Highways Engineer / R&D I refer to your letter dated 30.11.95 enclosing drawings showing the proposed extent of friction course to be laid on the captioned road section and have the following comments:- a) The extent of friction course from the bus bays should be specified on the drawings. Please note that a gully grating should be provided at the wearing course and friction course interface to take away the surface runoff; b) Polymer modified friction course material should be used. In addition, the typical road cross section shown on the drawing appears not to be in accordance with the TPDM. Please check.	Noted, and mitigation is planned taking this letter and further discussions into account.

Comments	Responses
Transport Department/ N.T. Region I refer to your above letter dated 28.11.95 regarding the captioned subject. It appears not desirable to change the legal speed limit over a short section of carriageway. The legal speed limit indicates the maximum allowable/safety speed for motorists. It is apparent that motorists would choose suitable speed within the limit to cope with various site conditions, like the presence of road junction or signal crossing.	Noted, with thanks.
Project Manager/N.T. North, TDD I refer to your letter dated 14 Nov., 1995 in connection with the captioned Report. I have no further comments to make on your responses to my previous remarks contained in my letter dated 20 Oct., 1995 of the even series. However, please be reminded that it is advisable for you to notify CE/DP, DSD specifically concerning the possible effect on 43CD embankment due to the loading from the stockpiled areas of the Bypass.	Noted, with thanks. Your comment has been passed to the Engineers. This issue will be considered during the detailed design.

Agreement No. CE 7/94
Kam Tin Bypass
Third Round of Responses to Comments on Draft Environmental Impact Assessment Report

Department/Division	Reference Number	Date
Environmental Protection Officer for Director of Environmental Protection, EPD	EP2/N6/23 IV	4/1/96
for Principal Government Geotechnical Engineer, Geotechnical Engineering Office	GCP 1/10/407X	9/1/96

Comments	Responses
Environmental Protection Department I refer to your letters dated 28.12.95 and 29.12.95 and have the following comments on the revised report:-	
a) s2.14 - With the exception of DPA/YL-KTS/29, the planning applications quoted cannot be found on Figure 2.3. Please show the locations of these planned developments on Figure 2.3 and confirm whether these planning applications were approved by PlanD.	None of the planning applications were of a sensitive nature. We received a request from Planning Department to remove these from Figure 2.3. Consequently, these have been removed from Figure 2.3.
b) Table 5.1 - Instead of estimating the no. of people affected, the Consultant should state the no. of dwellings and the no. of classrooms affected.	In the revised Report submitted, the only revision made to Table 5.1 was the title. In a previous letter EPD requested that the word "representative" be included in the title. Table 5.1 will be amended as suggested.
c) s.5.4 - Details of the planned future NSRs should be shown on a table similar to Table 5.1 for the existing NSRs.	All the information known about future planned sensitive receivers is given in Chapter 2 and relates entirely to planning zones under the OZPs. As previously discussed with EPD, "potential" future sensitive receivers were placed at 10 metres from the boundary. The maximum number of storeys and height allowed in each area was used in the calculations and has been available in Table 2.2. This text has not changed since the draft.
d) s5.52-s5.67 - As advised previously, it is not necessary to detailed the CRTN calculation steps in the report.	Noted.
e) s5.77 - The traffic data used for the noise modelling should be first endorsed by TD as I previously advised. (Your response to my previous comment that the traffic data was circulated to TD is inadequate. Please confirm whether TD has accepted the traffic data. Perhaps you could seek HyD's assistance on this issue.)	We anticipate that TD's formal endorsement on the traffic data for the current EIA is forthcoming.
f) Figure 5.14 - As discussed between your Ms Pamela Sanders and our Mr Andrew Cheung on 3.1.96, this figure is incorrect and out-dated. An updated version showing the cantilevered noise barrier should be submitted. The arrangement and dimensions of the proposed cantilever noise barrier should be shown and should be checked with HyD on its acceptance.	Figure 5.14 has been changed. HyD has agreed to the concept of using cantilevered barrier. The barrier does not overhang the carriageway. Text has been added to describe the proposed cantilevered barrier.

Comments	Responses
g) s5.113 - It is indicated that 2 schools would exceed the HKPSG criterion. Some classrooms (but not all) of NSR 18 has been provided with air conditioners under the Noise Abatement Measures In Schools programme (NAMISP). Please assess whether the Kam Tin Bypass would cause additional impact and recommend additional acoustic insulation and conditioning if necessary. (Based on our information, Classroom Nos.5 & 6 have not been provided with air conditioning. Please check with ED and ASD on the details of the provision under the NAMISP.)	We agree that the school NSR 18 will be badly impacted by traffic noise. Facade 18.1 which faces directly away from Kam Tin Road will have acceptable noise levels >75 dB(A). This is due almost completely to Kam Tin Road traffic. Kam Tin Bypass only increases noise levels by 0.1 dB(A) above that from future traffic on Kam Tin Road. All the classrooms facing Kam Tin Road have been air-conditioned. Ideally, classrooms experiencing traffic noise levels above 75 dB(A) should be double-glazed. Facade 18.3 which faces both Kam Tin Bypass and Kam Tin Road has predicted noise levels between 70 and 75 dB(A). Again Kam Tin Road is responsible for most of the noise. Kam Tin Bypass is only responsible for <1dB(A) of the increase. Classrooms experiencing traffic noise levels between 70 and 75 dB(A) are ideally air-conditioned and have good quality, sealed windows. Two classrooms are not currently air-conditioned.
h) Table 5.17 - As stated in this table, noise levels of NSR 30 (planned development?) would exceed the HKPSG criterion. Please confirm whether all practicable direct technical remedies have been proposed to protect this NSR and make appropriate recommendations for this NSR.	Yes, no further practicable direct technical remedies can be formulated. Recommendations were first made in the September draft report and no comments were received. The area between NSR3 and NSR30 is currently used for non-sensitive purposes. We recommended that this practice be continued or that if future NSRs be built in this area that they be designed with non-sensitive facades.
i) On the EM&A, Table 7.2 on page A-41, please be reminded that the construction noise target levels during the restricted hours shall depend on the Area Sensitivity Ratings (ASRs) as advised by the Noise Control Authority and may vary with different NSRs.	i) Noted. The text has been amended.
j) Please amend the Executive Summary (ES) in accordance with the above comments as appropriate. I shall reserve my comments on the ES upon the clarification of the above.	The ES will be amended appropriately.
for Principal Government Geotechnical Engineer, Geotechnical Engineering Office, CED Thank you for your letter dated 28.12.1995 regarding the captioned subject. Our office has no comment on Chapter 10 "Impacts Summary and Recommendation" of the Final EIA Report.	Noted, with thanks.

Agreement No. CE 7/94
Design and Construction Consultancy for
Kam Tin Bypass
Fourth Round of Responses to Comments
on Final Environmental Impact Assessment Report

Department/Division	Reference Number	Date
Environmental Protection Officer for Director of Environmental Protection, EPD	EPD 2/N6/23 V	14/2/96

Comments	Responses
Environmental Protection Department I refer to your letters dated 19.1.96 and have the following comments on the draft Final Report (DFR):-	
a) Table 5.17 is missing in the report.	Noted and done.
b) Contents; p.v/vi, Table 5.13 to 5.17 is missing in this content page.	Noted and done.
I would like to advise that para (d) of my letter dated 4.1.96 in this series should read "As advised previously, it is not necessary to ....". Please amend "Appendix C - Responses to Comments" accordingly. I apologize to any confusion caused.	Amendment has been made.
In addition to the above comments on the DFR, I would like to draw your attention to the noise reflection effect of the noise barriers, in particular the tall ones, on the NSRs located opposite to the road. The reflected noise should be minimized with the use of sound absorptive surfaces on the noise barriers. This issue should be addressed in the detail design stage of the noise barriers.	This comment has been brought to the attention of the engineers.
Regarding chapter 6 - Air Quality of the DFR, I understand that our comments have already been forwarded to your Ms Pamela Sanders from my colleague (Mr Allen Wong) direct.	Amendments necessary discussed by phone and faxed to Mr Wong.

本署檔號
OUR REF: EP2/N6/23 IV
來函檔號
YOUR REF: LSL/HCW/0960/D01/11
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96 MAR 8 18:24

8 March 1996

Binnie Consultants Ltd
11/F New Town Tower
Pak Hok Ting Street
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Fax : 2601 3988

(Attn: Mr. Tong LAM)

ACTION REQUIRED			
BY	LSL		
FILE			
REPLY		DATE	
TO SEE			

cc WSA
H&S
cc [redacted]

Dear Sir,

Agreement No. CE 7/94
Kam Tin Bypass
Draft Final EIA Executive Summary

I refer to your fax dated 1.3.96 and would like to advise that we have no further comment on the Executive Summary.

Yours faithfully,

(Stanley C F LAU)
Environmental Protection Officer
for Director of Environmental Protection

c.c. CE/MW, HyD
(Attn: Mr. Ken LEE) Fax: 2714 5289

1.9. LTR8-8

MEMO

From Director of Environmental Protection	**To** CE/MW, HyD (Attn: Mr. Ken LEE)
Ref EP 2/N6/23 V	
Tel No. 28351867 (FAX : 2591-0558)	**Your Ref** ( ) in HYD MWPMO 246TH/STG
Date 8 March 1996	**Dated**

Agreement No. CE 7/94
Design and Construction (D&C) Consultancy
PWP Item No. 6246 TH - Kam Tin Bypass

I refer to our recent telephone conversation (Lee/Lau) and would like to confirm that we have no further comment on the Draft Final EIA report other than the comments stated in my letter dated 14.2.96 to Binnie Consultants Ltd.

(Stanley C F LAU)
Environmental Protection Officer
for Director of Environmental Protection

c.c. Binnie Consultants Ltd
(Attn: Mr. T.L.S. LAM) Fax: 26013988