Hong Kong Government
Highways Department

Route 5
Section Between
Shek Wai Kok and Chai Wan Kok

Environmental Impact Assessment

Final Report

Volume I - Main Report and Appendices

Mott MacDonald Hong Kong Ltd.

in association with

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ROUTE 5 - SECTION BETWEEN SHEK WAI KOK AND CHAI WAN KOK

ENVIRONMENTAL IMPACT ASSESSMENT STUDY

AGREEMENT NO. CE 38/92

PROJECT NO. T350

Final Report

Prepared by
Project Manager

Name R M Bradley

Signature

Date 10 March 1995

Approved by
Project Director

Name R M Bradley

Signature

Date 10 March 1995

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CONTENTS

Tables

Tables (Cont'd)

1. INTRODUCTION

1.1 Background

Route 5 comprises the section of the New Territories Circular Road between Shatin and Tsuen Wan. The Route from Shatin to Shek Wai Kok was completed and opened to traffic in April 1990. Hong Kong Government now intends to construct the outstanding section of Route 5 between Shek Wai Kok and Chai Wan Kok. The design of the proposed section of route is being undertaken by Highways Department. As a Government project, the construction of the proposed scheme is subject to an Environmental Impact Assessment (EIA).

The Highways Department have commissioned Mott MacDonald Hong Kong Limited to undertake an EIA of the construction and operation of the proposed new section of Route 5 from Shek Wai Kok to Chai Wan Kok. The Study commenced on 31st August 1993 and an Initial Environmental Assessment Report (IEAR) was produced on 27 September 1993. This report summarised the preliminary evaluation of the environmental impacts arising from the scheme. Key issues associated with the design, construction and operation of the scheme, which require more detailed consideration, were identified and these have been fully evaluated in this Final Report.

1.2 Purpose of the Environmental Assessment Study

The Environmental Assessment Study has the following objectives:

(a) to describe the characteristics of the proposed project and related facilities and the requirements for their development;

(b) to identify and describe the existing and proposed elements of the community and environment likely to affect/be affected by the proposed project;

(c) to minimise pollution, environmental disturbance and nuisance arising from the project and related facilities, and its construction and operation;

(d) to identify, predict and evaluate the net environmental impacts and cumulative effects expected to arise due to the construction and operation of the project in relation to the existing and planned community and the neighbouring land uses;

(e) to identify and specify cost-effective methods, measures and standards for the inclusion into the design, which are necessary to mitigate these impacts to an acceptable level;

(f) to recommend environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted;

(g) to identify the nature and extent of the potential environmental impacts associated with the mitigation measures recommended in the study, e.g. visual impact or changes in air qualities inside and immediately outside road enclosures which are proposed as mitigation measures, and to propose methods to minimise the identified impacts;

(h) to identify other potential constraints associated with the mitigation measures recommended in the study, e.g. structural, visual and maintenance problems, and to recommend proposals to resolve the constraints;

(i) to identify and specify cost-effective mitigatory measures to the ecological landscape and visual impacts during the construction and operation of the proposed project; and

(j) to identify additional studies where necessary to fulfil the objectives or requirements of this Assignment.

1.3 Approach

The Study has been considered in two stages. The Initial Environmental Assessment Report (IEAR) submitted to the client on 27 September 1993 included:

(a) a description of the characteristics of the project and related facilities and development;

(b) identification of the existing and proposed elements of the community and environment requirements which could be affected by the project;

(c) an initial assessment and evaluation of the environmental impacts arising from the project, sufficient to identify those issues of key concern during the construction and operation of the project, which are likely to influence decisions on the project. These issues were identified as:

- noise;
- air quality;
- water quality;
- visual and landscape quality; and
- ecology.

(d) the definition of measurable parameters likely to be affected by the project and identification of monitoring studies necessary to provide a baseline profile of existing environmental conditions; and

(e) a detailed programme of investigation and reporting able to meet all other objectives of the Study.

The objectives of this Final Assessment Report are to:

(a) report on the findings of the baseline survey;

(b) fully evaluate and quantify where possible those environmental impacts identified in the IEAR as key issues;

(c) consider the acceptability of the impacts and recommend cost-effective mitigation measures where appropriate to reduce impacts to an acceptable level; and

(d) evaluate and quantify the potential environmental impacts or other constraints associated with the mitigation measures and propose methods to minimise such impacts and constraints.

2. PROJECT DESCRIPTION

2.1 Proposed Scheme

The project comprises the improvement of the section of Route 5 between the interchange with Tsuen Wan Road in the vicinity of Shek Wai Kok at the west and the interchange with Texaco Road at the east. The improvement will provide a high speed dual carriageway, partly through construction along a new alignment and partly through improvement of a section of the existing Castle Peak Road. The alignment of the new road is shown on Figure 2.1 and its key components are discussed below.

Route 5 presently approaches Tsuen Wan through the Shing Mun tunnels and along the Cheung Pei Shan Road. The road is dual three lane to the intersection with Texaco Road, Route Twisk, Wai Tsuen Road and Tai Ho Road North. This intersection is proposed to be improved with a dual two lane underpass being built under the interchange to carry traffic onto the new section of Route 5. Two new bridges will be constructed together with some reconstruction of existing roads on the bridge approaches. There will also be two new slip roads on the interchange, one to allow eastbound traffic to leave the new road and one to allow westbound traffic on the interchange to join the new road. The slip roads will fall from a level of between about 27m and 29mPD on the intersection to about 23mPD where they join the new dual carriageway. A contractor's works area will be constructed alongside the interchange.

The new road then passes to the north of and approximately parallel to the Tsuen Wan MTR depot before turning to the south and entering a tunnel through the proposed China Dyeing Works redevelopment. This section of the road will involve major slope reconstruction works both to the north and south together with a pedestrian subway. The slope works to the north will extend to Route Twisk which rises from about 34mPD close to the Tsuen Kam Interchange to about 60mPD north west of the MTR depot. The maximum height of the slope above the new road will be nearly 40m with a slope height of 10m to 15m below the road to the MTR depot.

The road will cross the MTR west of the depot on an overbridge at a level of about 24.6mPD and falls to a level of about 17.7mPD through the China Dyeing Works redevelopment in a tunnel. This section of the new road will be on structure within the podium of the development with the road structure being isolated from the podium structure.

The existing junction between Castle Peak Road and Tsuen King Circuit will be modified and improved to accommodate the flyover for Route 5 and to improve traffic circulation. The new road will drop to existing ground level immediately to the west of this junction. A new overbridge will be constructed at the junction of Castle Peak Road and Sha Tsui Road. The project limit at the western end will be at the intersection with Tuen Mun Road in Chai Wan Kok where new slip roads will be constructed to the existing interchange.

2.2 Construction Phase

2.2.1 Introduction

The construction phase characteristics are introduced in this section. The assessment of the construction impacts is considered in the relevant specialist chapters in this report.

2.2.2 Works Area

A total of four contractor's works areas will be provided for construction operations. These are:

(a) at the eastern end of the project to the north of the Tsuen Kam Interchange;

(b) to the north of the crossing of the MTR;

(c) at the north west of the interchange of Castle Peak Road with the Tsuen King Circuit; and

(d) along Tsuen King Circuit close to the Yan Chai Hospital Lim Por Yen Secondary School. This works area will be used for the Resident Engineer's offices.

These are all contiguous with the works except the last which is about ¾km from the works.

2.2.3 Construction Programme

A review of the construction programme indicates that an overall duration of six years is required for construction. The construction programme supplied by Highway Department and shown in Figure 2.2 indicates that construction is programmed to commence in April 1996 and last until May 2002. In general the working hours will be 9 hours per day, 6 days a week, although some night time working will be required for construction of the falsework at the MTR crossing.

2.2.4 Construction Traffic and Site Access

The construction traffic will mainly consist of heavy vehicles for the transport of equipment and material to and from the work areas, and internal traffic between the sites.

Access to sites (a) and (d) above will be directly from the Tsuen Kam Interchange and Route 5 while that to site (c) will be from Tsuen King Circuit. In view of the high volumes of HGVs already using these roads (Table 2.1) any impact due to construction traffic on the existing road network is considered to be minimal and has not therefore been included in this assessment. One haul road will be used during construction; this will be built between Tsuen Kam Interchange and the contractor' site (b), north of the MTR and will serve construction activities in Segments B and C, described below. The impacts from the existence of and movement of construction traffic on this road has been considered in the assessment.

2.2.5 Construction Activities

The main construction activities will comprise:

(a) excavation works;
(b) fill/embankment works;
(c) bridge foundation and superstructure works;
(d) formation and paving of carriageways;
(e) demolition of existing masonry and culverts; and
(f) reconstruction of culverts, drainage etc.

Construction work will be undertaken in six work segments as follows:

Segment A - Tsuen Kam Interchange (April 1996-September 1998): work at this location will comprise:

(a) demolition of the existing pavement on two bridges on the east and west of Tsuen Kam Interchange;
(b) the construction of new bridges on the east and west sections of the interchange (temporary embankments and pavements will also be constructed to carry diverted traffic during bridge construction and will be demolished on completion of the bridges);
(c) construction of a concrete bridge and viaduct from the Tsuen Kam Interchange to the westbound carriageway of Route 5;
(d) construction of a footbridge over the Tsuen Kam Interchange;
(e) construction of three new branch culverts; and
(f) relocation of foul water and storm water pipes.

Segment B - Tsuen Kam Interchange to MTR Depot (April 1996 - March 1999): work at this location will comprise:

(a) demolition of existing masonry, buildings and drainage and cut and fill earthworks to the formation level of the carriageway;
(b) construction of a subway; and
(c) formation and paving of at-grade sections of carriageway.

Segment C - MTR Crossing (April 1996 - September 1998): work at this location will comprise:

(a) construction of a haul road;
(b) excavation and earthworks to form a working platform and construction works area;
(c) formation of foundations to support the MTR flyover;
(d) construction and later removal of falsework over MTR lines;
(e) construction of superstructure over MTR line; and
(f) carriageway finishes.

Segment D - Tuen Mun road Flyover and Underpass, West Contract (April 1997 - May 2002): work at this location will comprise construction of the junctions between Route 5 and Tuen Mun Road and between Route 5 and the Chai Wan Kok Interchange. This will include:

(a) demolition of existing roads, abutments, flyover and decked nullah;
(b) construction of a boxed nullah, carriageway, pavement, abutment, bridge, retaining wall, underpass and embankment;
(c) stabilization of rock slope;
(d) various traffic diversions involving the construction and removal of temporary roads and decks; and
(e) demolition of a factory.

Segment E - Tsuen King Circuit - Kam Fung Garden (August 1996 - September 1997): work at this location will comprise:

(a) construction of approximately 200 metres of caisson wall.

Segment F - China Dyeing Redevelopment Site - Kam Fung Garden (April 1998 - May 2002): work at this location will comprise:

(a) demolition of old police headquarters;
(b) phased demolition of existing pavement and formation of new carriageway;
(c) drainage and utility diversion;
(d) construction of traffic diversions; and
(e) earthworks, foundation and superstructure for viaduct.

A detailed description of the construction activities, plant, periods of operation and quantities of incoming and outgoing material is provided in Appendix B1. In addition to the site specific activities itemised in that Appendix, the following will apply to all segments of the route:

(a) *Highway Finishes* - Finishes will include traffic signs and their supports, street lighting, pavement markings, traffic barriers and fences. It is assumed that the equipment used for these items will consist of light to medium delivery trucks, small cranes etc. However, it is not expected that many of these vehicles will be active at any given time.

(b) *Construction Traffic* - The import and export of material from the site will generate additional vehicle movement in the vicinity of the new road. Estimates of peak vehicle movements have been made from incoming and outgoing material quantities using the following information:

- capacity of lorry;
- total incoming/outgoing material quantity involved in each activity;
- period over which operation requiring incoming/outgoing material extends;
- peaking factor; and
- length of working day.

(c) *Stockpiling* - It is understood that material excavated during construction of the MTR platforms may be stockpiled directly east of the Tsuen Kam Interchange, while the work over the MTR line takes place and could be replaced at that location on completion of the works; alternatively the material may be removed from the site and new material brought in on completion of the works. Both scenarios have been considered in this assessment.

It is understood that the following activities will not take place at the site at any time during the construction period:

(a) concrete batching;
(b) asphalt plant; or
(c) percussive piling.

2.3 Operation of Route 5

The route is expected to be commissioned by 2002. In accordance with instructions from the Highways Department, a design horizon of 2011 has been used in this Study for predicting noise and air pollution emissions from traffic.

The air and noise pollution assessments in Working Paper No. 1 and the Draft Final Report of 16th February 1994 used traffic figures which were based on the Transport Department memorandum dated 25th October 1993 (Table 2.2). Transport Department subsequently revised the traffic figures in their memorandum of 18th March 1994.

All the traffic noise was therefore fully reassessed using the latest figures (Table 2.1).

However, it was deemed unnecessary to re-run the air pollution assessments. This was because the initial assessments, had been based on a higher proportion of heavy vehicles in most cases. The exceptions are Tai Chung Road, Route Twist and Wai Tsuen Road. (a comparison for these three roads is shown in Table 2.3). Reference to Fig. 3.3 for the locations of the air sensitive receivers, shows that no. 8, Muk Min Ha Tsuen, is the only receiver directly affected, (that is, by the increased traffic of Route Twisk.) On this basis, the previously predicted peak hour NO_2 levels (Table 5.7) and 24 hour levels of RSP (Table 5.9) for this location were compared with the Hong Kong Air Quality Objectives (Table 5.1) and found to be well below the limits (Table 2.4) It was therfore judged highly unlikely that they would exceed the standards even if the somewhat increased heavy vehicle flows of the latest Transport Department memorandum were used to re-run the assessments.

Table 2.1 Predicted Traffic Volumes and speeds in 2011 (supplied by Transport Department 18.3.94)

Road		Traffic Volume	
		(veh/hr)	% Heavy Vehicle
Route 5			
- Cheung Pei Shan to	WB	1500	50
Tsuen Kam Interchange	EB	800	72
Route 5			
- Tsuen Kam Interchange	WB	2400	57
to Castle Peak Road	EB	2400	53
Slip Road from Route 5 to Tsuen Kam Interchange	EB	1600	43
Slip Road from Tsuen Kam Interchange to Route 5	WB	900	69
Castle Peak Rd			
Tai Chung Rd to Tai Ho Rd North	WB	1000	94
	EB	1600	39
Route 5 to Tai Chung Rd	WB	1400	40
	EB	1900	40
Sha Tsui Rd to Route 5	WB	3800	52
	EB	4200	49
Chai Wai Kok Interchange to	WB	2000	48
Sha Tsui Rd	EB	2600	40
Tuen Mun Rd	WB	1300	59
	EB	1500	63
Tai Chung Road	WB	600	38
	EB	700	42
Tsuen King Circuit	WB	200	4
	EB	200	11
Route Twisk	WB	1100	71
	EB	900	37
Cheung Pei Shan Road	WB	900	37
	EB	1200	59
Tai Ho Road North	WB	1200	35
	EB	700	49
Texaco Road North	WB	2300	60
	EB	2200	49
Wai Tsuen Road	WB	300	54
	EB	500	34

Note: These figures were from the Transport Department's Memorandum of 18th March 1994 were used for the noise modelling. The air pollution assessment used different figures (Table 2.2) that were available at the time that the assessment was carried out.

Table 2.2 Predicted Traffic Volumes and speeds in 2011 (supplied by Transport Department 25.10.93)

Road		Traffic Volume		Vehicle Speed (Km/hr)	
		(veh/hr)	% Heavy Vehicle	Model	Design
Route 5					
- Cheung Pei Shan to	WB	1242	60.2	38	70
Tsuen Kam Interchange	EB	961	79.3	40	70
Route 5					
- Tsuen Kam Interchange	WB	2420	66.2	14	70
to Castle Peak Road	EB	2423	69.8	12	70
Slip Road from Route 5 to Tsuen Kam Interchange	EB	1461	63.6	6	50
Slip Road from Tsuen Kam Interchange to Route 5	WB	1182	72.6	15	50
Castle Peak Road					
Tai Chung Rd to Tai Ho Rd North		3955	79.9	-	50
Route 5 to Tai Chung Rd		4270	78.8	-	50
Sha Tsui Road to Route 5		8212	71.3	-	50
Chai Wai Kok Interchange to Sha Tsui Rd		4212	67.7	-	50
Tuen Mun Rd		2995	80.8	-	70
Tai Chung Road		740	48.0	29	50
Tsuen King Circuit		509	98.0	24	50
Route Twisk		1282	79.5	33	50
Cheung Pei Shan Road		2400	64.4	39	50
Tai Ho Road North		1800	46.5	39	50
Texaco Road North		4587	65.6	19	50
Wai Tsuen Road		812	37.1	36	50

Note : These figures were from the Transport Department's Memorandum of 25th October 1993 and were used for the air modelling

Table 2.3 Comparison of previous and latest Traffic Figures provided by Transport Department, for Tai Chung Road, Route Twist and Wai Tsuen Road

Road	No. of Vehicles (Veh/hr)		Percentage of heavy vehicle	
	Traffic data of 10/1993	Traffic data of 3/1994	Traffic data of 10/1993	Traffic data of 3/1994
Tai Chung Road	740	WB 600 EB 700	48.0	WB 38 EB 42
Route Twisk	1282	WB 1100 EB 900	79.5	WB 71 EB 37
Wai Tsuen Road	812	WB 300 EB 500	37.1	WB 54 EB 34

Table 2.4 Comparison of Air Quality Objectives with Estimated Pollutant Concentrations, Muk Min Ha Tsuen, based on the earlier traffic predictions (Table 2.2)

Pollutant	Pollutant Concentration, $\mu g/m^3$		Air Quality Objectives ($\mu g/m^3$)
	Podium Level	10 metres above podium level	
NO_2 (1 hr)	181	162	300
Respirable Suspended Particulates (24 hrs)	101	-	180

For the purposes of the noise and air assessment, peak morning hour traffic flows have been used. Traffic speeds and the flow characteristics are important in assessing the noise pollution. The noise from vehicles varies according to the speed (assuming that other factors such as gradient and road surfacing are constant). The transport model data provided by Transport Department shows that the road will be operating at very high traffic flow and speeds will be reduced to below design speeds, in some cases quite dramatically. However, in accordance with suggestions from the Environmental Protection Department, the design speeds, with traffic flowing under constant flow conditions, were assumed for the environmental assessment, rather than the speeds predicted by the transport models.

Traffic volumes and percentage heavy goods vehicles on Tsuen Kam Interchange and its eastern slip roads have been estimated through consideration of the predicted traffic levels supplied by the Transport Department for the surrounding roads. A vehicle speed of 50 km/hr was assumed.

3.0 ENVIRONMENTAL FRAMEWORK

3.1 Introduction

Tsuen Wan currently suffers many environmental problems as a result of the complex character of the area. Interface problems between industry, roads and residential developments result in severe noise and air pollution problems. Heavy through traffic, comprising goods vehicles, public transport and private vehicles, between Tuen Mun Road and Cheun Pei Shan currently uses the local road network through Tsuen Wan, resulting in severe congestion and contributing to already high local noise and air pollution levels.

Prior to the assessment of impacts from construction and operation of the project, it is important to review the prevailing background environment of the Study Area.

The following data have been collected and analysed:

(a) Tsuen Wan - Kwai Tsing Development Statement
- Transport Sectoral Study, Final Report;
(b) Tsuen Wan Central Outline Development Plan;
(c) Tsuen Wan North Outline Development Plan;
(d) Tsuen Wan Outline Zoning Plan;
(e) Tsuen Wan New Town 1991 Population Census;
(f) alignment of Route 5 - Section between Shek Wai Kok and Chai Wan Kok;
(g) preliminary Traffic Data of Route 5 for 2011;
(h) Tsuen Wan Air Quality Data, 1992;
(i) Development Plan for Tsuen Wan Area 3;
(j) section drawing of Route 5;
(k) details of China Dyeing Works Redevelopment and the environmental impact assessment carried out by the developer;
(l) meteorological data for Tsuen Wan;
(m) emission factors of vehicles;
(n) traffic data of all major roads at the Study area;
(o) drainage plans for the new road; and
(p) schedules of construction activities.

Where appropriate, additional data collection in the form of baseline surveys was undertaken as part of this study so that these could be incorporated into the key issues assessment at a later stage in the study. The existing data, additional surveys and their evaluation in terms of existing noise, air quality, water quality, ecology and visual and landscape quality are discussed in subsequent chapters. The following discussion will therefore concentrate on an analysis of the population and landuses in the vicinity of the proposed route and an identification of areas containing sensitive receivers that could be affected by the project.

3.2 Population and Land Uses

The following baseline data in the Study Area have been collected:

(a) population data have been obtained from the District Office and Census and

Statistics Department;
(b) land use data have been obtained from the Planning Department; and
(c) site inspections have been carried out by the consultants.

3.2.1 Population

The 1991 population census of Hong Kong produced background data on the population in the Study Area. The Study Area covers census areas 3.2.1, 3.2.2, 3.2.3, 3.2.4 and 3.2.5 as shown on Figure 3.1. The total population of the Study Area was estimated to be about 248,500. Table 3.1 shows the distribution of the population in the Study Area.

Table 3.1 Population Data

Census Area	Population
3.2.1	7,381
3.2.2	2,452
3.2.3	57,884
3.2.4	106,893
3.2.5	73,822

3.2.2 Land Uses

The Study Area is mixed and ranges from recreational, residential, commercial and industrial in an urban environment to semi-rural village and squatter type developments and established plantation/woodland. These landuses are identified in the Tsuen Wan Outline Zoning Plan as Government/Institution/Community, residential, Commercial, Comprehensive Development Area, Village, Green Belt and Open zones. Due to the rapid development of the region, the land uses of some areas have been rezoned from industrial to comprehensive development in recent years.

Current land uses near the Study Area are presented in Figure 3.2.

3.3 Areas Containing Sensitive Receivers

The land uses and the environmental framework discussed above have been analysed to identify the areas containing sensitive receivers that could be affected by the construction or operation of the route. Any committed developments (eg the proposed redevelopment of the China Dying Works) which could be similarly affected, were also established at this stage. The identified areas are as follows and are shown on Figure 3.3:

3.3.1 Air and Noise Sensitive Receivers

Air and noise sensitive receivers will be similar at all land uses, although the scale and magnitude of impacts will vary. The areas containing sensitive receivers are described below from east to west along the project:

Hoi Pa Village South Terrace

Village type houses have been proposed in the area of land between Ma Sim Pai Road and the eastbound slip road from Tsuen Kam Interchange onto Route 5. There will be 31 properties in the area and it is understood that they will be 3 storeys high. The population of the village is estimated to be 230. The project is scheduled to be finished by the end of 1995.

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Shek Wai Kok Estate

The estate comprises high rise residential blocks, east of Tsuen Kam Interchange, south of Route 5 and north of Texaco and Wai Tsuen Roads, with the closest block about 20m from the edge of the westbound slip road from Route 5. There is a playground between Shek To House and the Tsuen Kam Interchange which could be affected by increased air pollution but the school for the development (Shek Wai Kok Primary School) will be sheltered from the noise from Route 5 by the residential blocks.

Fairview Garden

This development has two high rise residential blocks alongside and south of Tsuen Kam Interchange between Texaco Road and Wai Tsuen Road with a open space area between the podium and the interchange.

Luk Yeung Sun Chuen

This is a major development built above the Tsuen Wan MTR depot. Blocks A and B are about 30m west of the interchange and about 90m from the new dual carriageway. Kwai Ming Wu Memorial School of the Precious Blood is located at the western end of the development. On the other hand, Liu Po Shan memorial School is sheltered from the project by the residential Blocks C and D and is thus unlikely to be affected by traffic noise.

Pak Tin Pa Tsuen, Nam Tin Chuk and Muk Min Ha Tsuen

These three areas have been grouped together as they have similar characteristics. They are largely low rise village areas located on the hillside north of the Tsuen Kam Interchange and Route Twisk and Ma Sim Pai Road with Route 5. There are about 20 properties that front onto the proposed new road. The remainder of the properties will be sheltered from noise impacts by the properties closest to the road. Nam Tin Chuk is further from the road than the other two villages but includes Tung Lam Home for the Aged and a sitting out area at the southern extremity of the village which could be affected by the project.

Pak Tin Pa

There are several village houses on the hillside either side of Route Twisk west of Muk Min Ha Tsuen. The houses to the south of route Twisk will be demolished as part of the new road scheme but the dwellings to the north will be approximately 90 metres from the new route and could therefore be subject to noise and air impacts as a result of its construction and operation. The proximity of the proposed haul road to these receivers could result in dust impacts during construction.

Tsuen Kam Centre

This development comprises two high rise residential blocks and is located on the north side of Castle Peak Road between the Nan Fung Centre and Sai Lau Kok Road. Although these buildings may be partially shielded from Route 5 by Tsuen Wan Government House, they could be subject to some noise impacts from that road as well as from Route Twisk.

Castle Peak Road

Fuk Loi Estate and several residential blocks are located along the southern side of Castle Peak Road in the section between Tai Ho Road and Tai Chung Road. Dwellings on the lower floors of these buildings may be screened by godowns along the northern side of Castle Peak Road but dwellings on the higher floors will be subjected to some impacts from the new road.

Pak Tin Pa San Tsuen

These village houses are scattered on the hillside between the MTR line and Route Twisk, close to the construction site for the MTR crossing.

China Dyeing Works Redevelopment

A proposal by HKR Properties Ltd (HKRP) to redevelop an area of land between Castle Peak Road and the tail tracks of the MTR, previously occupied by the China Dyeing Works Factory and a section of open space, has received approval from the Town Planning Board (TPB). The proposed scheme involves the construction of a 30 metres high podium for retail facilities with a residential development comprising 12 tower blocks on top. The orientation of the blocks will be away from the noise sources. Other community facilities could be incorporated in the scheme. Route 5 will pass through the podium at +24 mPD to +17 mPD and will be enclosed within a boxed structure within the podium, with the road structure being isolated from the podium structure to minimise noise and vibration effects.

Tsuen King Garden

Tsuen King Garden is not likely to be affected during operation of the project due to its distance from the road and the screening effect of a knoll between the development and Castle Peak Road. The Resident Engineers office will be built on Tsuen King Circuit but this is not likely to generate significant additional traffic.

Kam Fung Garden

Block 1 of Kam Fung Garden will be only about 20m from the edge of the new road. Block 2 will be about 60m from the road and will be partly sheltered from noise impacts by Block 1.

Tsuen Tak Garden

Blocks D and E of Tsuen Tak Garden will be about 40m to 50m from the edge of the new road.

Joyful Garden

This development comprises two blocks and is located on the south side of Tsuen King Circuit, opposite the junction with On Yin Street, to west of Tsuen Tak Gardens.

Nan Fung Textiles Redevelopment (Tsuen Wan Area 3)

A new development has been proposed by Nan Fung Textiles in the Study Area and it is understood that initial approvals have been given. The developer has provided details of initial layout and block plans indicating the construction of four residential tower blocks. It is understood that these blocks will not be complete prior to 1997.

3.3.2 Sensitive Receivers for Water Pollution

The Tai Chung Road Nullah and the receiving waters downstream in the Rambler Channel are the sensitive receivers for water quality for this project.

4. NOISE ASSESSMENT

4.1 Key Issues

There could be noise impacts during construction of the proposed road due to the operation of construction plant. The only noise impact during operation of the route will be that arising from road traffic noise.

The key factors determining the implications of noise impacts will be:

(a) the location, number and sensitivity of receivers and their compatibility with construction and road traffic noise;
(b) extent of construction works involved;
(c) nature and duration of construction activities;
(d) work cycle and programme
(e) background noise levels; and
(f) cost-effectiveness of noise mitigation measures in reducing landuse incompatibility.

4.2 Legislation

Noise is controlled through the Noise Control Ordinance (NCO) (Cap. 400), it's regulations and three technical memoranda (TMs), two of which apply to construction noise and the third to non-construction noise. The NCO imposes stringent controls on any construction work that is carried out in close proximity to any Noise Sensitive Receiver (NSR) and the Authority (Director of Environmental Protection) uses a permit system to control construction noise according to the criteria laid down in the TMs.

The Technical Memorandum on Noise from Construction Work other than Percussive Piling (TM1) sets out standards for construction noise and the method of calculating the noise impact. No work using powered mechanical equipment is allowed during restricted periods unless a Construction Noise Permit (CNP) is issued by the Authority. Basic Noise Levels (BNLs) are ascribed for the areas according to their sensitivity rating as shown in Table 4.1.

Table 4.1 Area Sensitivity Rating

Type of Area Containing Noise Sensitive Receiver	Degree to which NSR is affected by Influencing Factors		
	Not Affected	Indirectly Affected	Directly Affected
Rural area, including country parks or village type development	A	B	B
Low density residential area consisting of low rise associated high rise developments	A	B	C
Urban area	B	C	C

Source : TM1

Tuen Mun Road, Castle Peak Road - Tsuen Wan and Texaco Road North are the major roads within the Study Area. According to "The Annual Traffic Census 1992" by Transport Department, the Annual Average Daily Traffic (AADT) of these roads are in excess of 30,000. Areas containing the sensitive receivers are urban areas either directly or indirectly affected by Influencing Factors (IF). Hence, the Area Sensitivity Rating (ASR) of these receivers should be "C". The Acceptable Noise Levels (ANLs) for ASRs are shown in Table 4.2. The ANLs for construction are calculated from the BNLs following corrections for the duration of the CNP and for multiple site situations. The ANLs for this project have therefore been assumed to be the same as the BNLs.

Table 4.2 Acceptable Noise Levels for Construction

Time Period	ANL, dB(A)
Period 1 All days during the evening (1900 - 2300 hours), and general holidays (including Sundays) during the daytime and evening (0700 - 2300 hours)	70
Period 2 All days during the night time (2300 - 0700 hours)	55

Source : TM1

Work in these restricted periods using powered mechanical equipment can only proceed if the contractor has been granted a CNP.

Although there is no daytime limit for construction noise other than percussive piling, the EPD recommend a maximum noise level of 75 dB(A), measured over a 30 minute period, at any sensitive receiver during periods not restricted under the NCO.

Percussive piling is permitted only within the constraints of a CNP. The Technical Memorandum on Noise from Percussive Piling (TM2) sets out the requirements for working under a CNP and determination of the permitted hours of operation and other conditions where necessary. Percussive piling is prohibited during the restricted periods unless specifically exempted. Acceptable noise levels for percussive piling are set in TM2 depending on the type of NSR.

Further subsidiary regulations control the noise from hand held percussive breakers and air compressors and require compliance with the relevant noise emission standards and the fitting of Noise Emission Labels.

For the period of operation, the Hong Kong Planning Standards and Guidelines provide road traffic noise standards of:

- 70 dB(A) L10(1 hour) at the facades of domestic premises, hotels, hostels and offices;
- 65 dB(A) L10(1 hour) at the facades of educational institutions, places of worship and law courts; and
- 55 dB(A) L10(1 hour) at the facades of hospitals, clinics, homes for the aged, diagnostic rooms, wards etc.

The above operational standards apply to uses which rely on opened windows for ventilation.

4.3 Existing Conditions and Baseline Survey

4.3.1 Introduction

The existing noise environment is dominated by road traffic noise and noise from extensive industrial premises in addition to ongoing general construction work. Castle Peak Road presently passes through the centre of the industrial and residential areas to the south of the alignment proposed for Route 5. This road carries significant traffic volumes and is a major noise source. The industrial area of Chai Wan Kok is situated to the southwest of the proposed Route 5 alignment.

Noise from industry, traffic and the community all contribute to the background noise levels of the area during the daytime. Traffic noise becomes the major noise source during the night time as there is less industrial activity. No background noise data are available from previous studies.

A noise survey was conducted in December 1993. The purpose of the survey was to:

(a) identify the major noise sources; and
(b) measure the background noise levels and the temporal variation.

The measured noise data have been used to determine the background noise level prior to the construction and operation of Route 5 and to determine the most appropriate noise control standards for inclusion in the documentation.

The survey measured noise at the following sensitive receivers:

(a) Shek To House, Shek Wai Kok Estate;
(b) Block 1, Luk Yeung Sun Chuen;
(c) Pak Tin Pa Tsuen;
(d) Tung Lam Home for the Aged;
(e) Muk Min Ha Tsuen;
(f) Block A, Tsuen Kam Centre;
(g) Wing Hong House, Fok Loi Estate; and
(h) Block 1, Kam Fung Garden.

4.3.2 Survey Methodology

Ambient noise levels were measured with integrated sound level meters. The meters conform with the International Electrotechnical Commission Publications 651:1980 and 804:1985 for Type 1 precision sound level meters. Table 4.3 lists the equipment used for the survey.

Table 4.3 List of Equipment used for Noise Survey

Equipment	Manufacturer & Model
Sound Level Meter	B&K 2231 RION NL-14
Condenser Microphone	B&K 4155 RION UC-53A
Preamplifier	B&K 2639 RION NH-20
Windscreen	B&K UA0237 RION WS-02
Datalogger	Metrasonics dl-714

Note: All equipment was calibrated before and after each measurement using a B&K 4231 acoustic calibrator which was itself checked on 14 August 1993.

Continuous noise measurements were made at each monitoring location for a period of twenty-four hours on a typical weekday. The microphone was positioned at 1 metre from the facades of the buildings. Where a free field measurement was made, facade correction was applied to the results of the measurement. Equivalent noise level (Leq) and statistical noise levels (L10, L50 and L90) were recorded and stored in the dataloggers at hourly intervals.

4.3.3 Results and Discussion

Shek To House, Shek Wai Kok Estate

The major noise source of Shek Wai Kok Estate was attributable to the traffic at Tsuen Kam Interchange. Maximum traffic noise, L10, of 74.7 was recorded between 0900-1000 hours. Figure C1.1 shows the hourly variation of measured noise levels in L10, L50, L90 and L_{eq} over a typical day.

Block 1, Luk Yeung Sun Chuen

Similar to Shek To House, traffic noise from Tsuen Kam Interchange was the major noise source of the area. Maximum traffic noise of 72.1 dB(A) was recorded between 0800-0900 hours. Figure C1.2 shows the variations of measured noise levels at the site.

Pak Tin Pa Tsuen

Again, traffic noise from Tsuen Kam Interchange was the dominant noise source at this site. Traffic noise of 72.4 dB(A) was recorded between 0900-1000 hours. Figure C1.3 shows the variations of the noise levels.

Tung Lam Home for the Aged

Peak traffic noise of 72.9 dB(A) was recorded between at 1800-1900 hours. Traffic from Tsuen Kam Interchange and Texaco Road North are the major noise sources. Figure C1.4 shows the variations of noise levels.

Muk Min Ha Tsuen

Noise levels were measured at the roof of the village house adjacent to Route Twisk, which is the major noise source at this site. A noise level, L10, of 76.6 dB(A) was recorded between 0800-0900 hours. Figure C1.5 shows the hourly noise levels variations at the site.

Block A, Tsuen Kam Centre

Figure C1.6 shows the variations of noise levels at Tsuen Kam Centre. The bus terminal at Sai Lau Kok Road is the major noise source of the area. It is crowded with buses from the north-west region of the New Territories. Moreover, noise emitted from the MTR trains and Tsuen Wan bus terminal also affected the background level of the site. As a result, a sharp increase of the noise levels was recorded in the period between 0600 and 0700 hours. A maximum noise level, L10, of 73.4 dB(A) was recorded between 0800-0900 hours.

Wing Hong House, Fuk Loi Estate

Traffic from the Castle Peak Road - Tsuen Wan was the major noise source at Fuk Loi Estate. The traffic noise, L10, reached a maximum level of 75.5 dB(A) between 0800-0900 hours. Figure C1.7 shows the variations of the noise levels at the site.

Block 1, Kam Fung Garden

Similar to the noise environment at Fuk Loi Estate, Castle Peak Road - Tsuen Wan was the dominant noise source at this site. In addition, noise from the nearby factory buildings at Chai Wan Kok industrial area also affected the background level of the site. Variations of noise levels were small during the daytime. The maximum noise levels, L10, of 75.5 and 75.6 dB(A), were recorded during the morning and afternoon peak hours. Figure C1.8 shows the variations of noise levels at the site.

The measured maximum L10(1-hour) levels are summarised in Table 4.4 below.

Table 4.4: Maximum Measured L10(1-hour) Noise Levels

Location	Noise Level, L10 (dB(A))
Shek Wai Kok Estate	74.7
Luk Yeung San Tsuen	72.1
Pak Tin Pa Tsuen	72.4
Tung Lam Home for the Aged	72.9
Muk Min Ha Tsuen	76.6
Tsuen Kam Centre	73.4
Fok Loi Estate	75.6
Kam Fung Garden	74.6

Examination of the baseline data reveals that the daytime noise levels at Tsuen Wan are already in excess of the HKPSG recommended maximum level for traffic noise.

4.4 Noise Sensitive Receivers

Areas containing sensitive receivers have been discussed in Section 3.3.

For each area, one or more representative receivers were selected according to the criteria set out in the Hong Kong Planning Standards and Guidelines (HKPSG). The locations and number of representative NSRs were selected to represent all dwellings that could be affected by the scheme. Their choice was therefore determined by the anticipated noise variation within the particular area through consideration of the following:

(a) the location of the buildings with respect to the noise sources;
(b) the height of the buildings;
(c) the orientation of the buildings;
(d) the position of openable windows in each dwelling;
(e) the location of sensitive area within the building; and
(f) the presence of noise barriers eg existing buildings or natural terrain between the noise source and the receivers.

Consideration of the above parameters also enabled a determination of the number of dwellings represented by each chosen representative receiver.

For modelling of construction impacts, the representative receivers were placed at dwellings subject to the highest impact. In general these were those dwellings closest to the noise source - podium level in the tower blocks and ground floor level in low rise buildings. However where the lower levels are shielded from the noise source by intervening barriers, the construction noise level was also predicted at higher levels. Screening from the podium was also taken into account where appropriate.

For the operational assessment, the effect of roadside mitigation has been considered. Such mitigation may reduce the noise levels experienced at lower levels in tower blocks, and representative receivers for the operational assessment were therefore placed at three heights in these buildings - the first and middle residential floors and the roof of the building. For low rise buildings receivers were placed at one height only - on the roof of the building.

The location of the specific representative receivers is described below and shown in Figures 4.1-4.3.

Shek Wai Kok Estate

The representative receivers were placed at the centre of the west facade of the southern section of Shek To House, east of Tsuen Kam Interchange, south of Route 5 and north of Texaco and Wai Tsuen Roads. The dwellings represented by these receivers comprise all the west facing properties in Shek To House. Shek Lin House and Shek Wai Kok Primary School will be sheltered from Route 5 by Shek To House.

Fairview Garden

The representative receivers were placed at the north west facade of Block 1 which is situated south of Tsuen Kam Interchange between Texaco Road and Wai Tsuen Road. The dwellings represented by these receivers comprise all the west facing properties in blocks 1 and 2 of this development.

Luk Yeung Sun Chuen

Twelve representative receivers were considered in this area and were located as follows:

(a) on the 1st, 11th and 21st residential floors and the roof of the north facade of block A;
(b) on the 1st, 11th and 21st residential floors and the roof of the west facade of block A;
(c) on the 1st, 11th and 21st residential floors and the roof of the north facade of block F; and
(d) on the 1st, 11th and 21st residential floors and the roof of the west facade of block F.

The receivers are located south west of Tsuen Kam Interchange, south of Tai Ho Road, Route 5 and its slip road and also close to Wai Tsuen Road. The dwellings represented by these receivers comprise:

(a) the north-facing properties in blocks A-C (the north facing properties in blocks D and E will be shielded by intervening buildings);
(b) the west facing properties in block A (the west facing properties in blocks B-E are shielded by intervening buildings);
(c) the north-facing properties in blocks F and G (the north facing properties in blocks H-O will be shielded by intervening buildings); and
(d) the west facing properties in blocks F and L (the west facing properties in blocks G, H, M, N and O will be shielded by intervening buildings).

Kwai Ming Wu School

The representative receiver was placed at the north east facade of the school which is situated south of Tai Ho Road North and Route 5 and its slip road and south west of Tsuen Kam Interchange.

Hoi Pa Village South Terrace

The village is proposed to be constructed between Ma Sin Pa Road and Cheung Pei Shan Road. The buildings of this village will be three storeys high and one representative receiver was selected at the south east of the site. The dwellings represented by these receivers comprise all the village houses in this development. The village is expected to be completed by the end of 1995.

Pak Tin Pa Tsuen

As the buildings at this development are three storeys high only one receiver was selected at this site and was located on the roof of property number 2, in the centre of the most southerly block. The development is located on the hillside directly north of

the Tsuen Kam Interchange and the junction of Route Twisk with Ma Sim Pai Road. The dwellings represented by the receiver comprise properties 1-4, 6-9, 14, 15 and the new properties to the north of the car park. These properties will shield all other dwellings in this development from the noise sources.

Tung Lam Home for the Aged

This property is located on the hillside to the north west of the Tsuen Kam Interchange and north of Route Twisk and Route 5. The building is partly sheltered from Route Twisk by the intervening hillside. As the buildings at this development are two storeys high only one representative receiver was modelled. The location of this receiver was on the roof at centre of the south east facade of the building.

Muk Min Ha Tsuen

This village is located on the hillside immediately north of and above Route Twisk and north and above the alignment of the proposed Route 5 and its west bound slip road. As the buildings are only three storeys high, representative receivers were placed on the roof of properties 1 and 16 which are at either end of the row of the most southern buildings in the developments. The dwellings represented by these receivers comprise properties 1-16 and 33-34. These properties will shield all other dwellings located further north in this development from the noise sources.

Pak Tin Pa

These village houses are currently located on the hillside either side of Route Twisk. It is understood that those dwellings located to the south of Route Twisk will be demolished as part of the proposed scheme. One representative receiver was placed north of Route Twisk. The dwellings represented by this receiver comprise all the properties in this village that will be existence during operation of the route.

Tsuen Kam Centre

This development comprises two high rise residential blocks and is located on the north side of Castle Peak Road between the Nan Fung Centre and Sai Lau Kok Road. Although these buildings may be partially shielded from Route 5 by Tsuen Wan Government House, they could be subject to some noise impacts from that road as well as from Route Twisk. The receivers were placed on the north facades of both blocks. The dwellings represented by these receivers comprise the north-facing properties in both blocks.

Fuk Loi Estate

This development is located to the south of Castle Peak Road, close to its junction with Route 5. Representative receivers were placed in the middle of the north facade of Wing Hong House, Fuk Loi Estate. The number of dwellings represented by this receiver comprises all the north facing properties in Wing Hong House and Wing Lok House. Dwellings to the east and south of these blocks will be sheltered from Route 5 by those buildings and by other properties on Castle Peak Road. Dwellings on Castle Peak Road, west of Wing Hong House will be sheltered from Route 5 by the China Dyeing Works and the tower blocks in the proposed China Dyeing Works redevelopment to the east of these Works.

Pak Tin Pa San Tsuen

These village houses are scattered on the hillside between the MTR line and Route Twisk. One representative receiver was placed on the north facade of the most southern house. The dwellings represented by this receiver comprise all the properties in this village.

China Dyeing Works Redevelopment

Eighteen representative receivers were considered in this area and were located as follows:

(a) on the 1st, 14th and 27th residential floors and roof of the south west facade of block 1;
(b) on the 1st, 14th and 27th residential floors and roof of the south west facade of block 2;
(c) on the 1st, 14th and 27th residential floors and roof of the south west facade of block 4;
(d) on the 1st, 14th and 27th residential floors and roof of the north east facade of block 8;
(e) on the 1st, 14th and 27th residential floors and roof of the north east facade of block 9; and
(f) on the 1st, 14th and 27th residential floors and roof of the south west facade of block 12;

The locations of the various blocks with respect to Route 5, Castle Peak Road and Tsuen King Circuit is shown in Figure 4.3. The dwellings represented by these receivers comprise:

(a) the west facing properties in the south half of block 1;
(b) the west facing properties in the south half of blocks 2 and 3;
(c) the west facing properties in the south half of block 4;
(d) the north facing properties in blocks 5-8;
(e) the north-east facing properties in blocks 9 and 10; and
(f) the west facing properties in blocks 9 -12;

Tsuen King Garden south of Tsuen King Circuit

This development is located south of Tsuen King Circuit, north of the Police District Headquarters, to the north and above Route 5. Representative receivers were placed on the south facade of Block 3. The dwellings represented by these receivers comprise all the south-facing dwellings in Blocks 2-5. Blocks 6 and 7 will be shielded by the Police Headquarters and the blocks in the redevelopment of the China Dyeing Works site.

Kam Fung Garden

This development is located directly north of Castle Peak Road east of its intersection with Sha Tsui Road. Representative receivers were placed on the south facade of Block 1, the more southern of the two blocks in this development. The dwellings represented by these modelled receivers comprise all the south facing dwellings in Blocks 1. The dwellings in Block 2 will be shielded from Route 5 by Block 1 and Tsuen Tak Gardens.

Tsuen Tak Gardens

This development is located directly north of Castle Peak Road, west of its intersection with Sha Tsui Road. Representative receivers were placed on the south facade of Block D, the most southern of the five blocks in this development. The dwellings represented by these receivers comprise all the south facing dwellings in Blocks D and E. The other dwellings in this complex will be shielded from Route 5 by these buildings.

Joyful Garden

This development comprises two blocks and is located on the south side of Tsuen King Circuit, opposite the junction with On Yin Street, to west of Tsuen Tak Gardens. Representative receivers were placed on the south facade of the west wing of Block A. The dwellings represented by these receivers comprise all the south facing dwellings in Blocks A and B. It should be noted that Joyful Garden may be screened by residential blocks to be built in the proposed Tsuen Wan Area 3 development. This screening has been taken into account in the noise modelling based on the latest information available on the block layout for the Area 3 development.

Tsuen Wan Area 3

This redevelopment of the Nan Fung Textiles site will include four residential tower blocks, located north of Tuen Mun Road at its junction with Castle Peak Road. Representative receivers were placed on the south east facades of the south west and north east flats in Block 4. The dwellings represented by these receivers comprise all the dwellings whose windows face towards Route 5 and which are not shielded by intervening buildings; these are all the south west dwellings in Blocks 1-4 and the north east dwellings in Block 4.

4.5 Construction Phase

4.5.1 Assessment Methodology, Criteria and Assumptions

The construction programme (Figure 2.2) and construction schedule (Appendix B1) provided by Highways Department have been used as a basis for the prediction of the site activities taking place during construction.

The sound power levels (SWLs) of the mechanical equipment have been based on those given in TM1 and BS5228:Part 1:1984, "Noise Control on Construction and Open Sites" and the levels are listed in Appendix C2. The positioning of the noise sources for the assessment has been based on the procedures stated in TM1.

Where a single activity involves several sequential sub-activities, the activity which generates the most noise was assumed for the entire period of the activity. For example (due to the use of the hydraulic breaker and piling rig) the period during sub-activities A3.1 and A3.3 has been determined as the time when most noise will be generated during activity A3 and the noise predicted from this sub-activity has been assumed for the entire duration of activity A3, thus representing a worst case scenario. Where it was not possible to eliminate any overlap between individual activities or sub-activities, the assessment was based on the assumption that all these activities will occur simultaneously. In actuality, however, the noise level at any receiver will vary continuously as the mix of construction plant varies, being high perhaps for a short

duration and then becoming less as the mix alters. The programme of activities (ie worst case noise condition at any time) assumed for the construction noise assessment is summarised in Figure C3. Since, as shown in Appendix C2, the noisiest items of plant will be breakers, drills and boring rigs. Periods when these plant are operating are also indicated on Figure C3.

The construction stage noise levels have been modelled at the NSRs. These levels comprise the cumulative impacts from all plant operating in different zones at any one time as well as the background noise levels, determined from the baseline survey. Overall noise levels resulting from site activities have been predicted at the facades of the representative NSRs for site activities throughout the whole construction period.

For the purposes of the assessment the following assumptions have been made:

(a) there will be no percussive piling or blasting;
(b) half the number of trucks associated with any single activity will be working at any one time. This assumption is made because most of the trucks will be travelling to and from the site and much of their time will thus be away from the site or its immediate vicinity;
(c) in any single sub-activity breakers and drills will not be used simultaneously;
(d) where an activity is split into several sequential sub-activities the noise level is assumed to be that of the noisiest sub-activity;
(e) in view of the proximity of the receivers to the noise sources, effects due to the absorption by air or effects due to meteorological conditions have not been incorporated in the model calculations;
(f) the nature of ground conditions or topography has not been incorporated into the model, except where the topography impinges on the line of sight between the source and receiver;
(g) meteorological conditions have not been incorporated into the model calculations; and
(h) where natural or man-made barriers impinge on the line of sight between the source and receiver their effects were incorporated in the calculations;

Following the calculations, the potential noise impact from construction activities was assessed by comparing the predicted levels with the relevant criteria summarised in Section 4.2 above. The total number of dwellings subject to each of the calculated noise levels was obtained through consideration of the number represented by each modelled NSR.

4.5.2 Impact Assessment and Evaluation

4.5.2.1 Daytime Construction Noise

The maximum overall noise levels resulting from various parallel construction activities at the facades of the representative NSRs throughout the construction period have been predicted based on the single activity and background noise levels and are presented in Figures C4.1-C4.27 in Appendix C4. A summary of the highest predicted noise level at each representative receiver is presented in Table 4.5 below. These should be interpreted as the worst case noise levels which would be generated from all single activities planned for that period, each single noise level being itself a worst case noise level. In actual cases, however, the noise level at a receiver will vary continuously as the mix of construction plant varies.

Table 4.5: Maximum predicted noise level at each NSR during the construction period

Location	Number of dwellings represented	Maximum predicted construction noise level (dB(A))
Shek Wai Kok Estate	336	82
Fairview Gardens	156	80
Kwai Ming Wu School	1 school	80
Luk Yeung Sun Chuen Block A north	360	81
Luk Yeung Sun Chuen Block A west	360	79
Luk Yeung Sun Chuen Block F north	240	78
Luk Yeung Sun Chuen Block F west	240	76
Hoi Pa Village	93	80
Pak Tin Pa Tsuen	54	80
Tung Lam Home for the Aged	1 Home for the Aged	75
Muk Min Ha 1	24	83
Muk Min Ha 16	30	80
Pak Tin Pa	4	81
Tsuen Kam Centre Block 1	124	75
Tsuen Kam Centre Block 2	124	76
Fuk Loi Centre	512	74
Pak Tin Pa San Tsuen	4	82
China Dyeing Works Block 8	560	83
China Dyeing Works Block 9	160	84
China Dyeing Works Block 4	80	84
China Dyeing Works Block 2	160	85
China Dyeing Works Block 1	39	86
Tsuen King Garden	420	71
Kam Fung Gardens	140	91
Tsuen Tak Gardens	232	81
Joyful Garden	240	73
Tsuen Wan Area 3 Block 1	38	82
Tsuen Wan Area 3 Block 4	152	83

Assuming no mitigation, the maximum daytime level of 75dB(A) recommended by EPD will be exceeded at most of the NSRs at some time during construction. When considering the predicted noise level it should be recalled that the current noise level at most of these receivers is already in excess of 70dB(A) Leq. The potential impacts at locations which are most severely affected (assuming no mitigation) are discussed below.

Receivers in the vicinity of Tsuen Kam Interchange (Figures C4.1-C4.11)

Impacts at these receivers will be largely determined by noise arising from construction activities in Segments A and B, which are scheduled to occur simultaneously. Predicted daytime noise levels are particularly high in the first half of October 1996 and from June 1997 to April 1998.

The periods of high noise levels are largely attributable to simultaneous construction activity on the two work segments. In particular, coincident works on the west side of the interchange and westbound slip road onto Route 5 and the activities on Segment B in the vicinity of the interchange, could cause significant impact at the NSRs in that area. For example during October 1996 it has been assumed that breakers will be used for three activities - A3, A4 and B1 - in the vicinity of the interchange. In addition, activity A11 which involves piling is scheduled to commence in April 1998 which overlaps with breaking activity in A13.

Receivers at the east side of Muk Min Ha, in Block A of Luk Yeung Sun Chuen and at Shek Wai Kok will be most severely effected by construction noise as they will be subject to the highest combined impact from noise on work segments A and B. Muk Min Ha in particular will be subject to high noise levels throughout the construction period. If the work on the two segments (in particular the drilling and breaking activity) in the vicinity of the Tsuen Kam Interchange can be rescheduled to be non-simultaneous or the overlap minimised, it is anticipated that the total noise level experienced at the NSRs could be substantially reduced.

Pak Tin Pa (Figure C4.12)

These receivers will be subject to noise arising from construction activities in Segment B, which involves the breaking of existing road surface and masonry. Due to the proximity of the dwellings to the breaking activity they will be subject to prolonged construction noise impact with predicted daytime noise levels in excess of 79dB(A) from April 1996 to April 1998.

Since the use of only one breaker at any particular time has been assumed in the assessment, the noise impact cannot be reduced through rescheduling of activities. Although the use of silenced equipment may reduce the noise level at the representative receivers by up to 5dB(A), it may also be necessary to employ further mitigation measures at this location if a sufficient noise reduction cannot be achieved by these measures alone.

China Dyeing Works Blocks 8 and 9 (Figures C4.17-C4.18)

Impacts at these receivers will be largely determined by noise arising from construction activities in Segment C. The particularly high predicted daytime noise levels from April 1996 to August 1996 are attributable to the three hydraulic breakers for cutting the slope of the working platform (Activity C1). Higher noise levels are also expected between October 1997 and September 1998 due to the process of backfilling (Activity C7).

Mitigation measures include rescheduling of activities, reduce the number of construction plant and the use of silenced plant. Barriers and enclosures should be installed if necessary.

China Dyeing Works Blocks 1, 2 and 4 (Figures C4.19-C4.21)

Impacts at these receivers will be largely determined by noise arising from construction activities in Segments D, E and F.

Segment E comprises the construction of a caisson wall involving the use of six drills and six breakers between August 1996 and August 1997. Although it has been assumed that drills and breakers will not be operational at the same time, predicted noise levels at all three blocks exceed 80dB(A) throughout the period of work in segment E. It is understood that due to time constraints it would not be possible to further reduce the number of plant operating at any one time. Although the use of silenced plant may reduce the noise level experienced at the NSRs by up to 5dB(A), such mitigation may not be sufficient to reduce the impact to acceptable levels. Since most of the noise generating work in Segment E will take place below ground level, in a ditch, it should be possible to construct a noise enclosure above the works. It is anticipated that incorporation of this mitigation measure will achieve the necessary noise reduction.

Predicted noise levels exceed 79 dB(A) in April 1998 due to the use of hydraulic breakers for the demolition of the police headquarters.

From May 1999 to May 2002 the predicted noise levels at the receivers will again exceed 80dB(A) due to the use of hydraulic breakers associated with works in Segment F. The use of silenced plant may be sufficient to reduce the noise level to acceptable limits, but if the required noise reduction is not achieved, barriers close to the noise sources may have to be employed.

Tsuen King Garden, Kam Fung Garden and Tsuen Tak Garden (Figures C4.22-C4.24)

At Tsuen King Garden, dwellings will be protected by the knoll and the 75 dB(A) guideline will not be exceeded. On the other hand, Kam Fung Garden and Tsuen Tak Garden will receive significant noise impacts from construction activities in Segments E and F. Also they will be subject to noise impacts from activities in Segment D.

For the reasons discussed with reference to China Dyeing Works Redevelopment above, unmitigated noise levels will be high throughout Activity E from August 1996 to August 1997 due to the construction of the caisson wall. The adoption of the enclosures recommended for the China Dyeing Works should however also reduce the noise levels experienced at Kam Fung Gardens and Tsuen Tak Garden during that activity.

The combined effects of activities D4 and F1 and F2 will produce noise levels in excess of 90dB(A) from April 1998 to September 1998. The noise assessment has assumed that breakers will be operating simultaneously in all these activities. However, scheduling of these activities to avoid the simultaneous use of breaker could significantly reduce the noise levels. In March and April 1999 levels are once again high due to the operation of the 10 trucks associated with activity F4. Mitigation measures should therefore include rescheduling of activities and the use of silenced plant and if necessary barriers and enclosures.

Joyful Garden, Tsuen Wan Area 3 (Figures C4.25-C4.27)

Impacts at these receivers will be largely determined by noise arising from construction Activity D.

Due to the use of a breaker in activity D4.1, D7.1 and D14.1, noise levels will exceed 80dB(A) from June 1997 to November 1999 and from August 1999 to October 2000 at Tsuen wan Area 3. At Joyful Garden, dwellings will be protected by the nearby building blocks and the 75 dB(A) guideline will not be exceeded.

4.5.2.2 Night-time Construction Noise

It is expected that some activities will be carried out at night for the construction of the MTR crossing. The construction of the working platform (Activity C3.2) requires nightworking on three nights; while the falsework removal (Activity C6.1) needs nightworking on two nights. Table 4.6 shows the impact of the night-time construction activities upon the dwellings.

Table 4.6 Maximum predicted noise level during night time

Location	Maximum predicted night time noise level (dB(A))
Shek Wai Kok Estate	54
Fairview Garden	55
Luk Yeung Sun Chuen Block A west	57
Luk Yeung Sun Chuen Block F north	57
Luk Yeung Sun Chuen Block F west	58
Muk Min Ha Block 1	59
Muk Min Ha Block 16	61
Pak Tin Pa	67
Pak Tin Pa San Tsuen	73
China Dyeing Works Block 8	77
China Dyeing Works Block 9	80

It can be seen that the sensitive receivers will be affected by the night-time construction activities and the noise criteria of 55 dB(A) will be exceeded.

China Dyeing Works redevelopment will receive the greatest impact. Noise levels over 77 dB(A) are expected at the receivers of Block 8 and 9 of CDW for five nights. The contractor would be required to mitigate noise levels by 25 dB(A) in order to get a valid Construction Noise Permit (CNP) for undertaking construction at night.

Quieter construction plant is recommended for night-time activities. Mobile cranes and heavy lorries can be replaced by gantry cranes and lighter lorries respectively. Also, parallel operations of the powered mechanical equipment should be avoided. Noise barriers or enclosures should be employed when necessary. However, the required reduction of 25dB(A) is unlikely to be achieved even with the application of these mitigation measures. It is not possible to reschedule the programme of Activity C (MTR Crossing) so that the nightworks could be completed without causing high noise levels and it is therefore recommended that an application be made to the Director of Environmental Protection, as the Authority under the Noise Control Ordinance, that this project be considered under Paragraph 3.2 of TM1. This will allow a CNP to be granted even though the CNL exceeds the ANL. Discussions with EPD during the course of this Study have indicated that such an application would be considered favourably.

4.5.3 Mitigation Measures

While it is not feasible to dictate the methods of construction to the contractor, noise control requirements should be incorporated in the tender/contract documents to specify the noise standards to be met, and any noise monitoring to be carried out by the contractor. The noise monitoring will be particularly important and the results of these surveys will determine the level of mitigation required at any particular location and time.

Options for mitigating construction noise include:

(a) use of quieter and silenced equipment;
(b) scheduling activities to avoid parallel operations of several sets of powered mechanical equipment;
(d) siting of equipment as far as practical from noise sensitive receivers; and
(e) use of temporary enclosures and/or noise barriers placed close to the noise sources to screen specific receivers.

The noise generated from mechanical plant can often be reduced by the fitting of acoustic mufflers and linings. In general this can reduce the sound power levels by 5dB(A) for each activity. It is recommended that mufflers and linings are fitted to all equipment when the predicted or recorded unmitigated noise level is in excess of 75dB(A).

Section 4.5.2 above has identified certain specific periods when rescheduling of particularly noisy activities and use of quieter or silenced plant could reduce the noise levels experienced at the receivers to an acceptable level. When the predicted unmitigated noise level is in excess of 80dB(A) or when rescheduling is not possible it will be necessary to construct temporary barriers or enclosures. Due to the height of the receivers, temporary barriers will generally only be effective if they are placed close to the noise sources. The contractors should be instructed to supply noise data for the equipment that they propose to use to the Engineer for approval. In addition, in critical locations, the contractors should demonstrate that the stipulated 75 dB(A) (L_{eq} 30 minute) will not be exceeded.

It is recognised that the implementation of such mitigation measures, in particular rescheduling or use of barriers and enclosures, could affect the construction programme and the total length of the construction period required. Scheduling of construction activities will be the contractor's responsibility and it is recommended that the contract

conditions include clauses instructing the contractor to schedule his activities such that noisy activities are not carried out in parallel. This may have some effect on the total time taken for building the development and it is recommended that the construction period should be as long as practical to allow the contractor flexibility, even though this will increase the duration of environmental and other impacts during construction.

It is anticipated that if the above mitigation measures can be successfully applied, the noise levels experienced by the receivers could be reduced to within a few decibels of the guideline limit at all locations. The benefits of mitigation will, however, be limited by the high existing background noise levels.

4.5.4 Compliance Monitoring

Noise monitoring has been undertaken at eight locations (Section 4.3) so that representative background levels have already been established.

Compliance noise monitoring should be performed throughout the contract at the NSRs closest to any noisy construction activities. For construction during normal working (unrestricted) hours (0700-1900 hours) monitoring should comprise Leq (30 minute) taken at least twice per week. Monitoring for construction outside normal working (restricted) hours (1900 - 0700 hours) should comprise Leq (5 minute) taken twice per day, once in each of the restricted periods, unless complaints are received in which case more frequent measurements will be necessary. The precise programme for compliance monitoring should be determined when details of the contractor's programme for construction are known.

The reporting and auditing of this impact compliance programme will be carried out on a quarterly basis and will commence on completion and approval of the Environmental Monitoring and Audit (EM+A) manual. This manual will include data collected during the baseline monitoring programme and also contingency plans to take account of the following:

(a) prolonged non-availability of monitoring assistants;
(b) non-suitability of monitoring site;
(c) equipment failure or theft;
(d) non-availability of laboratory facilities; and
(e) adverse weather conditions.

The contingency plans should also be included in contract documents in accordance with the HKPSG, Pollution Ordinances, and EPD monitoring guidelines.

Where monitoring of noise shows an excessive noise level, the Contractor should take necessary steps to ensure that his actions are not contributing to the excess. These steps should include, but not be limited to, the following :

(a) checking plant and equipment;
(b) maintenance or replacement of any plant or equipment contributing to the excess; and
(c) review of working methods.

The Resident Site Staff should be kept informed of steps taken, and written reports and proposals for action should be passed to the contractor whenever monitoring shows an excessive noise level has been breached or is in danger of being breached.

Table 4.7 shows a proposed action plan should there be any complaints or concern with respect to exceedance of the specified noise levels.

Table 4.7 Construction Noise Action Plan

Event	Action	
	Engineer	Contractor
When a complaint is received	o Notify Contractor o Conduct measurement o Investigate noisy operations	-
When more than one complaint is received within a 2 weeks period	o Notify Contractor o Analyse investigation o Require Contractor to propose measures to reduce the noise o Increase monitoring frequency to check mitigation effectiveness	o Submit noise mitigation proposals to Engineer o Implement noise mitigation measures
75 dB(A) L_{eq} 30 minute exceeded between 0700 - 1900 hrs on normal weekdays 70 dB(A) L_{eq} 5 minute exceeded between 0700 - 2300 hrs on holidays and 1900 - 2300 hrs on all other days. 55 dB(A) L_{eq} 5 minute exceeded between 2300 - 0700 hrs of next day.	o Notify Contractor o Require Contractor to implement mitigation measures o Increase monitoring frequency to check mitigation effectiveness	o Submit noise mitigation proposals to the Engineer o Implement mitigation measures o Prove to Engineer effectiveness of measures applied

4.6 Operational Phase

4.6.1 Assessment Methodology, Assumptions and Criteria

Operational noise will be attributable solely to road traffic. The impact of road noise arising from Route 5 and other roads in the area has been calculated at the facades of the representative NSRs identified in Section 4.4 in terms of the L10(1 hour) in dB(A) using a computer model based on "Calculation of Road Traffic Noise", UK Department of Transport, 1988 (CRTN). Receivers were simulated at several heights in the tower blocks to obtain a profile of noise impacts over the height of the building.

The roads incorporated in the calculation are listed in Table 2.1 of Chapter 2, together with their design speeds, projected morning peak hour traffic flows and corresponding percentages of heavy vehicles predicted for 2011. These data were provided by the Transport Department and have been discussed in Chapter 2. In accordance with the requirements of Environmental Protection Department, the highway design speeds were used for the environmental assessment rather than the speed predicted by the transport model.

The following assumptions have been made:

(a) in view of the close proximity of the receivers to the noise sources, effects due to the absorption of air have not been allowed for;
(b) the nature of ground conditions or topography has not been allowed for, except where the topography impinges on the line of sight between the source and receiver;
(c) meteorological conditions have not been allowed for;
(d) highway design speeds were used;
(e) the noise contribution from roads not included in Table 2.1 is assumed to be negligible compared to those included in the assessment; and
(f) all commercial buildings and office blocks do not rely on opened windows for ventilation.

The EPD Guideline for Traffic Noise Assessment Report (TNAR) specifies that where exceedence of the total traffic noise levels recommended in the HKPSG is identified, direct technical remedies should be incorporated in the design and the resultant noise level should be predicted. Where direct mitigation cannot reduce the noise levels to the guideline values, the EPD recommend that the CRTN test conditions be applied to assess whether the property should be considered for indirect mitigation (insulation at the receiver). This only applies to traffic noise generated from new roads, ie receptors subject to increases in noise from improved or existing roads are not considered for indirect mitigation. Under the CRTN criteria, three conditions have to be satisfied:

1. the combined expected maximum traffic noise level, ie the relevant noise level from the new highway together with other traffic in the vicinity, must not be less than the specified noise level (1.0 dB(A) above the HKPSG for the particular receiver);

2. the relevant noise level is at least 1.0 dB(A) more than the prevailing noise level ie the total traffic noise level existing before the works to construct or improve the highway were begun;

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

For the purposes of this assessment the following segments have been defined as new roads (and hence for consideration for insulation after incorporation of direct mitigation):

(a) the proposed new section of Route 5 from Cheung Pei Shan Road to Castle Peak Road immediately west of the China Dyeing Works Development;
(b) the slip roads from Route 5 to and from the Tsuen Kam Interchange and to and from Castle Peak Road to Tsuen Mun Road.

Castle Peak Road from its junction with Route 5 to the roundabout at Chai Wan Kok is considered as an improved road.

The new and improved roads together comprise the Route 5 Extension Area. All other roads listed in Table 2.1, including the Tsuen Kam Interchange, are considered as being outside the Route 5 Extension Area and comprise all "other highways" as defined in the CRTN criteria.

The prevailing conditions of the receivers were determined by modelling the L10 (1-hr) levels for 1992 traffic conditions. It was assumed that the peak hour traffic flow will be equal to 7% of Annual Average Daily Traffic (AADT) and the percentage of heavy vehicles will be the same as the pattern of the projected year, i.e. year 2011.

The potential noise impact from road traffic was assessed by comparing the predicted level for 2011 with the HKPSG and the CRTN criteria. The total number of dwellings subject to noise levels in excess of this value was determined through consideration of the number represented by each modelled NSR.

Noise levels at each representative receiver are presented as total predicted noise levels from all road traffic sources as well as from roads outside the Route 5 extension area, where the Route 5 extension area comprises "the altered or completely new highway" as specified in the CRTN. The breakdown of the total predicted levels into these two components allows an identification of the major traffic noise source at each receiver, thus enabling the assessment using the CRTN criteria.

4.6.2 Impact Assessment and Evaluation

Full details of the noise calculations and results are shown in Appendix C. The results are discussed below.

Noise Impacts

Results of the noise calculations are summarised in Tables 4.8 and 4.9. These tables present the data for the project divided into two sections defining the main areas of interest, that is to the east and west respectively of the China Dyeing Works Redevelopment. A test of the noise level against the HKPSG criteria can be made by inspecting Column 7 - "Total Noise Level" in Tables 4.8 and 4.9 and it can be seen that nearly all dwellings in the Study Area will experience total noise levels in excess of 70 dB(A). Table 4.10 summarises the number of NSRs where noise levels will be in excess of the HKPSG and CRTN criteria respectively.

The predictions indicate that the unmitigated noise levels will exceed the HKPSG levels at 4319 dwellings, two schools and one Home for the Aged. 3065 of these dwellings with the two schools and the Home for the Aged should be considered for noise mitigation under the CRTN criteria. It is therefore necessary to consider methods of mitigation that could be applied. These could either be direct, where the noise is reduced at some by enclosures or by barriers between the source and receivers, or indirect by insulation at the receiver. Direct means are much preferred.

The following receivers need to be considered further for direct noise mitigation wherever practical:

(a) Shek Wai Kok Estate;
(b) Fairview Garden;
(c) Luk Yeung Sun Chuen;
(d) Kwai Ming Wu School;
(e) Muk Min Ha Tsuen;
(f) Tung Lam Home for the Aged;
(g) Hoi Pa Village;
(h) Pak Tin Pa Tsuen;

(i) Pak Tin Pa San Tsuen;
(j) Pak Tin Pa;
(k) CDW Development, Blocks 1, 2, 4, 8 and 9
(l) Tsuen King Gardens;
(m) Tsuen Tak Garden;
(n) Tsuen Wan Area 3 (Nan Fung Development);
(o) Fuk Loi Estate;
(p) Joyful Garden; and
(q) Kam Fung Garden.

Table 4.8 Predicted Noise Levels and Test of the CRTN Criteria - East of China Dyeing Works Development

Location	Floor	Height (mPD)	PredictedNoise Level dB(A)				Prevailing Background Level dB(A)	Comparison with CRTN Criteria dB(A)		
			Route 5	Slip Road	Other	Total dB(A)		1	2	3
Shek Wai Kok West Facade	1	31.5	65.7	63.6	75.4	76.1	71.4	6	4.5	0.7
	5	42.7	70.5	64	77.8	78.7	74.7	9	4.0	0.9
	10	56.7	71.8	63.8	77.4	78.6	74.3	9	4.3	1.2
	12	62.3	71.9	63.6	77.2	78.5	74.1	8	4.4	1.3
	14	67.9	71.9	63.5	77.1	78.4	74	8	4.4	1.3
	16	73.5	71.8	63.3	76.9	78.2	73.8	8	4.4	1.3
	18	79.1	71.8	63	76.7	78.1	73.6	8	4.5	1.4
	20	84.7	71.7	62.5	76.6	77.9	73.5	8	4.4	1.3
Shek Wai Kok North Facade	1	31.5	72	0	74.7	76.6	78.8	7	-2.2	1.9
	5	42.7	73.6	0	74.7	77.2	77.6	7	-0.4	2.5
	10	56.7	73.2	0	76.8	78.4	76.4	8	2.0	1.6
	14	67.9	72.8	0	77.6	78.8	75.7	9	3.1	1.2
	16	73.5	72.6	0	77.3	78.6	75.3	9	3.3	1.3
	18	79.1	72.3	0	77	78.3	75	8	3.3	1.3
	20	84.7	72.1	0	76.7	78.0	74.7	8	3.3	1.3
Fairview Garden	1	24.4	64.4	64.2	78.6	78.9	79.2	9	-0.3	0.3
	10	49.6	69.7	66.6	77.5	78.5	76.9	8	1.6	1.0
	18	72	70.3	66.5	76.6	77.8	75.4	8	2.4	1.2
	20	77.6	70.2	66.5	76.4	77.7	75.1	8	2.6	1.3
	22	83.2	70.3	66.4	76.2	77.5	74.9	8	2.6	1.3
	24	88.8	70.3	66.3	76.1	77.5	74.6	7	2.9	1.4
	26	94.4	70.2	66.3	75.9	77.3	74.4	7	2.9	1.4
Luk Yeung Sun Chuen Block A, North	1	20.8	62.1	61.5	72.1	72.8	69.5	3	3.3	0.7
	10	46	72.4	70	79.1	80.4	76.1	10	4.3	1.3
	20	74	72.1	69.8	78	79.5	75.1	9	4.4	1.5
	23	79.6	72.1	69.8	77.8	79.3	74.8	9	4.5	1.5
	25	85.2	72.1	69.5	77.7	79.2	74.6	9	4.6	1.5
	27	90.8	71.8	69.4	77.5	79.0	74.5	9	4.5	1.5
	29	96.4	71.7	69.1	77.3	78.8	74.3	9	4.5	1.5
	31	102	71.5	69	77	78.6	74.1	9	4.5	1.6
Luk Yeung Sun Chuen Block A, West	1	20.8	62.3	63.1	73.1	73.8	71.3	4	2.5	0.7
	10	46	71.2	70.6	76.1	78.2	72.5	8	5.7	2.1
	20	74	70.8	70.4	75.5	77.7	71.9	8	5.8	2.2
	23	79.6	70.8	70.4	75.3	77.5	71.7	8	5.8	2.2
	25	85.2	70.8	70.1	75.2	77.4	71.5	7	5.9	2.2
	28	90.8	70.6	70	75	77.3	71.4	7	5.9	2.3
	29	96.4	70.5	69.8	74.9	77.1	71.2	7	5.9	2.2
	31	102	70.4	69.7	74.6	76.9	71.1	7	5.8	2.3
Luk Yeung Sun Chuen Block F, North	1	20.8	62.5	59.9	63.8	67.1	58.4	-3	8.7	3.3
	10	46	68.4	64.8	68.7	72.4	71.6	2	0.8	3.7
	20	74	72.1	70.1	74.6	77.4	71.1	7	6.3	2.8
	23	79.6	72	70	74.5	77.3	71	7	6.3	2.8
	25	85.2	72	69.8	74.4	77.2	70.9	7	6.3	2.8
	28	90.8	71.9	69.8	74.3	77.2	70.8	7	6.4	2.9
	29	96.4	71.8	69.7	74.2	77.1	70.7	7	6.4	2.9
	31	102	71.7	69.6	74	76.9	70.6	7	6.3	2.9

Table 4.8 Predicted Noise Levels and Test of the CRTN Criteria - East of China Dyeing Works Development (Cont'd)

Location	Floor	Height (mPD)	PredictedNoise Level dB(A)				Prevailing Background Level dB(A)	Comparison with CRTN Criteria dB(A)		
			Route 5	Slip Road	Other	Total dB(A)		1	2	3
Luk Yeung Sun Chuen Block F, West	1	20.8	65.8	63.2	68.7	71.2	64.1	1	7.1	2.5
	10	46	70.6	68.4	73	75.8	70.6	6	5.2	2.8
	20	74	71.5	69.7	73.6	76.7	70.5	7	6.2	3.1
	23	79.6	71.4	69.6	73.5	76.6	70.4	7	6.2	3.1
	25	85.2	71.3	69.6	73.4	76.5	70.3	6	6.2	3.1
	28	90.8	71.3	69.4	73.3	76.4	70.2	6	6.2	3.1
	29	96.4	71.2	69.3	73.2	76.3	70	6	6.3	3.1
	31	102	71.1	69.3	73	76.2	69.9	6	6.3	3.2
Kwai Ming Wu School	1	21	66.6	66.3	75	76.1	71.5	11	4.6	1.1
	4	31.2	73	70.9	77.1	79.2	73.5	14	5.7	2.1
	7	41.4	73.1	71.6	77.4	79.5	73.9	15	5.6	2.1
Muk Min Ha Tsuen, 1	1	39	72.7	72.6	84.7	85.2	78.7	15	6.5	0.5
	3	45	76.2	78.6	83.6	85.4	77.7	15	7.7	1.8
Muk Mun Ha Tsuen 16	1	39	69.1	71.7	82.6	83.1	76.5	13	6.6	0.5
	3	45	76.9	77	82.1	84.2	76	14	8.2	2.1
Tung Lam House for Aged	1	57	60.6	60.4	70.0	70.9	66.5	16	4.4	0.9
	2	60	65.7	62.6	72.3	73.5	69.2	19	4.3	1.2
Hoi Pa Village	1	35	72.1	66.5	81.9	82.4	76.7	12	5.7	0.5
	3	41	72.9	66.7	81.7	82.4	76.6	12	5.8	0.7
Pak Tin Pa Tsuen	1	50	69.2	66.1	77.9	78.7	69.9	9	8.8	0.8
	2	56	70.1	66.3	77.7	78.7	72.2	9	6.5	1.0
China Dyeing Works BK8	1	41.5	77.8	43.3	71.3	78.7	59.2	9	9.5	7.4
	10	66.7	75.4	46.2	71.4	76.9	59.9	7	17.0	5.5
	20	91.9	73.9	47.7	71.4	75.8	60.1	6	15.7	4.4
	30	117.1	72.7	47.6	71.3	75.1	60.4	5	14.7	3.8
	40	142.3	71.8	47.2	71	74.4	60.4	4	14.0	3.4
China Dyeing Works Bk9	1	41.5	79.6	51	71.8	80.3	60.7	10	19.6	8.5
	10	66.7	77.7	51.6	71.9	78.7	61.3	9	17.4	6.8
	20	91.9	76.3	52	71.9	77.7	61.4	8	16.3	5.8
	30	117.1	75.2	51.7	72.1	76.9	64.3	7	12.6	4.8
	40	142.3	74.3	51.3	72.2	76.4	65.4	6	11.0	4.2
Tsuen Kam Center Bk1	1	21.5	60.9	33.6	61.5	64.2	53.6	-6	10.6	2.7
	10	60	71.7	33.5	69.1	73.6	60.6	4	13.0	4.5
	20	85.2	71.6	34	69.1	73.5	60.7	4	12.8	4.4
	30	105.5	72.4	62.3	70.8	74.9	64	5	10.9	4.1
Tsuen Kam Center Bk2	1	21.5	53.2	46.6	55.6	57.9	52.6	-12	5.3	2.3
	10	60	70.7	64.5	69.2	73.6	64.3	4	9.3	4.4
	20	85.2	70.6	64.3	69.3	73.6	64.4	4	9.2	4.3
	30	105.5	70.6	64.2	70.3	73.9	64.4	4	9.5	3.6
Pak Tin Pa San Tsuen	1	41.5	69.7	51.6	71	73.4	60.4	3	13.0	2.4
Pak Tin Pa	1	58.3	78.3	65.2	85.2	86.0	78.9	16	7.1	0.8
Fuk Loi Estate	1	13.5	63	30.7	80.1	80.2	74.1	10	6.1	0.1
	10	38.7	67.7	40	77.6	78.1	75.6	8	2.4	0.4
	18	52.7	68.4	48.8	76.5	77.1	75.4	7	1.7	0.6

Table 4.9 Predicted Noise Levels and Test of the CRTN Criteria - West of the China Dyeing Works Redevelopment

Location	Floor	Height mPD	Predicted Noise Level dB(A)				Prevailing Background Level dB(A)	Comparison with CRTN Criteria dB(A)		
			Route 5	Slip Road	Other	Total dB(A)		1	2	3
Nan Fung Development	1	36	64.93	69.14	44.52	70.5	69.6	1	1.0	26.0
	10	61.2	66.27	70.02	52.94	71.6	69.6	2	1.7	18.7
	20	89.2	68.54	71.79	57.01	73.6	71.6	4	2.0	16.6
	30	117.2	68.35	71.21	56.78	73.1	71.2	3	1.9	16.3
	38	139.6	67.79	70.77	58.78	72.7	70.8	3	1.9	13.9
Nan Fung Development Tower 4, Block 1	1	36	65.81	70.06	64.93	72.3	71.2	2	1.1	7.4
	10	61.2	67.76	73.56	73.12	76.9	75.9	7	1.0	3.8
	20	89.2	71.21	74.32	72.95	77.8	77.1	8	0.7	4.8
	30	117.2	79.49	73.84	72.7	77.3	76.5	7	0.8	4.6
	38	139.6	69.96	73.35	72.47	76.9	76.1	7	0.8	4.5
Nan Fung Development Tower 1, Block 1	1	45.6	65.89	68.24	75.49	76.6	76.7	7	-0.1	1.1
	10	70.8	65.72	68.41	75.17	76.4	76.5	6	-0.1	1.2
	20	98.8	65.75	68.95	74.81	76.2	76.3	6	-0.1	1.4
	30	126.9	65.39	69.06	74.44	75.9	76.0	6	-0.0	1.5
	38	149.2	65.07	68.84	74.13	75.7	75.7	6	0.0	1.5
Tsuen Tak Garden	1	17.6	77.07	76.67	74.63	81.0	77.3	11	3.7	6.4
	10	42.8	78.52	75.97	72.88	81.1	77.8	11	3.4	8.3
	20	70.8	77.06	74.81	71.28	79.8	76.5	10	3.3	8.5
	23	79.2	76.67	74.48	70.98	79.4	76.1	9	3.3	8.4
	25	84.8	76.42	74.27	70.83	79.2	75.9	9	3.3	8.3
	27	90.4	76.18	74.07	70.75	79.0	75.7	9	3.2	8.2
	29	96	75.95	73.87	70.98	78.8	75.6	9	3.2	7.8
Kam Fung Garden	1	16.5	81.44	73.38	70.74	82.4	78.2	12	4.2	11.6
	10	41.7	81.14	72.30	70.2	82.0	77.5	12	4.5	11.8
	20	69.7	79.51	70.94	69.13	80.4	75.9	10	4.5	11.3
	30	97.7	78.20	69.82	68.59	79.2	74.8	9	4.4	10.6
	35	111.7	77.66	69.50	69.22	78.8	74.5	9	4.3	9.6
Tsuen King Garden	1	22.5	59.51	56.97	59.35	63.5	60.9	-6	2.7	4.2
	10	47.7	62.33	61.70	59.82	66.2	63.2	-4	3.0	6.4
	20	75.7	69.20	62.92	61.47	70.7	65.7	1	4.9	9.2
	22	81.3	69.67	62.87	61.47	71.0	65.8	1	5.2	9.5
	24	86.8	70.29	62.81	61.48	71.5	65.9	1	5.6	10.0
	26	92.5	71.03	62.76	61.53	72.0	66.4	2	5.6	10.5
	28	98.1	71.05	62.69	61.82	72.1	66.5	2	5.6	10.3
	30	103.7	71.23	62.64	61.82	72.2	66.6	2	5.6	10.4
China Dyeing Works Block 1	1	41.5	79.98	55.53	57.56	80.0	73.9	10	6.1	22.5
	10	66.7	78.47	55.43	61.63	78.6	73.0	9	5.6	16.9
	20	91.9	77.06	55.28	61.14	77.2	71.7	7	5.5	16.1
	30	117.1	75.96	55.12	63.22	76.2	71.0	6	5.3	13.0
	40	142.3	75.08	55.03	63.03	75.4	70.2	5	5.2	12.4
China Dyeing Works Block 2	1	41.5	77.26	55.60	58.35	77.3	71.0	7	6.3	19.0
	10	66.7	76.52	55.78	61.6	76.7	71.3	7	5.4	15.1
	20	91.9	75.57	55.60	60.68	75.7	70.2	6	5.5	15.1
	30	117.1	74.70	55.41	61.01	74.9	69.5	5	5.5	13.9
	40	142.3	73.95	55.26	62.21	74.3	69.0	4	5.3	12.1
China Dyeing Works Block 4	1	41.5	74.54	58.85	59.8	74.8	69.2	5	5.6	15.0
	10	66.7	74.80	58.72	62.61	75.2	70.8	5	4.3	12.5
	20	91.9	74.57	58.22	61.64	74.9	70.2	5	4.7	13.2
	30	117.1	74.16	57.74	62.46	74.5	69.7	5	4.8	12.1
	40	142.3	73.67	56.04	62.16	74.0	69.2	4	4.8	11.9
China Dyeing Works Block 12	1	41.5	64.57	29.23	54.09	64.9	59.3	-5	5.6	10.9
	10	66.7	67.82	30.37	53.99	68.0	64.1	-2	3.9	14.0
	20	91.9	68.88	32.30	54.34	69.0	66.3	-1	2.7	14.7
	30	117.1	68.18	35.50	57.35	68.5	66.3	-1	2.2	11.2
	40	142.3	67.55	41.02	60.16	68.3	67.1	-2	1.2	8.1

Table 4.9 Predicted Noise Levels and Test of the CRTN Criteria - West of the China Dyeing Works Redevelopment (Cont'd)

Location	Floor	Height mPD	Predicted Noise Level dB(A)				Prevailing Background Level dB(A)	Comparison with CRTN Criteria dB(A)		
			Route 5	Slip Road	Other	Total dB(A)		1	2	3
Joyful Garden	1	31	61.91	66.51	55.59	68.1	66.9	-2	1.2	12.5
	10	56.2	62.61	66.62	66.97	70.6	69.3	1	1.2	3.6
	20	81.4	66.16	68.94	67.15	72.3	70.4	2	2.0	5.2
	22	87	66.11	69.66	67.11	72.7	70.8	3	1.9	5.6
	24	92.6	66.10	69.71	67.08	72.7	70.8	3	1.9	5.6
	26	98.2	66.18	70.41	67.05	73.1	71.2	3	1.9	6.0
	28	103.8	66.83	70.69	67.05	73.3	71.7	3	1.6	6.3
	30	109.4	67.09	70.66	67.23	73.4	71.9	3	1.6	6.2
Nan Fung School	1	16.7	62.84	63.85	61.67	67.6	63.1	-2	4.5	6.0
	7	37.1	73.32	71.93	61.57	75.9	73.1	6	2.8	14.3

In accordance with lease requirements, the Kam Fung Garden has been developed incorporating adequate mitigation measures to ameliorate the potential noise from Castle Peak Road and is thus not considered further. The Kwai Ming Wu school also has noise insulation and will not need additional direct mitigation . The Nan Fung School is not considered further for the same reason. Tsuen Kam Centre has been excluded because of the very high background noise levels from the nearby bus station.

Table 4.10 Number of Receivers Exceeding the Specified Levels for Total Traffic Noise

Location	HKPSG	CRTN
Shek Wai Kok Estate	480	312
Fairview Garden	156	126
Luk Yeung Sun Chuen	868	678
Kwai Ming Wu School	1 School	1 School
Tung Lam Home for the Aged	1 House for the Aged	1 House for the Aged
Pak Tin Pa	4	0
Pak Tin Pa Tsuen	54	36
Muk Min Ha Tsuen	54	36
Hoi Pa Village	93	93
Fuk Loi Estate	512	0
Pak Tin Pa San Tsuen	4	4
CDW	1000	1000

Table 4.10 Number of Receivers Exceeding the Specified Levels for Total Traffic Noise (Cont'd)

Location	HKPSG	CRTN
Joyful Garden	200	200
Tsuen Tak Garden	232	232
Tsuen King Garden	192	0
Kam Fung Garden	280	280
Nan Fung Development	190	68
Nan Fung School	1 School	1 School
Total	**4319 + 2 Schools + 1 Home for the Aged**	**3065 + 2 Schools + 1 Home for the Aged**

4.6.3 Options for Noise Mitigation

Direct Mitigation

Several possibilities are available for direct mitigation. The options available on this project are shown on Figure 4.4 and are discussed below.

Low Noise Road Surface

The CRTN specifies that a noise reduction of 3.5dB(A) can be assumed when a low noise road surface is used. Low noise road surfaces also have safety advantages of high friction, but because of high maintenance costs, the Highways Department generally only supports their use on roads where the speed is 70km/h or above.

Barriers

The effectiveness of barriers may be limited because of the height of most of the NSRs and their proximity to the noise source. In addition there may be a need to create gaps in barriers to allow access for pedestrians, vehicles, emergency services and the like and a barrier may also encroach on pavements or have visual effects, including reduction in driving visibility. Barriers built on structures will result in a higher cost for the structure as a result of the windloading. However, barriers can be effective, even for high rise receivers, if they can be built on embankments or raised sections of the highway. Two types of barrier have been considered (see Figure 4.4):

(a) vertical barriers with heights of 3m to 5.1m; and

(b) a curved barrier comprising a vertical barrier topped by a 2.2m long canopy at an angle of 30 degree over the carriageway.

The vertical barriers may have noise absorbent or noise reflective surfaces.

Enclosures

Enclosures will be more effective than barriers in protecting high rise properties. The problems associated with access, safety, and visual and physical intrusion will be similar to those associated with barriers. Central columns may be necessary and these raise additional questions with respect to driver visibility. Enclosures on elevated sections of the project will impose a very high loading on the bridge or viaduct substructures and will be expensive. In addition there could be requirements for forced ventilation in enclosed sections.

Two types of enclosure have been considered (see Figure 4.4):

(a) a full enclosure; and

(b) a semi enclosure open on the side away from the sensitive receivers. This option will be less expensive than a full enclosure and air pollution within the enclosure will not be an issue since there will be natural ventilation through the open side.

4.6.4 Recommendations for Noise Mitigation

Low Noise Road Surface

The first form of mitigation that has been considered is a low noise road surface over the whole length of the Route 5 main carriageway as shown on Figure 4.5. The benefits of this are shown in Table 4.11, where it can be seen that the total number of properties that do not meet the CRTN criteria reduces from 3065 to 2282.

Table 4.11 Noise Reduction Assuming Low Noise Road Surfacing

Location	HKPSG	CRTN
Shek Wai Kok Estate	480	40
Fairview Garden	156	36
Luk Yeung Sun Chuen	868	558
King Ming Wu School	1 School	1 School
Muk Min Ha Tsuen	54	36
Tung Lam House for Aged	1	1
Hoi Pa Village	93	0
Pak Tin Pa Tsuen	54	0
CDW	1000	1000
Pak Tin Pa San Tsuen	4	4
Pak Tin Pa	4	0
Fuk Loi Estate	512	0

Location	HKPSG	CRTN
Nan Fung Development	185	0
Tsuen Tak Garden	232	232
Kam Fung Garden	280	280
Tsuen King Garden	24	0
Joyful Garden	120	96
Nan Fung School	1 School	1 School
Total	**4066 + 2 Schools + 1 House for Aged**	**2282 + 2 Schools + 1 House for Aged**

There are a large number of dwellings where the noise levels still exceed the HKPSG criteria even with the installation of a low noise road surface. Noise barriers and enclosures have been considered to reduce the noise to maximise the protection for existing NSRs wherever practical. The potential locations of the barriers and enclosures are listed below.

Possible Location of Noise Barriers

Various types of noise barrier may be used to suit the location, structure and traffic engineering requirements. Barriers could be vertical or curved as shown on Figure 4.4. The locations that have been considered for barriers are shown on Figure 4.6 and listed below.

A Adjacent to the southern verge of Route 5, between the westbound slip road exit and the Tsuen Kam Interchange

B On the southern edge of the westbound slip road from Route 5 to the Tsuen Kam Interchange.

C Within the Tsuen Kam Interchange on the top of an embankment to be constructed to the south of the route, inside the interchange. It has been assumed that the embankment height will be 26.5m PD and the gradient will be 1:2.

D Along the southern edge of the raised westbound slip road from Tsuen Kam Interchange to Route 5.

E Along the southern edge of eastbound slip road from Route 5 to the Tsuen Kam Interchange.

F Along the southern of Route Twisk in front of Muk Min Ha Tsuen.

G Along the southern edge of Route.5 for a distance up to 100 metres running west from the junction between the westbound slip road from the Tsuen Kam Interchange and Route 5. Consideration should also be given to the feasibility of placing this barrier on top of the raised land that already exists at this location/or building an embankment at this location.

H Along the southern edge of Route 5 between the Tsuen Kam Interchange and the west bound slip road from the Tsuen Kam Interchange and Route 5 possibly on top of an embankment.

J On the northern edge of the eastbound slip road from the Tsuen Wan Interchange to Route 5.

K On the northern edge of the westbound slip road from Castle Peak Road to Chai Wan Kok Interchange.

L On the northern edge of the raised slip road from Castle Peak Road to Tsuen Mun Road.

M On top of the embankment in front of the Nan Fung Development.

N On the northern side of the flyover at the west of the China Dyeing Works redevelopment.

O On the southern edge of the Tsuen Kam Interchange in front of Luk Yeung Sun Chuen.

P At the top of the Route 5 embankment in front of Muk Min Ha Tsuen.

Possible Location of Noise Enclosures

Various types of noise enclosure may be used to suit the location, structure and traffic engineering requirements. The enclosures may cover carriageways in one or both directions and may or may not have open sides. The locations that have been considered for enclosures are shown on Figure 4.6 and listed below.

1. Over Route 5 between the slip road junctions with Route 5 east of the Tsuen Kam Interchange

2. Over Route 5 within the Tsuen Kam Interchange

3. Over Route 5 directly to the west of the Tsuen Kam Interchange for a distance of approximately 200 metres. Section 3a in Figure 4.9 of the enclosure is between the western overbridge of the Tsuen Kam Interchange and the sliproad westbound from the interchange to Route 5.

4. Over Route 5 and the slip roads directly to the west of enclosure 3, for a distance of up to 130 metres.

5. As enclosure 4, but only over the eastbound carriageways.

6. Over the eastbound carriageway of Route 5 to the east of the Sha Tsui flyover.

7. Over the eastbound carriageway of Route 5 to the west of the Sha Tsui flyover.

8. Over the eastbound slip road from Route 5 to the Tsuen Kam Interchange.

9. Over the raised westbound slip road from the Tsuen Kam Interchange to Route 5.

10. Over the eastbound slip road from Tsuen Kam Interchange to Cheung Pei Shan Road.

11. Over the westbound slip road from Cheung Pei Shan Road to Tsuen Kam Interchnge.

Effectiveness of Noise Barriers and Enclosures

The road section in question has been divided into three parts so that the effectiveness of the noise mitigation can be presented more clearly. These are:

(a) the Chai Wan Kok Interchange and the part of the road to the west of the China Dyeing Works Redevelopment;

(b) the properties in the vicinity of the China Dyeing Works Redevelopment; and

(c) the Tsuen Kam Interchange and other properties to the east of the China Dyeing Works Redevelopment.

These are discussed in turn in the following paragraphs.

West of the China Dyeing Works Redevelopment

Table 4.12 shows that a large number of dwellings and one school will receive noise impacts in excess of the HKPSG. Noise barriers and enclosures (together with the low noise road surfacing) have been considered whenever practicable.

Table 4.12 Effect of the Applying Direct Noise Mitigation Measures - HKPSG West of China Dyeing Works Redevelopment

Location	Number of Dwellings not Meeting HKPSG Guidelines
Nan Fung Development	155
Tsuen Tak Garden	232
Kam Fung Garden	140
Joyful Garden	120
Nan Fung School	1 School

Low noise road surfacing will be applied over the main carriageway of Route 5 and the slip roads connecting the main carriageway with Tuen Mun Road. It has been found that a combination of a semi-enclosure at location 7 plus a barrier at location L, as shown in Figure 4.7, will be effective in meeting the CRTN criteria. The semi-enclosure will be open to the south, but closed where it faces the residential blocks at Tsuen Tak Gardens. The barrier will be 3m high and constructed from noise absorbent material to avoid noise reflections from the eastbound sliproad from Tuen Mun Road to Castle Peak Road. The low noise road surfacing will be applied through the enclosure.

An additional barrier will be built by the developer of the Tsuen Wan Area 3 development at the top of the embankment to the north of Route 5 (see Figure 4.7) and the noise modelling has assumed that this will be in place.

The noise mitigation proposed for this section of the project is thus:

(a) a semi-enclosure, 85m long, over the eastbound carriageway of Castle Peak Road to the west of the Sha Tsui flyover;

(b) a 3m high barrier, 150m long on the north side of the raised slip road from Castle Peak Road to Tuen Mun Road;

(c) low noise road surfacing on the main carriageway of Castle Peak Road and on the slip roads to Tuen Mun Road; and

(d) a barrier in front of the proposed Nan Fung Development (or other form of noise mitigation) to be built by the developer.

The CRTN guidelines will be achieved at all dwellings in this section of the project with this direct mitigation in place and no indirect means of noise mitigation will be required, even though some of the properties will still receive noise impacts in excess of the HKPSG. (see Table 4.12). It should be noted that dwellings in Kam Fung Garden and the Nan Fung School have been excluded from the CRTN assessment because they have been considered to be self-protected.

China Dyeing Works Redevelopment

It has previously been agreed at the planning stage of the China Dyeing Works Redevelopment that noise mitigation will be applied both as direct measures to Route 5 and as indirect measures to the development so that the noise levels at each dwelling will achieve the required standards. The recommended direct noise mitigation is shown on Figure 4.8 and will comprise:

(a) the enclosure of a 30m section of Route 5 as it exits from the podium on the eastern side of the China Dyeing Works Redevelopment;

(b) a 4m high barrier on the northern side of the Route 5 viaduct as it approaches the development; and

(c) low noise road surfacing on the Route 5 carriageway (this will also be applied through the enclosure).

East of the China Dyeing Works Redevelopment

Noise sensitive receivers in this area comprise the high rise residential blocks around and to the south west of the Tsuen Kam Interchange together with the (generally) low rise development along Route Twisk. There will be noise impacts from the sliproads of Route 5, the main carriageway and the existing roads. The assessment of the effectiveness of the direct mitigation measures has considered the barriers and enclosures as grouped into four Schemes. This is necessary since many of the receivers are affected by noise from several segments of the project and mitigation on more that one segment will be required. The four Schemes considered as shown on Figures 4.9 to 4.12.

The effectiveness of each Scheme is shown in Appendix C and summarised in Table 4.13 as compared against the HKPSG and Table 4.14 when the CRTN standards are applied.

Table 4.13: Effect of the Application of Direct Noise Mitigation Measures - HKPSG East of China Dyeing Works Redevelopment

	Number of Dwellings Not Meeting HKPSG Guidelines			
Location	Scheme 1	Scheme 2	Scheme 3	Scheme 4
Shek Wai Kok Estate	480	480	480	480
Fairview Garden	156	156	156	156
Luk Yeung Sun Chuen	648	728	728	648
Kwai Ming Wu School	1	1	1	1
Muk Min Ha Tsuen	54	54	54	54
Tung Lam House for Aged	1	1	1	1
✓ Hoi Pa Village	93	93	93	93
✓ Pak Tin Pa Tsuen	54	54	54	54
Tsuen King Garden	200	200	200	200
✓ Pak Tin Pa San Tsuen	4	4	4	4
✓ Pak Tin Pa	4	4	4	4
Fuk Loi Estate	512	512	512	512

2207

Table 4.14 Effect of the Application of Noise Mitigation Measures - CRTN

	Number of Dwellings			
Location	**Scheme 1**	**Scheme 2**	**Scheme 3**	**Scheme 4**
Luk Yeung Sun Chuen	24	136	68	0

There are a number of dwellings where noise will exceed the HKPSG standards for each of the four Schemes. However when the need for indirect noise mitigation is tested under the CRTN the only dwellings that qualify to be considered for additional mitigation (that is in addition to low noise road surfacing) in Schemes 1, 2 and 3 are those in Luk Yeung Sun Chuen. Scheme 4 was thus developed as a modification of Scheme 3 to protect these dwellings and this Scheme is able to protect all dwellings to the standards of the CRTN. The difference between Schemes 3 and 4 are that the two noise barriers (barriers E and F) on the eastbound sliproad from Route 5 to the interchange are replaced by a semi-enclosure (enclosure 8) open to the north and a barrier (barrier P) is proposed at the top of the embankment close to Route Twisk. This barrier will be noise absorbent to prevent reflected noise from traffic on Route Twisk having an additional impact on the dwellings to the north of Route Twisk.

Scheme 4 is thus recommended for implementation on this section of the project. In summary the recommended noise mitigation is as follows (see Figure 4.13):

(a) a semi-enclosure, open on its north side, 85m long over the main carriageway of Route 5 (enclosure 4);

(b) a semi-enclosure, open on its north side, 185m long over the main carriageway of Route 5 (enclosure 3);

(c) a semi-enclosure 210m long, open on its north side, over the eastbound slip road from Route 5 to the Tsuen Kam Interchange (enclosure 8);

(d) a 4m high noise barrier faced with noise absorbent material at the top of the Route 5 embankment in front of Muk Min Ha Tsuen. This barrier will be 200m long;

(e) a 4m high reflective noise barrier (barrier D) on the south side of the westbound sliproad from the Tsuen Kam Interchange to Route 5. This barrier will be 260m long;

(f) a 5m high reflective barrier 105m long (barrier H) on the south side of Route 5 between the flyover for the westbound sliproad from the Tsuen Kam Interchange to Route 5 and the overbridge on the western side of the interchange;

(g) a 5.1m high curved barrier 125m long on the south side of Route 5 inside the Tsuen Kam Interchange (barrier C). The slope and pedestrian arrangements inside the interchange will be redesigned to allow this barrier to be on top of an embankment immediately to the south of the road;

(h) a 5.1m high curved barrier 100m long on the southern side of the Tsuen Kam Interchange infront of Luk Yeung Sun Chuen (barrier O);

(i) a 5m high reflective barrier on the northern side of Tsuen Kam Interchange between the interchange and Hoi Pa Village South Terrace. This barrier will be 110m long;

(j) a 4m high reflective barrier on the south east side of Tsuen Kam Interchange in front of Shek Wai Kok Estate (barrier B). This barrier will be 80m long;

(k) semi-enclosure 10, open on its southern side, over the eastbound sliproad from the Tsuen Kam Interchange to Route 5. This will be 120m long;

(l) semi-enclosure 11, open on its northern side, over the westbound sliproad from Route 5 to the Tsuen Kam Interchange. This will be 90m long; and

(m) low noise road surfacing over the main carriageway of Route 5.

4.6.5 Cost Benefit Analysis

A cost benefit analysis has been carried out to compare the four schemes. This is presented in Table 4.15.

Table 4.15: Cost Benefit Analysis

Mitigation Measures	Low Noise Road Surface	Scheme 1	Scheme 2	Scheme 3	Scheme 4
No of dwellings to be considered for noise insulation treatment	2282 + 1 Home for Aged	24	136	68	0
Capital costs ($M)					
- Structure	-	263	145	191	242
- A/C and glazing	47	1	3	1	0
Total capital cost	47	264	148	192	242
Annual recurrent costs ($M)					
- A/C energy	14	0.1	1	.4	0
- A/C replacement	7	0.1	0.5	.2	0
- Panel replacement	-	6	3	5	5
Total recurrent cost	21	6	5	5	5
Net Present Value of recurrent costs ($M)					
- 4% for 50 years	468	152	108	120	135
- 10% for 50 years	228	74	53	59	66
Net Present Value for total costs ($M)					
- 4% for 50 years	515	415	256	313	377
- 10% for 50 years	275	338	201	251	308

Assumptions:
1. Capital cost of air conditioners plus thicker glazing: $20,000 per dwelling and $400,000 per school;
2. Replacement of air-conditioners: $15,000 per dwelling per five years and $150,000 per school per five years.
3. Annual energy cost for air conditioners: $6,000 per dwelling and 60,000 per school.
4. Acrylic panels of life for 10 years are used.
5. Excludes works at the China Dyeing Works Redevelopment which will not be funded by Government.

The cost benefit analysis shows that Scheme 1 is the least cost-effective, Scheme 2 would be the most cost effective per se (that is this Scheme has the lowest Net Present Value of total costs). However, this Scheme would result in 136 properties having to be considered for noise insulation and this is undesirable.

Scheme 3 has a slightly lower Net Present Value for total costs than Scheme 4, but this would involve indirect mitigation measures at 68 properties.

Scheme 4.1, the recommended Scheme, can be regarded as cost-effective when viewed against the requirement to minimise use of indirect mitigation. It also compares favourably with the option whereby only low noise road surfacing would be applied.

4.7 Conclusions

4.7.1 Construction Phase

Noise impacts during the construction phase are likely to arise from a number of construction activities. The daytime guideline value of 75 dB(A) will be exceeded by 10 dB(A) at most of the receivers at some time during construction. At Kam Fung Garden, a noise level of 90 dB(A) is expected for six months but this could reduce by as much as 10 dB(A) with the noise mitigation measures proposed.

Noise mitigation measures have been recommended to reduce the noise impact on the sensitive receivers. Noise monitoring has also been recommended to check for compliance with the specified limits and the effectiveness of the noise mitigation measures adopted.

4.7.2 Operational Phase

Traffic noise levels experienced at sensitive receivers during operation of Route 5 without mitigation will exceed the HKPSG level at over 4,300 dwellings, two schools and one Home for the Aged.

A package of direct noise mitigation measures comprising low noise road surfacing, noise barriers and semi-enclosures has been recommended which will reduce the noise impacts from the Route 5 section in question to a practicable minimum. It has also been shown that the recommended scheme will be cost effective.

Details of the costs of the recommended mitigation schemes are given in Chapter 9.

The benefits of the recommended noise mitigation are shown on Figures 4.14 to 4.16.

5 AIR QUALITY

5.1 Key Issues

Impacts on air quality during construction of the route section will be due to dust emissions from:

(a) excavation;
(b) earthmoving (loading, unloading bulldozing);
(c) breaking and drilling;
(d) stockpiles of construction materials; and
(e) haul road traffic.

Impacts on air quality during operation will be due to:

(a) vehicle emissions comprising NO_x, CO and RSP.

The key factors determining the implications of such impacts will be:

(a) the location, number and sensitivity of receivers and their compatibility with air emissions;
(b) background air quality; and
(c) cost-effectiveness of mitigation measures in maintaining landuse compatibility.

5.2 Legislation and Guidelines

Regulations in force under the 1983 Air Pollution Control Ordinance (APCO), Cap. 311, provide for the control of air pollutant emissions from industrial activities and other stationary sources.

Under the legislation the Statement of Air Quality Objectives (AQOs), presented in Table 5.1, provides the statutory AQOs for the Air Control Zones (ACZs) that have been declared for the whole of the territory. In addition, the Fuel Restriction Regulations of APCO limit the content of sulphur in fuels.

Certain Specified Processes are named under the APCO and have specific controls attached. None of the construction activities identified to date are specified processes and so it is not anticipated that a specified process licence will be required; however if any such activities are added at a later stage, the contractor will required to obtain a specified process licence if he needs to undertake such activities.

Table 5.1 Hong Kong Air Quality Objectives

Pollutant	Concentration $\mu g/m^3$ (i) Averaging Time				
	1 Hour (i)	8 Hours (iii)	24 Hours (iii)	3 Months (iv)	1 Year (iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulates (v)			260		80
Respirable Suspended Particulates (v)			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30000	10000			
Photochemical Oxidants (as ozone (vi))	240				
Lead				1.5	

(i) - Measured at 298°K (25°C) and 101.325 kPa (one atmosphere).
(ii) - Not to be exceeded more than three times per year.
(iii) - Not to be exceeded more than once per year.
(iv) - Arithmetic means.
(v) - Respirable Suspended Particulates means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometers and smaller..
(vi) - Photochemical oxidants are determined by measurements of ozone only.

Source : Air Pollution Control Ordinance

In addition to the above, EPD recommend a maximum level of Total Suspended Particulates of 500 $\mu g/m^3$ at the boundary of any construction site.

EPD have proposed the following air quality standards for inside tunnels:

(a) carbon monoxide 115,000 $\mu g/m^3$ or 100ppm; and
(b) nitrogen dioxide 1,800 $\mu g/m^3$ or 1ppm.

Sensitive receivers for air pollution are identified in the HKPSG as:

(a) residential areas;
(b) nurseries;
(c) homes for the aged;
(d) hospitals and clinics; and
(e) schools.

5.3 Baseline Conditions

EPD operate a fixed monitoring station to the south of the Study Area at Tai Ho Road, Tsuen Wan and it is considered that data from this station will be representative of the Study Area. Data for 1992 have been provided by EPD for this assessment.

The air quality of Tsuen Wan is relatively poor and in 1992 both the annual averages of Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) did not comply with the Hong Kong Air Quality Objectives (AQO). The 24 hour levels of TSP were higher than the 24 hour objective twice during this period while levels of RSP were only marginally acceptable. The 1 hour levels of NO_2 were within the AQO.

A summary of the 90-percentile statistics for NO_2, TSP and RSP at Tsuen Wan monitoring station in 1992 is presented in Table 5.2.

Table 5.2 90-percentile Concentration of Selected Pollutants at Tsuen Wan

Pollutant	90-percentile Concentration (μg/m3)	Air Quality Objective (μg/m3)
NO_2 (1 hr)	105	300
TSP (24 hr)	155	260
RSP (24 hr)	93	180

The data provided by EPD was used for the key issues assessment and no additional data collection was carried out for baseline air pollution levels.

5.4 Air Sensitive Receivers

Areas containing sensitive receivers have been discussed in Section 3.3.

For each area, one or more representative receivers were selected according to the criteria set out in the Hong Kong Planning Standards and Guidelines (HKPSG). The selected air sensitive receivers are similar to the noise sensitive receivers (identified and discussed in section 4.4), although due to the different propagation characteristics of noise and air pollutants, the number of representative receivers required for the air pollution assessment is less than that required for the noise study. This arises from the difference in dispersion characteristics of these two pollutants. In particular, concentrations of air pollutants will be less dependent on orientation of the receiver with respect to the pollutant source.

As agreed with EPD, air pollutant levels were modelled at two heights at each receiver; podium level and 10 metres above podium level.

5.5 Construction Phase

5.5.1 Assessment Methodology and Impact Assessment

The Fugitive Dust Model (FDM) has been used to predict air quality at the receivers during the construction phase. The FDM is specifically designed for computing construction impacts from dust sources and uses an area or line source algorithm to quantify dust impacts from the construction activities.

The main sources of dust on site will be loading, unloading, bulldozing, excavating, drilling, breaking and storage piles.

In addition, vehicles passing over unpaved haul roads can cause the pulverisation and subsequent entrainment of surface materials which leads to increased levels of particulates in the air. As agreed with EPD, predicted levels of Total Suspended Particulates (TSP) have been considered in this assessment of construction activities.

It has been assumed that all construction activities will proceed in parallel. A more conservative situation will be simulated by this approach because in reality, the activities are of limited duration and could vary with time.

TSP includes all sizes of particulates. However those with aerodynamic diameters greater than 30μm tend to settle out a few metres from the source under typical wind conditions; smaller particles have much slower rates of settling, and are therefore more affected by wind turbulence. Particle sizes of 30 μm with an average particle density of 2000 kg/m^3 have been assumed in this study.

The input data required for the model were:

(a)	receiver data	-	location and height;
(b)	meterological data	-	wind speed.
		-	wind direction;
		-	atmospheric stability;
		-	temperature;
		-	mixing height.
(c)	source data	-	location;
		-	source characteristics;
		-	emission rates.

The identification of receivers has been discussed in Section 5.4 above.

Meterological data has been supplied for 1992 by the Royal Observatory weather station at the Mobil Oil Depot, Tsing Yi and King's Park, Tsim Sha Tsui. The data were examined to identify the worst case condition (in terms of wind speed, wind direction, stability class, temperature and mixing height) to be used in the model runs, for each combination of receiver and dust source. Both the worst case scenario of one-hour and 24-hour average concentrations of TSP at the receivers have been calculated.

Particulate emission rates for each source have been determined using the "Compilation of Air Pollutant Emission Factors" (AP-42) (USEPA, 4th edition, 1985) which are presented in Appendix D1.

5.5.2 Impact Assessment and Evaluation

The results generated by the various meterological conditions have been compared and the highest value has been chosen for each receiver to estimate the worst case conditions. Table 5.3 shows the maximum predicted 24 hour TSP level for each receptor at podium level and 10 metres above podium level, assuming no mitigation of dust.

Table 5.3: Predicted Worst Case TSP Levels at Air Sensitive Receivers Assuming No Mitigation

Location	1-hr TSP Level (ug/m^3)		24-hr TSP Level (ug/m^3)	
	Podium Level	10 metres above Podium	Podium Level	10 metres above Podium
Hoi Pa Village ST	338	285	172	166
Shek Wai Kok Estate	399	319	180	172
Fairview Gardens	544	407	213	194
Kwai Ming Wu School	981	607	285	236
Luk Yeung San Chuen	893	575	258	223
Pak Tin Pa Tsuen	276	251	164	160
Tung Lam Home for the Aged	305	267	165	161
Muk Min Ha Tsuen	454	330	178	167
Pak Tin Pa	238	208	162	159
Tsuen Kam Centre	556	370	224	201
Fuk Loi Estate	585	436	213	199
Pak Tin Pa San Tsuen	1092	759	233	217
China Dyeing Works Block 1	386	311	192	181
China Dyeing Works Block 8	535	359	217	189
China Dyeing Works Block 9	525	345	218	191
China Dyeing Works Block 12	501	345	212	189
Tsuen King Gardens	364	321	178	174
Kam Fung Gardens	335	298	182	176
Tsuen Tak Gardens	311	278	178	173
Tsuen Wan Area 3	255	234	170	167

Note: Predicted levels include background TSP levels of 155 ug/m3 (24-hr average)

The predicted TSP levels suggested that the 1-hr criteria of 500 ug/m^3 will be exceeded at most of the receivers. At Luk Yeung San Chuen and Kwai Ming Wu School, the 24-hr criterion of 260 ug/m^3 will also be exceeded. The adverse air quality is due to the high background dust level in the Study Area and the proximity of the receivers to the construction site.

5.5.3 Mitigation Measures

The unmitigated dust levels from building the new section of Route 5 are expected to be higher than the AQOs at some of the receivers. Dust suppression measures are therefore recommended to reduce the emissions during construction.

Dust generated by haul road traffic will account for the major dust levels of the area. The implementation of water suppression systems alone cannot signigicantly reduced the TSP levels to within the 1-hr critera of 500 ug/m^3 at some of the receivers. The haul road should therefore be paved to mitigated the dust level during transport. Emission of dust from hauling can be reduced by 80% with paving.

Further dust mitigation measures should include, but not limited to, the following general measures:

(a) the contractor should undertake measures at all times to prevent dust nuisance as a result of his activities. Any air pollution control system which is installed should be operated whenever the plant is in operation.

(b) no debris or any other material should be burnt on the site.

(c) dust generated during earthworks should be minimised through wetting or covering exposed earth. Watering is the most common control method for an exposed site surface, but the effectiveness of such a measure depends on the frequency of application and extent of coverage. In general, twice-daily watering reduces dust emissions by up to 50% but will depend on parameters such as surrounding site activity and ambient temperature and humidity. Chemical wetting agents can enhance the level of mitigation achieved but could have adverse effects on plants and animals exposed to run-off. Adequate dust suppression plant including water bowsers with spray bars or means of applying surface chemical treatment should be provided by the contractor and details of these should be submitted to and approved by the (Resident Site Staff) RSS.

(d) water sprays should be used during the handling of fill material at the site and at active cuts, excavation and fill sites when dust is likely to be created and to dampen all stored materials during dry and windy weather. Chemical stabilisation is not effective at these locations due to the degree of disturbance but can be used on completed drills and cuts to prevent wind erosion.

(e) to reduce dust generation during transport, dump trucks should not be loaded to a level higher than the side and tailboards and the contents should be dampened and covered prior to transport. Dust levels can be further reduced by providing a gravel surface or a temporary sealed surface on unpaved areas within the site where there is a regular movement of vehicle and such areas should also be kept clear of loose surface material;

(f) unless otherwise approved by the RSS, all motorised vehicles on the site should be restricted to a maximum speed of 10 km per hour and confined haulage and delivery vehicles to designated roadways inside the site.

(g) at all vehicle exit points from the unpaved construction areas onto public roads, wheel washing troughs should be provided.

(h) all stockpiles of aggregate or spoil should be enclosed or covered and water applied in dry or windy conditions. Enclosures should be rigid and reach above the height of the stockpile. In addition chemical wetting may be applied. The access area around the stockpile should be watered or even temporarily paved to reduce the emissions arising from mobile equipment manoeuvring in its vicinity.

(i) at loading, unloading and transfer points wetting and use of windbreaks can minimise material loss. Alternatively if these activities can be confined to an enclosure a baghouse filter may be used to filter dust during transfer.

(j) measures to mitigate against dust nuisance should be incorporated in the contract documents.

Table 5.4 shows the predicted TSP levels for the sensitive receivers assuming these methods of mitigation are applied and this table shows that acceptable levels above the existing background situation should be achievable.

Table 5.4: Mitigated TSP Levels at the Air Sensitive Receivers

Location	1-hr TSP Level ($\mu g/m^3$)		24-hr TSP Level ($\mu g/m^3$)	
	Podium Level	10 metres above Podium	Podium Level	10 metres above Podium
Hoi Pa Village ST	195	183	158	157
Shek Wai Kok Estate	208	191	160	158
Fairview Gardens	237	208	166	162
Kwai Ming Wu School	324	248	179	170
Luk Yeung San Chuen	306	241	174	167
Pak Tin Pa Tsuen	181	175	157	156
Tung Lam Home for the Aged	187	179	157	156
Muk Min Ha Tsuen	217	191	159	157
Pak Tin Pa	173	167	156	156
Tsuen Kam Centre	239	201	168	163
Fuk Loi Estate	246	214	166	163
Pak Tin Pa San Tsuen	351	288	169	167
China Dyeing Works Block 1	204	188	162	160
China Dyeing Works Block 8	237	198	167	161
China Dyeing Works Block 9	233	195	167	162
China Dyeing Works Block 12	228	195	166	161
Tsuen King Gardens	239	201	168	163
Kam Fung Gardens	199	187	160	159
Tsuen Tak Gardens	194	183	159	158
Tsuen Wan Area 3	178	172	158	157

Note: Predicted levels include background TSP levels of 155 $\mu g/m^3$ (24-hr average)

5.5.4 Dust Monitoring and Audit

Monitoring should be undertaken at the construction site boundary and should ensure that the EPD recommended boundary criteria (1-hr TSP, 500 $\mu g/m^3$) is not exceeded. 24-hr TSP levels should also be monitored close to the air sensitive receivers in accordance with the requirements stated in the HKPSG guideline. The EPD boundary criteria and HKPSG will be the target levels for construction dust.

Baseline Monitoring

Dust monitoring stations for baseline and impact monitoring should be established at the site boundary. TSP baseline monitoring should be carried out for at least two weeks with measurements taken every day prior to the start of the construction works to establish representative TSP background levels, taking into account influencing factors such as weather conditions.

Compliance Monitoring

Compliance monitoring of 1 hour and 24 hour TSP levels should then be carried out throughout the works at the site boundary. The programme for monitoring should be determined when the Contractor's detailed works programme is available and should be updated to reflect any changes in the Contractor's programme as the works progress. As a guide, 24-hour samples should be taken on three in every six days at the sensitive receivers that are likely to be affected and at selected points around the site boundary.

The reporting and auditing of the dust compliance monitoring programme caused by construction activities will be carried out on a quarterly basis and will commence on completion and approval of the Environmental Monitoring and Audit (EM+A) manual. This manual will include data collected during the baseline monitoring programme and also contingency plans to take account of the following:

(a) prolonged non-availability of monitoring assistants;

(b) non-suitability of monitoring site;

(c) equipment failure or theft;

(d) non-availability of laboratory facilities; and

(e) adverse weather conditions.

The contingency plans will also be included in contractual documents in accordance with the HKPSG, Air Pollution Control Ordinance, and EPD monitoring guidelines.

Where monitoring at the site boundary indicates deteriorating air quality, (i.e. the trigger, action or target levels are exceeded) the contractor should take necessary additional steps to ensure that his actions are not contributing to the deterioration. These steps should include, but not be limited to the following :

(a) checking of all plant and equipment;

(b) maintenance or replacement of any plant or equipment contributing to the deterioration; and

(c) review of working methods. The Engineer should be kept informed of steps taken, and written reports and proposals for action should be passed to the Engineer by the Contractor whenever monitoring shows an adverse impact upon site boundary air quality.

Table 5.5 shows the proposed trigger, action and target levels for the construction to prevent deterioration in site boundary air quality.

Table 5.5 Trigger, Action and Target Levels for Dust

TSP Monitoring Parameter in $\mu g/m^3$	Location	1-hour TSP level in $\mu g/m^3$		
		Trigger	Action	Target
1-hour TSP level	Site Boundary	30% above baseline	average of trigger and target levels	500
24-hour TSP level	Air Sensitive Receivers	30% above baseline	average of trigger and target levels	AQO(260)

Table 5.6 shows a proposed action plan should any of the trigger, action or target levels be exceeded.

Table 5.6 Proposed Action Plan for Dust

Event	Action	
	Engineer	Contractor
Trigger level exceeded for one sample	Repeat measurement as soon as possible	Identify source.
Trigger level exceeded for more than one consecutive sample	Repeat measurements as soon possible Notify contractor and EPD immediately	Identify source and impose necessary mitigation measures
Action level exceeded for one sample	Repeat measurement as soon as possible Notify contractor and EPD immediately	Identify source and impose necessary mitigation measures

Event	Action	
	Engineer	Contractor
Action level exceeded for more than one consecutive sample	Daily monitoring to be imposed Notify contractor and EPD immediately Require contractor to make additional proposals for dust suppression	Identify source Review plant and equipment and working procedures Submit proposals for reducing dust to Engineer Implement remedial action to dust emission immediately Notify Engineer of action taken
Target level exceeded for one sample	Daily monitoring is to be imposed Notify Contractor and EPD immediately Require Contractor to make additional proposals for dust suppression Provide investigation report which should be sent to EPD as soon as possible	Identify source Review plant and equipment and working procedures Submit proposals for reducing dust to Engineer Implement remedial action to reduce the dust emission immediately Notify Engineer of action taken Provide investigation report
Target level exceeded for more than one sample	Daily monitoring is to be imposed immediately Notify contractor and EPD immediately Require Contractor to make additional proposals and to take immediate steps to reduce dust, and to provide report for such instance to the EPD as soon as possible	Identify source Review plant and equipment and working procedures Submit proposals for reducing dust to Engineer Implement dust suppression measures to reduce dust immediately Notify Engineer of action taken Provide investigation report which should include the findings and suggestions to prevent such exceedance happening again Stop the relevant portion of work as necessary as determined by the Engineer

5.6 Operational Phase

5.6.1 Assessment Methodology and Impact Assessment

The impact of air emissions arising from Route 5 and other sources in the area has been calculated at the representative receivers identified in Section 5.4 above. As agreed with EPD, levels of NO_2 and RSP from Route 5 traffic have been calculated and superimposed on baseline conditions to predict total air pollution levels for worst case meterological conditions.

CALINE 4 has been used as the computer model to predict the levels from open sections of the new route which have then been superimposed on baseline conditions to predict the total air pollution during operation of the road in the vicinity of these open sections. The impact from the tunnel section has been modelled based on the theory developed by Ohashi and Koso in their paper entitled "Longitudinal Diffusion of Exhaust Pollutants in Two-way Automobile Tunnels" presented to the International Symposium on the Aerodynamics & Ventilation of Vehicle Tunnels, 1985. Results of portal emissions have been superimposed on the CALINE 4 and baseline levels to predict pollutant levels in the vicinity of the tunnel portals. In addition, levels of NO_2, CO and RSP have been predicted within the tunnel using the Ohashi & Koso theory.

Vehicle emission rates are dependent on the engine size and type (diesel or petrol) although emission levels from individual vehicles will also be affected by vehicle age and condition and whether the engine is running hot or cold. Total emissions on a given stretch of road will therefore be largely determined by vehicle flow rate and vehicle mix. In addition, the power output (for a given vehicle this will be a function of vehicle speed and gradient) can also influence the pollutant emission rate.

Emission factors of NOx and RSP (which take account of average speed, percentage cold start, and the year in question) for each vehicle type in 2011 were supplied by EPD and compound emission factors were calculated to represent average emission rates for all traffic on Route 5 (Appendix D2). Gaseous pollutants have been assumed to be inert and levels of NO2 have been taken as 20% of total NOx emissions.

Projected morning peak hour traffic flows and vehicle mix in 2011 was obtained from the transport model data provided by the Transport Department; this data has been presented and discussed in Section 2.3. For the section of Route 5 west of Tsuen King Circuit, the traffic volume attributable to the operation of Route 5 was estimated by subtracting the current peak hour traffic volume of each vehicle type from the total volumes predicted in 2011; this resultant value was used in the model calculations (the pollutant contribution from the existing traffic component is included in the baseline pollutant concentration). Similarly, it was assumed that any pollutant contribution from traffic on the Tseun Kam Interchange would be included in the baseline level.

As agreed with EPD, the background air quality in the design year is assumed to be the 90 percentile values of those recorded at Tsuen Wan in 1992.

CALINE 4 Calculations

The methodology, input parameters and assumptions have been agreed with EPD. The input parameters are as follows:

Stability class	D
Wind speed	2 m/s
Wind direction	worst case for each receiver
Wind direction variation	15°
Mixing height	500 m
Temperature	25 °C

The background air quality in the design year is assumed to be the 90 percentile values of those recorded at the Tsuen Wan fixed monitoring station in 1992. The effect of road gradient has not been incorporated in the modelling studies.

The route was split into 20 homogeneous links according to various criteria, including nature of the link (bridge, embankment, cutting etc), orientation of link, number of vehicles on the link etc. The pollutant contribution from each link was calculated and summed to predict peak hour design year pollution (NO_2 and RSP) levels at two heights - podium level and 10 metres above podium level at the representative receivers in the vicinity of open sections of the new road. 24 hour average RSP levels were also calculated using an averaging method agreed with EPD.

5.6.2 Impact Assessment and Evaluation

Open Section

The predicted pollutant concentrations in these sections include the contribution from traffic on the open road and from tunnel portals as well as the background levels. Peak hour concentrations of nitrogen dioxide at sensitive receivers are summarised in Tables 5.7 and 5.8. The highest level of 286$\mu g/m^3$ is predicted at Block 8 of China Dyeing Works Redevelopment. NO_2 levels at Block 1 & 12 of CDW Redevelopment, Tsuen Tak Gardens and Kam Fung Garden are over 250$\mu g/m^3$. However none of the predicted levels exceeds the hourly AQO of 300$\mu g/m^3$.

Predicted RSP levels at sensitive receivers are shown in Table 5.9. Daily averages range from 135$\mu g/m^3$ at Kam Fung Garden to 96 at Pa Tin Pa Tsuen, Muk Min Ha Tsuen and Shek Wai Kok Estate. Levels are well below the AQO of 180 $\mu g/m^3$.

Tunnel Sections

China Dyeing Works Tunnel

The pollutant concentrations and portal emissions within the Route 5 tunnel through the China Dyeing Works development and the enclosures contiguous to the tunnel which have been recommended for noise mitigation to the west of it have been studied. At the suggestion of the EPD, the Longitudinal Dispersion Coefficient method proposed by Ohashi and Koso (referred to herein as O&K) has been used.

The base data for the analysis is as follows:

Length:	204 m
Height:	6 m
Width:	20.5 m
Traffic flow:	2240 veh/hr in each direction (ie 4480 veh/hr total) at 15 kph.
Design year:	2011
Average NO_x emissions:	5.8 g/km-veh
Average CO emissions:	7.6 g/km-veh

The maximum concentrations of pollutants calculated using this method and these assumptions are as follows:

NO_2 concentration (10 percent conversion):	0.4 ppm
NO concentration	3.4 ppm
CO concentration	5.6 ppm

These are well within the standards set by EPD and it may be concluded that mechanical ventilation will not be required in the tunnel during non-incident conditions with flowing traffic.

We have also examined the report 'Assessment of Tunnel Air Quality' which was prepared by the developer's consultant. The report treats the O&K method in a conservative manner and approaches the ambiguities in the application of the method in a way that would predict the highest concentrations. The developer's report used a speed of 10 kph and total flow of 2990 veh/hr when calculating the dispersion coefficient and 3736 veh/hr when calculating the emissions. We used a total of 4480 veh/hr at 15 kph throughout.

The O&K model gives strange results for pollutant distribution when the nett longitudinal flow is near zero. Because the longitudinal flow is uncertain, it is reasonable to assume, for the purposes of portal emission calculations, that it is zero. It is also reasonable to assume that, in the case of zero nett longitudinal flow, the total emission from a portal is the total in-tunnel emission for the traffic leaving that portal. The average plume velocity over the tunnel cross-section will be zero, but there will be a plume of pollutant which comes out with, and is carried along the road by, the traffic.

Calculating the portal concentration with the O&K method is difficult with low longitudinal velocities. Also, the average concentration thus produced would not be representative of the plume concentration.

We have calculated the plume concentration on the assumption that it is at the maximum concentration as given above, and that the velocity is that which would be required to achieve the equivalent air exchange, ie 2.24 m/s. The plume concentrations for congested operation are thus as follows:

East portal: 5.6 ppm CO, 3.8 ppm NO_x, 176 m^3/s, 2.24 m/s
West portal: 5.6 ppm CO, 3.8 ppm NO_x, 118 m^3/s, 2.24 m/s

Portal Emissions

Air quality impacts were assessed based on the procedures stated in Section III.2 of PIARC 91. The portal air jets are taken as area sources at the portal area. The dispersion was calculated using the Industrial Source Complex Short Term (ISCST) model developed by the United States Environmental Protection Agency (USEPA).

Table 5.7: Predicted Peak Hour NO_2 Levels at Sensitive Receivers (including portal emissions)

Location	Podium Level $\mu g/m^3$	10 metres above podium level $\mu g/m^3$
Hoi Pa Village ST	160	154
Shek Wai Kok Estate	189	174
Fairview Gardens	171	167
Kwai Ming Wu School	182	174
Luk Yeung San Chuen	181	173
Pak Tin Pa Tsuen	146	139
Tung Lam	149	144
Muk Min Ha Tsuen	181	162
Pak Tin Pa	161	146
Tsuen Kam Centre	189	176
Fuk Loi Estate	235	223
Pak Tin Pa San Tsuen	218	201
China Dyeing Works Block 1	253	216
China Dyeing Works Block 8	286	195
China Dyeing Works Block 9	227	179
China Dyeing Works Block 12	225	179
Tsuen King Gardens	160	167
Kam Fung Gardens	282	265
Tsuen Tak Gardens	275	252
Tsuen Wan Area 3	205	198

Note: Predictions include the background level of $105\mu g/m^3$
HKPSG peak hour level for NO_2 is $300\mu g/m^3$

Air Quality in Semi-enclosures

Much of the noise mitigation recommended for this project is in the form of semi-enclosures. These will be completely open on the side facing away from the noise sensitive receiver and hence there will be a free flow of air in and out of the semi-enclosure. The forcing of the air will be by the piston effect of traffic in the semi-enclosure and from winds blowing over the semi-enclosure. Most of the ventilation will be from piston effects since the lack of restriction on the open side will allow more movement of air than in a sealed enclosure even though traffic will be moving in both directions in the semi-enclosure.

The air pollution in the full enclosure through the China Dyeing Works redevelopment has been assessed and it has been concluded that this will be acceptable. The movement of air in the semi-enclosures will be greater than in the China Dyeing Works enclosure and traffic volume and speeds will be similar. Hence it may be concluded that the air quality in the semi-enclosures will be at least as good and will also be within acceptable limits.

Table 5.8: NO_2 Impacts at Sensitive Receivers from Tunnel Portal Emissions

Location	Podium Level $\mu g/m^3$	10 metres above podium level $\mu g/m^3$
Hoi Pa Village ST	10.4	10.5
Shek Wai Kok Estate	8.8	8.6
Fairview Gardens	9.6	9.4
Kwai Ming Wu School	13.3	12.9
Luk Yeung San Chuen	12.1	11.8
Pak Tin Pa Tsuen	11.0	10.4
Tung Lam	13.5	12.5
Muk Min Ha Tsuen	20.4	18.5
Pak Tin Pa	25.9	18.1
Tsuen Kam Centre	42.7	33.4
Fuk Loi Estate	73.4	63.8
Pak Tin Pa San Tsuen	37.5	28.6
China Dyeing Works Block 1	49.9	36.4
China Dyeing Works Block 8	49.0	26.1
China Dyeing Works Block 9	46.6	29.0
China Dyeing Works Block 12	51.8	24.9
Tsuen King Gardens	28.3	24.4
Kam Fung Gardens	30.3	28.3
Tsuen Tak Gardens	23.2	22.8

Location	Podium Level $\mu g/m^3$	10 metres above podium level $\mu g/m^3$
Hoi Pa Village ST	10.4	10.5
Tsuen Wan Area 3	14.1	13.6

Table 5.9: Predicted 24 hour Levels of RSP at Sensitive Receivers during Operational Phase (excluding Portal Emissions)

Sensitive Receiver	Podium level $\mu g/m^3$	Levels exclusive of tunnel contribution $\mu g/m^3$
Hoi Pa Village ST	101	97
Shek Wai Kok Estate	100	98
Fairview Gardens	107	105
Kwai Ming Wu School	106	103
Luk Yeung San Chuen	112	109
Pak Tin Pa Tsuen	96	95
Tung Lam	97	95
Muk Min Ha Tsuen	101	97
Pak Tin Pa	96	95
Tsuen Kam Centre	109	108
Fuk Loi Estate	109	107
Pak Tin Pa San Tsuen	109	107
China Dyeing Works Block 1	104	101
China Dyeing Works Block 8	121	106
China Dyeing Works Block 9	124	104
China Dyeing Works Block 12	117	105
Tsuen King Gardens	103	98
Kam Fung Gardens	135	130
Tsuen Tak Gardens	127	121
Tsuen Wan Area 3	110	107

Note: Predictions include the background level of 93.4 $\mu g/m^3$
HKPSG 24 hour level for RSP is 180 $\mu g/m^3$

5.6.3 Mitigation Measures

Neither RSP nor NO_2 emissions from vehicles on the open road or tunnel will have significant environmental impacts on receivers around the open road in Tsuen Wan in 2011. No special mitigatory measures will therefore be required.

5.7 Conclusions

5.7.1 Construction activities

Truck movements on unpaved haul roads together with other dust generating activities have been predicted to have potential to cause dust nuisance at some of the receivers along the alignment. Unmitigated dust levels at receivers in the proximity of Tsuen Kam Interchange could be higher than the guideline values.

Practical dust mitigation measures have been recommended to reduce dust emission from the site. Dust monitoring and audit procedures have been recommended to check for compliance with the dust standard and the effectiveness of the dust control measures adopted.

5.7.2 Operational activities

Modelling of NO_2 and RSP emissions predict that the AQOs will not be exceeded in the design year at any receivers along the route.

6. WATER QUALITY

6.1 Key Issues

6.1.1 Impacts

Key issues identified for the construction phase of this Project relate to activities at work sites, contamination of surface water runoff by pollutants such as bentonite, concrete or asphalt, handling and spillage of construction materials, and effluent from office accomodation and canteen facilities provided on-site.

For the operational phase the key issues pertain to pollution of highway drainage through accidental spillages.

6.1.2 Factors Determining Impacts

Both the nature and the extent of individual construction activities will determine the extent of the water quality impact. Impacts on water quality will be evaluated by the actual location of individual activities, the duration and the proximity to drainage channels, the Tai Chung Road Nullah and any other sensitive receivers.

It is understood that, with the exception of the night watchmens' huts, there will be no living accomodation provided on-site. It is also understood there will be no concrete or asphalt batching facilities on-site.

6.2 Legislation and Guidelines

The principal legislation governing marine water quality in Hong Kong is the Water Pollution Control Ordinance (Cap 358) (WPCO). Under an amendment to the original Ordinance of 1980, Territorial waters were subdivided into Water Control Zones (WCZ) which were assigned a series of Water Quality Objectives (WQO). WQO's pertain to both the Beneficial Uses (BU) and the assimilative capacity of the particular water body or part thereof. The most recent definition of WCZ's indicates the northern section of the Rambler Channel is located within the Western Buffer Water Control Zone with the eastern section forming part of the promulgated Victoria Harbour Water Control Zone.

A summary of general WQO's are given in Table 6.1.

Table 6.1 Water Quality Objectives

Water Quality Parameter	Objective	Sub-zone
Offensive odour, tints and colours	Not to be present	Whole zone
Visible foam, oil grease, scum, litter	Not to be present	Whole zone
E.coli	Not to exceed 610 per 100ml, calculated as the geometric mean of all samples collected in a calendar year Not to exceed 180 per 100ml, calculated as the geometric mean of all samples collected between March and October inclusive in one calendar year	Secondary contact recreation subzones and fish culture zones Bathing beach subzones
D.O. within 2m of bottom Depth average D.O. Depth average D.O.	Not less than 2mg/l for 90% samples Not less than 4mg/l for 90% samples during year Not less than 5mg/l for 90% samples Waste discharges not to cause less than 4mg/l	Whole zone Marine waters except fish culture sub zone Fish culture sub zone Inland waters of the zone
pH	To be in the range 6.5 - 8.5, change due to waste discharge not to exceed 0.2	Marine waters except bathing beaches
Temperature change	Change due to waste discharge not to exceed 2°C	Whole zone
Salinity	Change due to waste discharge not to exceed 10% of natural ambient level	Whole zone
Suspended solids	Waste discharge not to raise the natural ambient level by 30% nor accumulation of suspended solids	Marine waters
Ammonia	Annual mean not to exceed 0.021mg/l calculated as the annual average, unionised form	Whole zone
Nutrients	Quantity shall not cause excessive algal growth Annual mean depth average inorganic nitrogen not to exceed 0.1mg/l	Whole zone
BOD5	Waste discharges not to exceed 5mg/l	Inland waters of the zone
COD	Waste discharges not to exceed 30mg/l	Inland waters of the zone
Toxicants producing significant toxic effects	Not to be present	Marine waters

In 1990, a Technical Memorandum was prepared which defined quality standards for the discharge of effluent into any foul sewers, stormwater drains, inland and coastal waters within each WCZ. In January 1991 the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters, (TMSE), was issued and thus provides the principal criteria for this EIA.

6.3 Baseline Conditions

6.3.1 Water Quality

Baseline conditions for the Study Area are defined in terms of the ultimate receiving waters of the Rambler Channel as there are no data available for the nullah which runs parallel to the Tai Chung Road. It was stated in the Initial Assessment Report that no additional water quality data would be collected under this Study.

Water quality within the Rambler Channel is characterised by effluent discharges from various industrial and domestic sources. From these sources, which include electroplating industries, printed circuit board manufacture and textiles, an estimated 40 tonnes of BOD is discharged into the Rambler Channel from Tsuen Wan daily.

Routine water quality monitoring data collected by the Environmental Protection Department within the Rambler Channel and the typhoon shelter are summarised below. Data taken from locations in northern and eastern Rambler Channel and the Rambler Channel Typhoon Shelter are illustrated in Table 6.2.

Table 6.2 Summary of Water Quality Statistics (Source Marine Water Quality in Hong Kong, EPD 1993)

Pollution Indicator	Rambler Channel (VM14) North	Rambler Channel (VM13) East	Rambler Channel Typhoon Shelter VT7	VT8
Temperature C				
- Surface	22.4	22.2	21.0	20.9
- Bottom	22.2	22.1	20.8	20.8
Salinity (ppt)				
- Surface	29.1 (18.8-32.1)	29.9 (21.5-32.6)	30.9	31.3
- Bottom	30.5 (24.1-32.9)	30.9 (25.2-32.8)	31.3	31.4
D.O. %				
- Surface	80 (45-121)	71 (43-115)	53	57
- Bottom	71 (41-146)	66 (45-141)	53	58
pH	8.1	8.0	8.0	8.0
Secchi Disc (m)	1.5 (0.6-2.4)	1.3 (0.6-2.6)	0.9	1.2
Turbidity (NTU)	6.9 (1.7-14.0)	8.6 (1.2-15.7)	18.3	5.3
S.S. (mg/l)	7.1 (2.3-16.3)	10.1 (3.0-21.0)	14.3	9.0
BOD5 (mg/l)	1 (< 1-3)	1 (< 1-2)	4	1
Inorganic N (mg/l)	2.91 (0.20-1.24)	0.45 (0.21-0.78)	0.61	0.41
Total N (mg/l)	3.35 (0.37-2.89)	0.87 (0.47-2.19)	1.25	0.88
PO4-P (mg/l)	0.06 (0.01-0.15)	0.07 (0.04-0.10)	0.18	0.07
TP (mg/l)	0.12 (0.04-0.32)	0.13 (0.06-0.28)	0.29	0.12
Chlorophyll-a (ug/l)	2.27 (0.20-19.30)	1.33 (0.27-7.93)	1.49	1.48
E.coli (no./100ml)	640 (29-32000)	1700 (150-58000)	1800	1500

From the data provided above it is appparent from the broad range of values obtained at monitoring stations (VT13 and VT14) reflect a very polluted water body. This is particularly so for the values reported for nitrogen, E.coli and dissolved oxygen. In addition to the foregoing, the differences in water quality over the short distance between the monitoring stations in the north and east of the Channel confirm the point loadings of pollutants.

As the potential impacts relating to the construction phase primarily pertain to contamination of surface water drainage systems, data for suspended solids, turbidity and clarity are the most relevant parameters for this assessment. Using the criterion of the WQO's the suspended solids load due to construction works must not exceed 2-3mg/l.

Once this section of Route 5 is operational, the main potential water quality issues will be restricted to spillage of fuels and possible contamination of surface waters with trace metals and organic materials derived from vehicles using the road. For the operational phase the pertinent WQOs relate to oil, grease and litter which must not be present in the receiving water bodies.

It should also be noted that while water quality within the Rambler Channel is, at present, generally regarded as poor, several major schemes are either planned or in progress which aim to improve water quality in the long term in this area. These include the Strategic Sewerage Disposal Scheme and the Tsuen Wan, Kwai Chung and Tsing Yi Sewerage Master Plan Scheme.

6.3.2 Sediment Quality

A comprehensive data base of marine sediment quality throughout the Territory was established in 1991 under the auspices of the Contaminated Mud Study (CMS) (Mott MacDonald). Findings of the CMS were subsequently translated into Technical Circular (TC) No. 1-1-92 which defines the levels of contamination of marine sediments (A - uncontaminated, B - moderately contaminated, C - severely contaminated).

The extent of contamination determines the disposal method for any dredged sediments. Levels of contamination are given in Table 6.3 below:

Table 6.3 Classification of Dredged Sediments for Marine Disposal

Class	Cd	Cr	Cu	Hg	Ni	Pb	Zn
A	0.0 - 0.9	0 - 49	0 - 54	0.0 - 0.7	0 - 34	0 - 64	0 - 140
B	1.0 - 1.4	50 - 79	55 - 64	0.8 - 0.9	35 - 39	65 - 74	150 - 190
C	> 1.5	> 80	> 65	> 1.0	> 40	> 75	> 200

Source : Technical Circular No. 1-1-92

Data was extracted from the CMS to indicate the level of contamination of sediments at the point of discharge of the Tai Chung Road Nullah and within the Rambler Channel. Mean concentrations or ranges of values are given in Table 6.4 below.

Table 6.4 Summary of Sediment Quality from the Contaminated Spoil Management Study, 1991 (mg/kg)

Parameter	At the Nullah Discharge Point	Rambler Channel
Copper (mg/kg)	500	(204 - 930) 515
Cadmium (mg/kg)	2	0.5 - 2.3
Lead (mg/kg)	75	320
Chromium (mg/kg)	75	100
Zinc (mg/kg)	150	188
Nickel (mg/kg)	60	33 - 124
Mercury (mg/kg)	0.5	3.44

Comparison of the above data with the criteria given in TC 1-1-92, generally reveals severe contamination (Class C) of sediments at the point where the Tai Chung Road Nullah discharges into the Rambler Channel.

The situation portrayed for the Rambler Channel as a whole is more severe than at the mouth of the nullah, as all parameters except zinc, indicate extremely contaminated conditions.

6.3.3 Hinterland Drainage

The nullah which runs parallel to the Tai Chung Road drains the hinterland of Tsuen Wan and Tso Kung Tam. From site inspection, it appears that the extensive squatter settlements upstream of Tso Kam Tam use the stream for discharging domestic wastes.

A small weir and coarse screen have been placed across the nullah where it passes under the Castle Peak Road. Inspection of these simple structures shows their efficiency in trapping suspended sediments and solids conveyed from the upper reaches of the water course.

6.3.4 Sewerage

The location and status of the main drainage channels within the Study Area was determined through examination of the findings of the Tsuen Wan, Kwai Chung, Tsing Yi Sewerage Master Plan Study, 1991. Existing drainage channels which could be affected by construction works include Tai Ho Road nullah, Tai Chung Road nullah and On Yun Street.

In many areas the existing sewerage system is inadequate to accomodate the domestic and industrial flows discharged on a daily basis. A series of measures to improve the system were recommended under the Sewerage Master Plan, including immediate works to remove sediments from foul sewers, the removal of overflows to the Tai Ho Road nullah and the construction of high level overflows in specified areas to relieve flooding. All these recommendations have been considered in the assessments of the potential construction and operational impacts associated with this Project.

6.4 Potential Sensitive Receivers

Potential sensitive receivers were identified through site surveys and aerial photographs. Reference was also made to the Tsuen Wan, Kwai Chung and Tsing Yi Sewerage Master Plan Study, 1991. Sensitive receivers thus identified are the drainage channels, and specifically the nullahs which run parallel to the Tai Chung Road and Tai Ho Road, and ultimately the receiving waters of the Rambler Channel downstream of the Study Area.

6.5 Construction

6.5.1 Assessment Methodology

Water quality issues were initially identified through a review of the works progamme for the six separate sections of the Route. Activities associated with each section which could adversely affect water quality were considered both in terms of their location, extent and duration of the actual works involved.

It is understood there will be no concrete batching or asphalt plant operating on-site for the duration of this Project and all materials will be imported onto the individual works sites ready mixed.

The size of the labour force engaged on construction works will vary depending upon the phase of the Contract and the works involved. When the numbers of personnel involved in the construction phase are known, effluent disposal arrangements can be defined for individual work sites.

Assessment criteria for both phases of this Project are the Water Quality Objectives and the Technical Memorandum on Standards for Effluents (TMSE).

6.5.2 Construction Phase Assessment

Potential water quality impacts arising during construction pertain to off-site drainage, contamination of surface water runoff with sediments or organic materials, and the disposal of domestic wastes. Sources of contamination include, but are not necessarily limited to:

a) erosion of and runoff from exposed surfaces, drainage channels and stockpiled materials;
b) bentonite slurries and other grouting materials;
c) fuel, oil and lubricants from vehicles used and maintained on-site;
d) domestic effluent from the labour force; and
e) fats and grease from canteen facilities which may be provided on-site for the labour force.

Contamination of surface waters can result in blocking culverts and drainage channels conveying these flows, increasing the downstream suspended sediments load and the biochemical oxygen demand on the receiving water body and, in addition, it can cause an adverse visual impact. Blockage of drainage channels could also cause flooding in this area which is already prone to such events.

Contamination of the stormwaters by grouting and surface finishing materials could increase the BOD of the receiving waters, although in the present context of the Rambler Channel this is unlikely.

Adequate on-site facilities will be required for the prevention of pollution due to runoff from work sites. Damping of stockpiled materials to suppress dust can cause runoff to become heavily charged with sediments, potentially creating blockages in the stormwater drains. Such events can also occur during periods of heavy rainfall. Consideration may need to be given to installing perimeter drains round work sites to trap and separate sediments from surface water runoff, especially at the works area for the MTR crossing (segment C).

Furthermore, if vehicle body and wheel wash facilities are provided for vehicles prior to using the public highway, sediments contained within the washwaters will need to be separated out prior to discharge to the foul sewer in accordance with the requirements of the TMSE (Table 1 thereof).

Domestic effluent will also be required to be disposed of to foul sewer, either directly or indirectly if chemical toilets are installed. Compliance with the TMSE will be mandatory.

Disposal of wastewater from canteen facilities which may be provided on-site will be required to achieve the standards set for grease and oil in the TMSE. The wastewater will be required to pass through a grease trap prior to discharge to the foul sewer. The grease trap will require frequent cleaning and the waste material collected and disposed of at landfill.

6.5.3 Evaluation

The construction programme has not yet been subdivided into individual work tasks nor have individual activities been defined. Therefore it has not been possible to determine the extent of the potential impacts other than in broad terms. Neither has it been possible to quantify impacts because of the lack of available data. Instead potential impacts associated with activities undertaken for each segment have been outlined in the following paragraphs and relevant mitigation measures have been proposed.

Section A : Activities included in this section include construction of new bridges and three new branch culverts in addition to the relocation of foul sewer and stormwater drains. Potential water quality impacts, which may arise over the thirty month period, relate to the conveyance downstream of surface waters contaminated with sediments and other construction materials. The distance between the works site and the receiving water of the Rambler Channel is approximately 1.5km and thus, except during periods of intense rainfall, it is anticipated that sediments would settle out in the drainage channels, potentially increasing the maintenance requirements.

Section B : work associated with the section between the Kam Tin Interchange and the MTR depot will involve the demolition of existing masonry, buildings, drainage and earthworks, construction of a subway and paving of the carriageway. Potential water quality impacts pertain to the provision of temporary drainage, the erosion of the exposed surfaces during demolition and earthworks and thus the conveyance of suspended sediments in the drainage channels. Deposition of sediments in the drainage channels is a potential problem which, as with Section A, could result in increased maintenance work. The time frame for construction works in this segment is only twelve months, which compared to segment A will minimise the risk of water pollution impacts.

Section C : for the MTR crossing, construction works which will be undertaken over a two and a half year period include the provision of a haul road, excavation and earthworks to form a works area, in addition to construction and finishing of the superstructure over the MTR line. Potential water quality issues primarily relate to sediment charged runoff from the excavation and earthworks associated with the construction works area. Once the existing vegetation cover is removed the potential for erosion will further increase. In addition to the foregoing, any vehicle repair and maintenance which may be undertaken at the construction works areas, creates the potential for spillages of oil, fuel and lubricants, which could then be washed off-site into the drainage channels. Because of the nature and extent of the works involved in this segment, the potential impacts on water quality may be termed as moderate.

Section D : This section between the Nan Fung Redevelopment and Tsuen Wan Road will include the provision of a box culvert, and is scheduled to be completed over a three year period. Potential water quality impacts may be similar to those identified for segment C, and relate to the discharge of sediments to the drainage channels possibly causing blockages or at least increased rates of sedimentation within the channels. As with segment C the potential water quality impacts may be rated as moderate.

Site E : Construction at the China Dyeing Redevelopment Site will include diversion of drainage, which is progammed to take 2 years to complete. The drainage channels at this location discharge into the Tai Chung Road Nullah and thus sediment or other construction related materials released into this water body will be highly visible. Decaying vegetation or sediments washed into water courses from the road construction works could become significant, albeit local, oxygen sinks. Although sediment transport in the nullah is a natural process, the rate at which this takes place could be accelerated by the road construction and vegetational clearing activities associated with the work site and the road construction itself. The impacts of increasing sediment loads include the reduction in the oxygen carrying capacity of the water course, the accumulation of sediment deposits which may require dredging and the visual impacts of deposition. Impacts on the receiving waters may be rated as moderate or in extremis (visually) severe.

Site F : Tsuen King Wai and China Dyeing Redevelopment will involve the replacement of the existing road surface, and is scheduled to be completed in one year. Existing drainage channels under this section of the road will most likely be incorporated into the new surface. Potential impacts relate to the conveyance of construction based materials into the drainage channels which ultimately connect with the Tai Chung Road nullah. Sediment deposition within the channels consitutes the primary water quality impact connected with this section of the road.

6.5.4 Mitigation Measures

It may be concluded that any adverse impacts on water quality which could arise during the construction phase, should all be minimised by good site practise.

Consideration will need to be given to the provision of a second screen and weir upstream of the existing facility in the Tai Chung Road nullah to prevent any vegetation, oil or sediment based construction wastes being conveyed into the Rambler Channel. This would have a secondary benefit as it would provide a physical barrier in the event of a spillage from the road once commissioned.

Avoidance of spillages of materials, and control of on-site drainage will be a prerequisite of the requirements imposed on the Contractor, through the Contract Documents. It is recommended that consideration is given to the collection of spent materials including bentonite or grouts. Such materials could be either cleaned and re-used or disposed of separately to landfill.

Liquids used to dampen stockpiled materials should be kept to a minimum to reduce the potential for sediment laden runoff, from this source, entering drainage channels.

It is recommended that perimeter drains are provided at works sites, especially at Segment C where a construction works area will be established. Perimeter drains, and sediment traps will permit the collection and separation of any pollutants contained within surface water prior to discharge to the foul sewers.

Provision of vehicle wheel and body washing facilities is recommended as it will prevent the conveyance of construction materials onto the public highway.

Canteen facilities which may be provided on-site for the labour force will be required to discharge the wastewater to an existing foul sewer via a grease trap. All domestic effluent discharged (either directly or through the use of chemical toilets) to the foul sewer will be required to comply with the requirements of the TMSE.

6.5.5 Compliance Monitoring

During construction, water quality monitoring will be required to confirm the standards set out in the Technical Memorandum (TMSE) are being achieved with respect to disposal of domestic effluent, canteen waste and wash water from any vehicle wheel and body washing units which may be provided on-site. Compliance monitoring schedules will only be able to be determined when the facilities provided by the Contractor and his actual working methods are specified. It is however recommended that confirmatory monitoring is included as a Particular Specification Clause in the Conditions of Contract for this Project.

6.5.6 Post Audit Monitoring

No post audit monitoring is proposed for water quality in this Project.

6.6 Operation

6.6.1 Assessment Methodology

Significant potential water quality impacts pertaining to the operation of this section of Route 5 are confined to spillages of fuel or loads from vehicles using this section of road and from highway drainage per se.

While it is possible to forecast future traffic volumes through existing transport models, the risk of incidences major of spillages and the pollution loads from highway drainage is more difficult to predict.

Mathematical models can be used to simulate stormwater drainage profiles which can then simulate stormwater quality within a system. In SE Asia, the best known models for this application are the Hydraulics Research models WALRUSS, used to predict the system hydraulics, and MOSQITO which simulates the associated water quality by assuming the input pollutant load is either in dissolved form or attached (through one of several mechanisms) to the sediment load. As the results of the models rely on the quality of input data applied, it was considered these predictive methods were too sophisticated for the data available for this Project.

6.6.2 Evaluation

Simple water quality models exist which could be applied to determine the contribution of suspended solids, heavy metals, COD and phenol from highway drainage systems to the receiving waters. However, in view of the heavily polluted nature of the Rambler Channel and the other ongoing major construction works within the area of influence, such a method is not considered appropriate.

Furthermore, the probability of the accidental spillage of materials from the highway to the drainage system being perceived as affecting water quality within the Rambler Channel is considered to be minor.

6.6.3 Mitigation Measures

Design of highway drainage systems will include consideration of the rainfall profile and the existing capacity within the stormwater systems. The Sewerage Master Plan recommended various remedial measures both to minimise flooding within this area and to improve the overall performance of the drainage system within Tsuen Wan, Kwai Chung and Tsing Yi. Implementation of these proposals in combination with the use of screens or traps, if required, to prevent the ingress of solids into the drainage system will assist in reducing potential water quality impacts.

6.6.4 Monitoring

It is proposed that neither compliance nor post audit monitoring is undertaken for water quality except in the event of spillages of fuel or other contaminants on this section of Route 5. Action will be required to ensure the spillages are cleaned up as quickly and effectively as possible, and that the drainage channels and receiving waters, if affected, are restored to their original status as quickly as possible.

6.7 Conclusions

From the foregoing it may be concluded that :

a) potentially sensitive receivers are the Tai Chung Road and Tai Ho Road Nullahs and other drainage channels;
b) during construction the potential impacts on water quality may be considered to be relatively minor assuming the mitigation measures proposed are applied, and good site practices adopted;
c) those sections of the route which are judged to have moderate potential for adversely affecting water quality include Segment C (MTR Crossing), Segment D (Nan Fung redevelopment) and Segment E (China Dyeing redevelopment) on account of the nature and extent of the construction works and the proximity to the Tai Chung Road nullah;
d) once operational the only impacts on water quality will be those relating to spillages of fuels or materials from vehicles using this section of road;
e) potential impacts on water quality may be minimised during the construction phase through good site management and application of special particular clauses in the Contract Document specifically for the protection of water quality.

7. VISUAL ASSESSMENT

7.1 Introduction

This section of the report seeks to assess the existing landscape quality of the site and the visual impact of the proposed Route 5 road section between Shek Wai Kok and Chai Wan Kok. Based upon the information available at present, recommendations and guidelines to mitigate the visual impact both during construction and operation of the road are set out in the following sections.

For the purposes of this study the site has been divided into 3 landscape areas (see Fig. 7.1), namely;

A. Tsuen Kam interchange and the eastern area of the site between Route Twisk and the MTR Station.

B. The area of hillside to the west of the MTR station above the China dyeing works redevelopment site including Pak Tin Pa village and an unnamed village on the hillside below Route Twisk.

C. The portion of the site lying between China dyeing works redevelopment site and Chai Wan Kok.

7.2 Existing Landscape Quality

7.2.1 Area A

This area of the site is characterized by Acacia and Bauhinia tree belts along the road side and MTR perimeters. These currently screen the existing interchange effectively at ground level and also significantly reduce its visual impact at higher levels. The belt of trees beside Route Twisk occupies a sloping strip of land above a large retaining wall and screens views into the site from Route Twisk and the housing area and hillside above. The mid-slope area between the tree belt along Route Twisk and the tree belt to the south of the site alongside the MTR comprises a hard paved storage area accessed from the roundabout and a large extent of grassy slope with scrub vegetation.

The roundabout island, which can be accessed by pedestrians via three subways is protected by being sunken and also by a screen belt of Acacia trees.

The tree belts appear to extend from the hillside above Route Twisk and were planted for the purpose of screening the interchange within the last 10 years. This area of the site is surrounded on the north, east and south by housing.

The landscape quality of this area is generally good despite the existing interchange, due to the extensive tree belts and open grassland that provide a green backdrop to the Tsuen Wan urban area. (Refer to Fig. 7.1).

7.2.2 Area B

The mid-section of the site comprises a steep scrub and grass covered slope with a few trees on the upper slope beside Route Twisk and within the two small village areas. The villages are located on stepped/terraced areas of the hillside and are connected by a network of footpaths to Route Twisk, and the footbridge over the MTR Lines.

This area is open, visible from surrounding areas, and also forms the largest portion of green space within the site. Factory buildings and the MTR tracks border the site to the south while open hillside with scattered housing lies to the north (Refer to Fig. 7.1).

7.2.3 Area C

The western part of the site lies within the urban area of Tsuen Wan and runs along Castle Peak Road. This part of the site is industrial in nature since it is dominated by factory buildings, although there are small areas of different character, such as the terraced hillside below the Tang grave site, presently used as a plant nursery. This hillside also contains the few mature trees in this area of the site and the grassed hillside behind forms a valuable visual relief to the unattractive factory buildings on the opposite side of Castle Peak Road. At present the demolition of buildings at the China Dyeing Works redevelopment site allows open views from Castle Peak Road towards the main portion of the site (Areas A & B).

Further west there are areas of road reserves in front of residential tower blocks which are either hard paved or disused slopes covered with grass and scrub vegetation.

The site's western boundary is at the Chai Wan Kok area interchange which is surrounded by unsightly factory buildings, godowns and cut rock slopes (Refer to Fig. 7.1).

7.3 Assessment of Visual Impact and Recommendations and Guidelines for Mitigation Measures

7.3.1 Area A

The visual impact of this section of Route 5 will be significant due to the proximity of many sensitive receivers - these being both high and low-rise residential developments. The portion of elevated road and elevated slip roads at the Tsuen Kam Interchange area will be particularly prominent to views into the site from surrounding areas especially since construction work is likely to remove some of the existing tree screen belts that line the interchange. The hillside is likely to be completely stripped of grass and scrub vegetation during the course of construction, due to the cut and fill requirements of the slope works causing ground disturbance and also to provide the contractors' working area.

Visual Impact during Construction :

. Loss of established vegetation.
. Temporary loss of the majority of green open space on hillside and roundabout.
. Unsightly construction traffic, broken ground and unfinished structures.

Visual Impact during Operation :

. Reduction of green open space on hillside and roundabout.
. Increased hard/man-made surfaces and structures.
. Increased traffic on a broad multi-lane highway.
(Refer to Fig 7.2).

Recommendations and Guidelines :

. Retention and protection of existing tree belts and associated slope retaining structures.
. Minimal disturbance, cut and fill, to existing slopes and level ground.
. Imposed restrictions on Contractor's working area.
. Grading of cut and filled slopes to mimic natural contours and to match adjacent undisturbed areas.
. Reinstatement planting to all slopes and areas where vegetation was lost during construction work.
. Mitigation planting to reduce visual impact of the development to affected areas both on and off-site.
. Advance planting to screen construction work where possible.
(Refer to Fig 7.3).

7.3.2 Area B

Although this area is the most open and exposed area of the site, there are fewer sensitive receivers such as residential areas in close proximity, and therefore the development here is likely to have less visual impact than in the eastern part of the site.

The main cause for concern in this area is the extent of temporary cut required for the construction of the road and contractor's storage area. A temporary cut slope down to rock base for a working area is not acceptable. Cutting of slopes should be strictly minimised and it would also be preferable to make all cut slopes permanent since this will allow advance planting works to be carried out that will mitigate the visual impact of the construction phase of the works as well as providing an established vegetation cover during the operational phase.

During construction most of the vegetation in this area is likely to be lost due to the steepness of this area and the disturbance caused by road construction and slope works in an area that is difficult to access.

The area is visible to some extent from Route Twisk and the hillside above as well as to distant views from residential areas to the East and West. To the south beyond the MTR tracks the site is overlooked by factories.

Visual Impact during construction :

- Loss of established vegetation.
- Temporary loss of the majority of green open space on hillside.
- Possible exposure of bare rock on cut slopes or formation of temporary retaining walls.
- Unsightly construction traffic, cut slopes, broken ground and unfinished structures.
- Extended works time and disturbance due to temporary works.

Visual Impact during operation :

- Reduction of green open space on hillside.
- Dominance of road on surrounding area.
- Increase of hard/man-made surfaces and structures.
- Increased visual disturbance by traffic.
  (Refer to Fig 7.2).

Recommendations of Guidelines :

- Retention and full protection of existing tree belts.
- Minimal cut and fill to existing slopes.
- Restrictions on Contractor's storage and working areas and the temporary works required for these.
- Grading of cut and filled slopes to mimic natural contours and to match adjacent undisturbed areas.
- Extensive reinstatement planting to all slopes and areas where vegetation cover was lost during construction.
- Planting or hydroseeding to temporary cut or filled slopes depending upon on construction time for each phase.
- Mitigation planting to reduce visual impact of the development to affected areas both on and off site.
- Advance planting to screen construction work where possible.
  (Refer to Fig 7.3).

7.3.3 Area C

The visual impact of the development of this section of the site is likely to be less pronounced since, although this portion of the development is within the Tsuen Wan urban area, the majority of the surrounding buildings are not sensitive receivers such as residential areas, but are unattractive factory buildings. Several areas will be lost or significantly affected by the development, particularly the Police Station and the hillside below the Tang grave site. The area in proximity to the grave site warrants particular attention since the site is listed as a Site of Archaeological and Historical Interest.

To the west of this area the development may actually improve the landscape quality since road reserves and a factory building which appear to be semi-derelict will be partly taken up by local open space areas which will provide valuable green space.

Visual Impact during construction :

- Increased traffic congestion at Castle Peak Road.
- Loss of plant nursery and mature trees on lower slope of hillside below Tang grave site.
- Loss of access to Tang grave site and temporary loss of pavilion.
- Loss of Police Station building.
- Unsightly construction traffic, broken ground and unfinished structures.

Visual impact during operation :

- Increased areas of road and hardpaving in the eastern part of Area C.
- Increased green open space with the proposed designation of local open space at western part of the site.
- Large retaining wall (max. Ht 13m) below Tang grave site.
- Increased visual intrusion of traffic.

(Refer to Fig 7.2).

Recommendations and Guidelines :

- Retention and protection of important existing trees and features (including Tang grave).
- Reinstatement planting to areas where vegetation lost during construction.
- Mitigation planting to reduce visual impact of road and construction work both on site and at affected offsite areas.
- Provision of street tree planting where possible.
- Reprovision of pavilion lost to construction.
- Reprovision of access to Tang grave and hillside from Castle Peak Road.

(Refer to Fig 7.3).

7.4 Landscape Design Proposals

The following recommendations and guidelines cover possible mitigation measures applicable to all areas and relate to both hard and soft landscape elements. (Refer to Figures 7.1A, 7.1B and 7.1C)

7.4.1 Road Design Recommendations

Details of the proposed road design is not yet available for comment, however, based upon the landscape analysis of the study area and the assessed likely visual impacts, the following design guidelines are proposed.

- All road structures, elevated sections and abutments should be of a integrated design type.
- Abutments and underpasses to the road should have coordinated finish treatments to provide visual interest at pedestrian and traffic level.
- Design should allow for incorporation of additional compatible elements such as noise barriers, tunnel sections and railings.
- Detail design of road and abutment forms and finishes should be developed with Architectural and Landscape Architectural design input.

7.4.2 Noise Barriers and Enclosed Tunnel Sections Recommendations

The detailed design of the proposed noise barriers and tunnel sections are not yet available although details of the preliminary design are included in Chapter 4 of this Report. However, based upon the landscape analysis of the study area and the assessed likely visual impacts, the following landscape design guidelines are proposed. The design in the respect of the appearance of these structures should be agreed by the Advisory Committee on the Appearance of Bridges and Associated Structures (ACABAS) before construction.

- The design intent of the barriers should preferably aim to break up the mass of the barrier and avoid adding to the visual intrusion of the road.
- Barriers should be fully or partially transparant and incorporate coloured elements and patterns to provide visual interest.
- Barriers and tunnel sections east of the China Dyeing Works redevelopment should have subdued colour schemes that relate to the backdrop hillside vegetation.
- Barriers and tunnel sections west of the China Dyeing Works may be brightly coloured to enliven this predominantly industrial area.
- Barriers and tunnel sections structural form should be integrated in design with the China Dyeing Works redevelopment.
- All proposals should be developed with Architectural and Landscape Architectural design input.
- All proposals should be balanced between the initial costs, recurrent maintenance liability and the intended visual merit.

7.4.3 Recommendations for Slopes

Whilst there is at present no detailed information on the extent of cut and fill for site formation and the gradients of proposed slopes, recommendations and guidelines for slopes are as follows:

- Cut slope gradients should not be steeper than 1:2.
- Filled slope gradients should not be steeper than 1:3.
- All slopes should be capable of receiving soft landscape planting in the form of hydroseeding and whip tree planting.
- No slopes should be cut back to expose the rock base, and in accordance with HK Government guidelines and standards, the use of chunam and shotcrete is not acceptable.
- Temporary or permanent slopes formed to allow the contractor working or storage space should be restricted to the minimum necessary and be capable of full vegetative reinstatement.

- All disturbed slopes should be graded to mimic natural contours and to match adjacent formed and undisturbed existing slopes.
- Drainage and berms for slopes should be visually unobtrusive.
- Permanent retaining wall faces should receive appropriate finishing treatment to break up the visual mass of the wall and provide visual interest.

7.4.4 Planting Recommendations

The following guidelines for planting are proposed for reinstatement works and visual impact mitigation :

- Reinstatement planting to areas where existing vegetation was lost.
- Offsite planting to areas beyond the site boundary to directly screen affected views.
- Transplanting of trees of suitable size and species to unaffected areas of the site or a holding nursery until project completion.
- Advance planting of permanently formed slopes and areas of completed works.
- Protection measures and access restrictions to areas of existing and advance planting throughout the contract duration.
- Use of plant species appropriate to the area and site conditions.
- Hydroseeding and whip tree planting as the minimum soft landscape treatment to all slopes.

7.5 Further Tasks

In addition to the above guidelines, it is recommended that the following tasks are carried out in a co-ordinated manner to ensure proper consideration of landscape issues during the design development :

- Preparation of detail topographical survey and record of existing conditions.
- Full detail design of proposed roads and associated structures and slope works for approval by relevant Government departments.
- Clear definition of site boundary, cut and fill requirements and restrictions of access, working area and storage facilities.
- Preparation of Master Landscape plan including hardworks and softworks elements.

7.6 Conclusion

The construction phase of the road will undoubtably be of greater visual intrusion than operation of the completed road. Mitigation measures and the sensitive design of the road and its related structures will help to reduce the visual impact but cannot disguise the fact that the majority of the site is to undergo a significant change from being a green hillside backdrop to the town of Tsuen Wan to a visually dominant traffic corridor.

Accordingly, full detail proposals for the scheme must be prepared before the visual impact can be fully appreciated and accurately assessed. It is recommended that such proposals are developed incorporating the landscape guidelines set out above.

8 ECOLOGY

8.1 Key Issues

Key issues during construction will be noise, dust and temporary loss of habitat. Key issues during operation will be noise, air emissions and permanent loss of habitat.

Factors determining the implications of such impacts will be:

- the location, number and sensitivity of receivers and their compatibility with construction and operational impacts;
- extent of temporary and permanent landtake; and
- cost-effectiveness of mitigation measures in reducing ecological incompatibility.

8.2 Legislation and Guidelines

Flora and fauna of Hong Kong are protected by local ordinances including the Forests and Countryside Ordinance (CAP 96), the Animals and Plants (Protection of Endangered Species) Ordinance (CAP 187), the Forestry Regulations (CAP 96), and the Wild Animals Protection Ordinance (CAP 170).

All birds and their nests and eggs are protected under the Wild Animals Protection Ordinance (CAP 170). Possession, disturbance, or destruction of birds, nests, or eggs may be recorded on the site, and a permit required.

Other fauna protected under the Wild Animals Protection Ordinance was not recorded on the site, therefore, special permission for disturbance will not be required.

The Forests and Countryside Ordinance protects trees on Crown land, and the Animals and Plants Ordinance lists protected plant species. Authorization may be required for removal of trees on an Crown land in the proposed project works area. There were not protected plants recorded on the study area.

Guidelines for landscape and conservation are listed in the Hong Kong Planning Standards & Guidelines, Chapter 10. The issues of minimizing Impact of projects in the urban landscape through attention to vegetation, landscape framework, functionally of design, and conservation of landscape and cultural features are addressed. These issues are considered in this assessment and in the proposed mitigation plans.

8.3 Baseline Conditions and Identification of Receivers

The general study area is described in Section 2.1 of this report. Ecological resources within the proposed works limits of the project have resulted from previous disturbances in the form of agricultural, commercial, or infrastructural developments. Much of the study area consists of existing transport corridors and revegetated slopes along them, residences and intervening agricultural plots, and industrial buildings. Due to this high level of disturbance ecological resources are limited in diversity and abundance. They are typical of urban settings in Hong Kong where human populations are dense and disturbances to nature are frequent and intense.

Surveys of the site were conducted on 7 and 24 October 1993 to record flora and fauna of special conservation interest, and to note features of the landform which provided sites useful to wildlife such as nest sites, perches, roost sites, or burrows and dens.

The portion of the works area which contained most of the remaining wild plants and animals was the area from the Tsuen Kam Interchange west to the MTR crossing. This area was predominantly on a slope of southerly aspect containing 2 small villages, a China Light & Power (CLP) site office, a former highway construction site office, and the Tsuen Kam Interchange with several Highway Department buildings in the centre of the roundabout. The area measured roughly 100m from north to south, and 900m from east to west, covering approximately 9 hectares. A view from the nearby Tsuen Wan Government Building is shown as Figure 8.1.

Available habitats were terrestrial except for small, channeled waterways which carried surface drainage flows and some sewage. No standing water was available on the site.

The nature conservation area nearest to the study area was Tai Mo Shan Country Park, roughly 0.7km to the north. There were no Sites of Special Scientific Interest or Special Areas on the study area.

Previous disturbances to the landform of the site included construction works for Route Twist, for the MTR line and station, and for the Tsuen Kam Interchange and associated roads. Each of these required substantial landform changes resulting in slope formation and subsequent revegetation. Other historic disturbances which altered the landform to a lesser degree, but which affected local ecology, were settlement of the villages and use of the surrounding areas for agriculture. Few remaining agricultural plots were seen on the site, and the only form of agriculture was banana and fruit horticulture. Although bamboo occurred on the site, there was no evidence of current harvest.

No construction or development projects were in progress on the area at the time of the ecological survey. The principal sources of impact were pedestrian, vehicle, and train traffic together with large numbers of domestic dogs and cats. Vehicle traffic was limited to the periphery of the site by roadway locations. It consisted mainly of personal vehicles associated with the villages. However, pedestrian traffic across the site was at a steady and high volume, particularly nearest the MTR station. From the Tsuen Kam Interchange to the CLP site office no pedestrian or vehicle traffic was observed, the area being closed as a former construction works site.

8.3.1 Flora

Vegetation of the above site was characterized by plants typical of revegetated or agricultural areas in the New Territories. A habitat map of the site is shown as Figure 8.2.

The predominant tree species were *Acacia confusa* and *Bauhinia* spp. which had been used to revegetate sites disturbed by earthworks related to the above listed transport construction projects. Other tree species recorded on the site are listed in Table 8.1 below. All recorded species were common or introduced to Hong Kong. No species protected by Hong Kong regulation or international convention were recorded.

In the eastern portion of the works area near the Tsuen Kam Interchange the vegetation was entirely the result of revegetation projects which followed completion of the highway project. Overstory vegetation was dominated by *Acacia confusa*, *Melaleuca leucodendron*, *Bauhinia* spp., and an occasional *Bombax malabaricum*. Although the species richness of these stands was low, vegetative cover along the periphery of the site was good. The central portion of the site was presumably not reseeded, but was left to revegetate naturally. Therefore, grasses and low shrubs or small *Acacia* spp. trees dominated.

In the village areas the predominant trees were *Ficus elastica* and *Bauhinia* spp. together with bamboo. There was no woodland that would meet the typical Hong Kong criteria for fung shui woodland, as the number and composition of tree species in the few wooded areas near villages was not representative of fung shui woods. The wooded area nearest the westernmost village was largely horticultural, and the woodland near the central village was dominated by *Ficus* spp. Neither woodland was positioned behind the village as would be a fung shui woodland.

Between the two villages was a roughly 0.6ha banana plantation. Other horticultural plants were *Citrus* spp.

In areas not dominated by tree cover the primary vegetation was grass, low shrub, and climbers which had overgrown former agricultural plots or disturbance sites.

Table 8.1 Tree species recorded on the proposed Route 5 works area.

Acacia confusa	*Euphoria longan*
Acacia decurrens	*Ficus elastica*
Antidesma bunius	*Ficus hispida*
Bamboo	*Ficus microcarpa*
Bauhinia blakeana	*Ficus rumphii*
Bauhinia variegata	*Leucaena leucocephala*
Bauhinia purpurea	*Litchi chinensis*
Bombax malabaricum	*Macaranga tanarius*
Cassia spp.	*Melaleuca leucadendron*
Casuarina spp.	*Musa paradisiaca*
Citrus grandis	*Phyllanthus emblica*

8.3.2 Fauna

The area was characterized by a paucity of fauna. No mammals or indications of mammal use were recorded on the site. The large number of free ranging domestic dogs and cats would make use of the site by other terrestrial mammals very unlikely. There is also abundant, relatively undisturbed habitat immediately north of the study area which would be more attractive to mammals.

Bird surveys were conducted during October only, which precluded recording many bird species which use the site seasonally but are absent in autumn. Because of the small size of the proposed works area, the limited diversity of available habitats, and the highly disturbed nature of the site, it is considered that the site is not of primary importance to Hong Kong bird life. However, the following observations were employed in this assessment.

Bird life was limited to those species which are most common near New Territories villages. These included species such as the spotted dove, swallow, black drongo, Chinese and crested bulbuls, magpie robins, crested mynah, black-faced laughing thrushes, white eyes, yellow-bellied wren warbler, fork-tailed sunbirds, greater coucals, great tits, and tree sparrows.

Because most of the overstory vegetation was relatively young, no tree nest sites or roost sites were recorded. No tree cavities were observed which could provide potential nest sites for owls or other cavity nesting birds. Some tree species recorded on site (*Ficus microcarpa*, *Macaranga tanarius*) are known to provide forage for frugivorous birds (Corlett 1992), therefore use of the site by such birds may increase beginning in November and December.

Because there was no standing water or natural stream channel on the works area, habitat for amphibians, reptiles, and fish or other aquatic species was limited. None of these species was recorded during the field surveys.

8.4 Construction Phase

8.4.1 Flora

Flora within the works area will be lost due to disturbance of the site during the construction phase. From an ecological perspective this loss is not significant, as the flora consists primarily of introduced or cultivated species.

It is possible that some of the existing stands of common or introduced trees could be preserved around the periphery of the works boundary. This could occur along the southern limit of the works area roughly from the MTR station eastward to the Tsuen Kam Interchange. Retention of these trees would not be particularly important from an ecological perspective, but would provide a useful visual barrier to the construction works and to the finished highway. Retention of screening vegetation would accelerate the post-construction restoration process.

Some forest habitats north of Route Twisk have higher floristic diversity and a greater percentage of native species than do habitats within the works limits. Woodlands north of Route Twisk may be at some risk of adverse impacts from construction dust transported by wind from the works area. Because this area also contains some private residences, it will be important to ensure that dust does not become a problem. This issue is addressed in the mitigation plan below.

8.4.2 Fauna

The project site is not characterized by abundant or diverse wildlife resources. It is small in extent, and surrounded by man-made barriers to wildlife movements. In addition, presence of villagers, domestic dogs and cats, and construction works preclude intensive use of the area by wildlife of particular conservation importance.

It is expected that birds may be somewhat adversely affected due to temporary loss of habitat. However, due to the high incidence of introduced plant species on the site and the near absence of habitats which are protected from disturbance by humans or domestic animals, it is anticipated that overall impacts on birds will be minimal. It may be possible to enhance bird foraging habitats on the post-construction project site through use of appropriate tree and shrub species in the revegetation plan. This is discussed below under mitigation.

All birds, their nests, and nest contents are protected by Hong Kong regulation, and may not be disturbed without a permit issued by the Agriculture and Fisheries Department. Therefore, a pre-construction survey should be conducted to ensure that proper permitting procedures are followed in the event that a nest site is located within the disturbance area.

8.5 Operational Phase

8.5.1 Flora

The operational phase is expected to affect only plants used in revegetation of disturbed sites, as all existing plants will likely be removed. The proposed roadway occupies the centre of the works area, so revegetation plantings will be distributed around the periphery of the site. It is expected that the revegetated areas will be no more adversely affected by operation of the highway than are other roadside planting projects throughout Hong Kong. Therefore, the operational impacts of the roadway on flora are considered to be minimal.

8.5.2 Fauna

As discussed above, the project site is not characterized by abundant or diverse wildlife resources and so the operational impacts of the roadway on fauna are considered to be minimal.

8.6 Mitigation

The baseline ecological condition on the project site is not of conservation importance in a Territory-wide or regional context. However, the revegetation plantings which followed previous works projects were quite successful in terms of establishment of vegetative cover. These plantings combined with existing village woodlands and horticultural sites to produce a green belt and visual screen between transport corridors.

Although this belt of vegetation will be lost during the construction phase, the loss presents an opportunity to replace the largely exotic and decorative baseline plant communities with native species which are of documented value to wildlife. This could result in a net ecological gain from the project. Examples of tree, shrub, and climber species which provide forage for frugivorous birds are listed by Corlett (1992). At least one of the listed species (Rhodomyrtus tomentosa) also provides forage for frugivorous mammals in Hong Kong. Plant species for use in revegetation should be selected from this list (See Table 8.2 below).

Impacts of fugitive dust on habitats to the north of the project site should be minimized through standard works practices such as watering of haul roads, washing of haul trucks, covering of material stockpiles, and covering loads of hauled material.

Table 8.2. Native plants attractive to frugivorous birds in Hong Kong. BIRDS = number of bird species known to eat the fruit (adapted from Corlett 1992)

SPECIES	HABIT	BIRDS
Aralia chinensis	small tree	3
Berchemia racemosa	climber	3
Bridelia tomentosa	small tree	4
Cassytha filiformis	parasite	3
Celtis sinensis	tree	2
Cinnamomum camphora	large tree	5
Diospyros morrisiana	tree	2
Elaeocarpus sylvestris	tree	2
Eurya chinensis	shrub	17
Eurya japonica	shrub	5
Evodia lepta	small tree	14
Evodia meliaefolia	tree	4
Ficus microcarpa	tree	3
Ficus superba	tree	3
Ficus virens	tree	5
Ilex pubescens	shrub	4
Litsea rotundifolia	shrub	8
Macaranga tanarius	tree	5
Machilus breviflora	tree	1
Machilus oreophila	tree	2
Machilus thunbergii	tree	2
Machilus velutina	tree	1
Maesa perlarius	shrub	2
Mallotus paniculatus	small tree	3
Melastoma candidum	shrub	4
Melastoma sanguineum	shrub	8
Microcos paniculata	small tree	5
Morinda umbellata	climber	3
Paederia scandens	climber	4
Psychotria rubra	shrub	8
Psychotria serpens	climber	7
Rhaphiolepis indica	shrub	2
Rhodomyrtus tomentosa	shrub	6
Rhus chinensis	small tree	8
Rhus hypoleuca	small tree	5
Sapium discolor	tree	12
Sapium sebiferum	tree	3
Schefflera octophylla	tree	7
Scolopia saeva	tree	2
Sterculia lanceolata	tree	4

8.7 Post Project Audit

Success of revegetation should be monitored following completion of the project. Areas where soil has eroded should immediately be restored. To prevent continued soil loss though erosion such sites should be covered with erosion control matting.

Trees and shrubs which do not survive should be replaced by new plantings to ensure rapid development of a complete vegetative cover on disturbed sites.

8.8 Conclusions

Because no vegetation or fauna of conservation significance was recorded on the proposed disturbance site, the consequences of the construction and operation phases of the project in terms of Hong Kong's overall botanical or ecological resources are minimal. Potential impacts from the project are not considered to result in potential net losses of ecological resources. Through proper selection of species for revegetation and by removal of villages and domestic animals it may be possible to construct a post-construction landscape which exceeds the baseline condition in terms of ecological utility. Therefore, there are seen to be no residual adverse impacts from the proposed development.

References cited

Corlett, R.T. 1992. Plants attractive to frugivorous birds in Hong Kong. Mem. H.K. Nat. Hist. Soc. 19: 115-116.

9. PRELIMINARY DESIGN PROPOSALS AND COST ESTIMATES

9.1 General

Section 4 of this Report has recommended noise mitigation protection to affected dwellings. This section present of the report deals with the design and construction of the recommended barriers and enclosures. Interface problems are identified and solutions discussed. In addition budget estimates for the various noise mitigation elements are provided. Details of the barrier and enclosure layouts are given on Figures 9.1, 9.2 and 9.3, construction details are shown on Figures 9.4 to 9.14 and elevations are shown on Figure 9.15.

The noise enclosure at China Dyeing Works will be built by the developer, and will therefore be designed as an integral part of that scheme. This section does not therefore address the design and construction of the enclosure but details are included for Barrier "N", to the west of the China Dyeing Works Redevelopment, which will be built by Highways Department.

The main area where the proposed mitigation measures are located is at the Tsuen Kam Interchange, at the east end of the site, where free-standing barriers and semi enclosures are provided to both Route 5 and its slip roads. On a smaller scale, a semi enclosure and barrier are also provided at the west end of the site to the west of Sha Tsui Road.

The primary objective governing the design of the mitigation measures, but particularly cladding panels, is that a 20 dB(A) minimum reduction in noise level must be achieved. The choice of cladding material to meet this criteria is discussed below. In addition, the designs should satisfy economic, aesthetic, safety and maintenance requirements which are also discussed in detail below.

The preliminary designs presented herein are based on the following criteria:-

(a) Form

The enclosures proposed will take the following form:-

(i) framework - Structural steel columns and beams at 7.5m centres. Columns clad with concrete, beams painted with intumescent paint. Secondary members including bracing and subframes for vision panels will be of structural steel.

(ii) roof panels will be wood fibre concrete; and

(iii) roof lights and side vision panels will be acrylic sheet.

The form of the barriers will, in general, be vertically cantilevering structural steel columns supporting horizontally spanning acoustic panels. There are many types of panel which could be used, however for the purposes of this report wood fibre concrete panels have been assumed.

Where vision panels are required to provide necessary sight lines, acrylic sheet panels are proposed.

(b) geometry

The geometry of the enclosures will be governed by:

(i) headroom and width: to suit carriageway widths or width of elevated road parapets. These will also need to be agreed with Fire Services Department;
(ii) sight lines taking into account Transport Department's requirements and road clearances according to Highways Department standards.

It is assumed that enclosures would be free spanning over carriageways, being supported only at the back of kerb lines, on elevated road parapets and from central reservations.

(c) loading

The structural framework of the enclosures and barriers will have to resist gravity and wind loads. It is anticipated that the piston effect from vehicles moving through enclosures will be negligible, particulary in view of the fact that one side will be open. The columns of the noise mitigation structures will be protected by barriers where space is available but collision loads should also be allowed for in the design of the structures. In accordance with standard highway structures design practice in Hong Kong an allowance for forces generated by earthquake will have to be considered.

(d) design codes and statutory requirements

Noise mitigation structures, including enclosures and barriers, should be designed in accordance with the general requirements stipulated in the Structures Design Manual for Highways and Railways. The Fire Resistance Period (FRP) is an important criteria for design and Fire Services Department have advised that a 2 hour period should be used.

(e) foundations

Within the scope of this report it is not possible to fully study foundation requirements, particularly in the absence of any site investigation. It has therefore been assumed that the enclosures will be piled and barriers can be supported on simple pad or strip footing foundations. It is expected that the foundation design will be constrained by major existing underground services such as the multi-cell box culvert along Route 5 at Tsuen Kam Interchange, the 1.2m diameter trunk water main along Castle Peak Road and other utilities. The budget costs given in Section 9.4 reflect these assumptions.

(f) materials and acoustic properties

The primary materials assumed to provide acoustic insulation are wood fibre concrete panels and acrylic vision panels. Coustone tiles are proposed for Barrier 'P' where an absorbent panel is required. Other materials could be used, subject to the requirements of the detail structural design and the final choice will be made by competitive tendering. Panels may be either absorptive or reflective and an acoustic specification for each type is given below.

(i) Absorptive Acoustic Panels

Transmission Loss

The minimum average allowable transmission loss (TL) for the panel, including all components, when tested in accordance with ASTM E90 or other equivalent testing methods with centre octave band frequencies 125Hz, 250Hz, 500Hz, 1KHz, 4KHz and 8KHz shall be 32 dB and the minimum allowable TL at 125Hz octave band shall be 22 dB and at 1KHz shall be 30dB.

Absorptive Coefficient

The composite panel assembly when tested in accordance with ASTM C423 or other equivalent testing method with centre band frequencies 125Hz, 250Hz, 500Hz, 1KHz, 2KHz, 4KHz and 8KHz, shall have an average minimum absorptive coefficient of 0.65 and the minimum allowable absorptive coefficient at 125Hz octave band shall be 0.2.

Resonant Vibration Frequency

The composite panel assembly when subjected to an impact vibration test shall not be resonant at frequencies of 125Hz and 1KHz octave bands.

(ii) Reflective Acoustic Panels

Transmission Loss

The minimum average allowable transmission loss (TL) for the panel, including all components, when tested in accordance with ASTM E90 or other equivalent testing method with centre octave band frequencies 125Hz, 500Hz, 1KHz, 2KHz and 8KHz shall be 32 dB and the minimum allowable TL at 125Hz octave band shall be 22dB and at 1KHz shall be 30dB.

Resonant Vibration Frequency

The composite panel assembly when subjected to an impact vibration test shall not be resonant at frequencies of 125Hz and 1KHz octave bands.

The three panel material types are described below.

(iii) Wood Fibre Concrete

Wood fibre concrete is a well proven and economic material which has been used extensively as roadside noise barriers in both America, Canada and Europe. The panels are a combination of wood fibre and a concrete matrix which combine to give a panel lighter in weight than normal concrete. Panels can be reinforced to give added strength and have proven to be extremely robust and durable over the past 20 years. They can be supplied in a range of thickness enabling spans up to 4.0m to be achieved. The panels are acoustically absorbent.

This type of product can be used as primary cladding alone for barriers although it has no architectural merit and cannot be manufactured to a curved profile. If used, it is therefore recommended that a coloured pigmentation is used in the mix or the panel is profiled to break up its bland appearance, or provided with a decorative concrete skin fascia.

The fire rating of the wood fibre concrete depends mainly on its thickness where ½hr, 1hr, 2hr, 2½hr and 4hr are available. Results of ignitability test, fire propagation test and surface spread of flame to BS476 are available from the manufacturers.

(iv) Coustone Tiles

Coustone tiles are rigid load bearing units 28mm thick manufactured from flint particles. They have good sound absorption characteristics because of pre-determined air cavities. It is a tough and durable product which can be decorative in nature due to its pumice like texture. The tiles can be coloured and curved as required and can also incorporate relief details if needed. The tiles measure 500mm x 500mm and can be predrilled for bolting or screwing to support purlins. This product has been assumed for Barrier 'P' and the costs given in Section 9.4 reflect this.

(v) Vision Panels

For the roof lights and vision panels a number of materials could be used, these include acrylic, polycarbonate, and safety glass. The relative merits of these materials are summarised in Table 9.1. On balance, acrylic normally provides the most suitable and economic material and this has been assumed. Of particular relevance to reaching this conclusion is the resistance of acrylic to UV degradation. Whilst polycarbonate can be coated to reduce its susceptibility, it is almost certain that this coating would be damaged during cleaning and maintenance and thus the life of the panels would be reduced. This is reflected in the "guaranteed life" quoted by suppliers.

In order to minimize the intrusion of passing traffic on adjacent properties and reduce the visible effects of the build up of dirt, a dense pigment could be used in the fabrication of the bottom panels to render the material semi-translucent.

Table 9.1 Relative Properties of Vision Panel Materials

Material	Acrylic	Polycarbonate	Safety Glass
Thickness to give 20 dB(A) reduction Specific gravity	1.2	1.2	2.5
Impact resistance	medium	high	low
Fire resistance	satisfactory with retarder	satisfactory	good
UV resistance	good	poor (needs surface coating)	good
Relative cost	1.0	1.05-1.2	1.0-1.15
Manufacture's guaranteed life	10 yrs	5 yrs	5 yrs

(g) services

Street lighting should be provided in all enclosures to Highways Department standards and lamps will be soffit mounted. For the China Dyeing Works enclosure it would be expected that a night and day system will be needed, as an integral part of the lighting system for the tunnel through the development podium. Traffic signs and signals would have to be provided, as appropriate, suspended from the enclosure roof structure.

A water supply system may be necessary for fire fighting and will be necessary for cleaning purposes as discussed in more detail in paragraphs (h) and (i).

Roof drainage will be into channels formed adjacent to the roof edge. This will in turn discharge into internal down pipes, which will be located adjacent to the roof support columns. All drains will discharge into the highway drainage system.

(h) fire provisions

The provision of fire fighting equipment and associated alarm and electrical and mechanical equipment has been discussed with Fire Services Department who have confirmed that they will require a Fireman's Radio Communication System in semi-enclosures to ensure continuity of communication for mobile units passing through the semi-enclosure, and emergency crossings. However, it is nonetheless considered that there is a possibility of vehicle fires occurring and whilst these semi-enclosures are not tunnels, it is proposed that they should comply in some respects with the "Code of Practice for Minimum Fire Service Installations and Equipment, Section 9.2 Road Tunnels." These requirements are listed in Table 9.2 together with proposed provisions. In addition the constraints imposed by the noise barriers and enclosures will mean that additional crossings and fire hydrants will be required along the whole of this section of Route 5.

Table 9.2 Proposed Provisions for the Enclosures

Code of practice requirements	Proposed provisions
Automatic fixed installation other than water	No reason to treat use of water as undesirable hence no provision proposed.
Closed circuit television system	Maximum semi-enclosure length is 230m but has one side open and vision panels on the other, hence no provision proposed.
Dynamic smoke extraction systems	Semi-enclosures do not exceed 230m in length therefore not required.
Emergency generators	No essential electrical services, hence no provision proposed.
Emergency lighting	Maximum semi-enclosure length is 230m but has one side open and vision panels on the other, hence no provision proposed.
Fire alarm systems	No provision proposed.
Fire control centre	Semi-enclosures are short, hence no provision proposed.
Fire hydrant/hose reel systems	Proposed provision of hydrants should be to suit maximum FSD hose reel length of 30m.
Fireman's communication system	Proposed allowance for telephones at hydrant positions and other measures considered necessary by FSD to ensure non-impairment of the Fireman's Radio Communication System.
Gas detection system	Semi-open structures hence no provision proposed.
Pedestrian cross over facilities	No centre wall between carriageways, hence no provision proposed.
Portable hand-operated approved appliances	No provision proposed.
Smoke/gas extraction system	Semi-enclosure 230m, maximum hence no provision proposed.
Traffic control signs proposed	No special provision.
Emergency crossings	The barriers have been designed such that emergency crossings can be provided where required.

(i) maintenance

Cleaning particularly of vision panels, and routine inspection of the semi-enclosures and barriers will be required. For barriers at grade, this can be accomplished from the footway or from the adjacent carriageway during off-peak traffic flow periods. For barriers on elevated structures access may be possible from below but it is recommended that a lorry mounted hydraulic inspection cradle (used for replacing street lamps) is used during off peak hours.

For the semi-enclosures, similar means of access could be used as previously described although for roof access it is recommended that external access ladders are provided, but these will have to be made secure to prevent unauthorised access.

General cleansing of vision panels and exposed steelwork elements could be carried out using a water jet operating from a small mobile pump unit connected to water points along the road. If necessary these points could serve a dual purpose as cleansing and fire fighting points.

9.2 Barriers

Noise barriers must be built close to the road in order for them to be most effective, but this can cause problems with sight lines on curves. Vision panels have been suggested for barriers which suffer from this disadvantage although provision of the vision panel does not completely solve the problem since vision panels need frames and the barriers need vertical column supports. When the column supports result in the sight line standards not being achieved a more complicated structure with fewer columns must be used.

Barrier B

Barrier B consists of 70m of 4.0m high vertical barrier located on the east side of the Tsuen Kam Interchange on the boundary of Shek Wai Kok Estate as shown on Figure 9.1. Details of the barrier are shown on Figure 9.5. In this location the footway is relatively narrow and access has to be maintained into the estate for Fire Services Department and for pedestrians using the interchange subway. It is therefore proposed that the barrier is mounted on a California Barrier styled plinth, located on the kerbline, which must incorporate an Fire Services Department access gap, but would allow pedestrian access to the subway at the rear of the barrier. Clearly the footway width will be compromised but this cannot be avoided. Utilities and drainage within the footway should be diverted with diversions required to build the remainder of the project.

Superstructure construction will be as outlined in paragraph 9.1. Criteria for visibility for motorists approaching a roundabout, as given in Transport Planning and Design Manual Volume 2, have been studied and the details are plotted on Figure 9.16. From the Figure it can be seen that forward visibility and visibility to the right criteria are maintained for motorists using the inside lane of the up ramp from Route 5. However, although Transport Department guidelines are met, it is recommended that vision panels are used throughout in this location to further improve visibility, refer Figure 9.16.

Barrier C

Barrier C consists of 125m of 6m high curved barrier located on the south side of Route 5 in the centre of the Tsuen Kam Interchange as shown on Figure 9.1. Details of the barrier are shown on Figure 9.6 which also shows the proposed position of the barrier in relation to the new carriageway. The typical section depicted on the Figure shows the maximum height of this barrier, but this will vary since in this location it will be necessary for the barrier to mount the interchange embankments. Alternatively, the barriers could be mounted on top of the underpass abutment walls. Foundation and superstructure construction details would be as outlined in Section 9.1. The DN250 fresh water main and DN200 salt water main can be accommodated by placing/designing the footings so they do not encroach on the mains.

Barrier D

Barrier D consists of 220m of 4.0m high vertical barrier located on the west bound slip road from the Tsuen Kam Interchange joining Route 5, as shown on Figure 9.1. Approximately 70m of the barrier will be on embankment, the remainder being on elevated structure. Details of the barriers are shown on Figures 9.5 and 9.6. For the embankment section a continuous R.C. footing has been proposed, although geotechnical criteria may dictate that deep individual foundations should be used. Where a continuous footing is adopted, it is suggested that the Armco barrier is mounted on the footing as shown on the Figure. On the elevated structure the structural steel columns will be bolted to the parapet as shown on the Figure. It should be noted that loads from the barrier should be taken into account in the design of the elevated structure. Sight distances for vehicles exiting the roundabout should be maintained by providing vision panels for the first 25m of the barrier, refer Figure 9.16.

Barrier H

Barrier H consists of 105m of 5.0m high vertical barrier located on the south side of Route 5 directly to the West of the Tsuen Kam Interchange as shown on Figure 9.1. Details of the barrier are similar to those for Barrier 'C' as shown on Figure 9.6. This barrier will need to continue below the interchange slip road to join semi-enclosure 3. The barrier will be located on top of the major drainage culvert which follows the Route 5 alignment but the barrier foundation design will be such that the structural integrity of the culvert will not be impaired. An agreement has also been reached between the maintenance division of Highways Department and DSD for the former to undertake to remove the noise barrier for non-routine box culvert maintenance purposed.

Barrier J

Barrier J consists of 180m of 5.0m high vertical barrier located on the north side of the Tsuen Kam Interchange as shown on Figures 9.1 and 9.4. Access will need to be maintained to the pedestrian subway passing under the north side of the interchange and therefore construction details should be as previously described for Barrier B. Referring to Figure 9.16 visibility for motorists entering the interchange from Route Twisk will not meet Transport Department's standard, therefore it is recommended that vision panels are used in this location, refer Figure 9.16. The DN150 salt water main can be accommodated by suitable measures such as locating the footings away from the main or designing the footings so they do not encroach on the main.

Barrier L

Barrier L consist of 120m of 3m high vertical barrier located on the elevated structure of the westbound slip road at the west end of Route 5 at the junction with the Tuen Mun Road as shown on Figure 9.3. Since this barrier will be structure mounted, construction details will be similar to those described for Barrier D as depicted on Figure 9.5.

Barrier N

Barrier N consists of 120m of 4m high vertical barrier mounted on the north side of the elevated road directly to the west of the China Dyeing Works Redevelopment, as shown on Figure 9.2. Construction details are identical to Barrier 'D', as described above and as depicted on Figure 9.5.

Barrier O

Barrier O consists of 100m of 6.25m high curved barrier located on the south side of the Tsuen Kam Interchange along Tai Po Road North, as shown on Figure 9.1. The barrier will be positioned at the kerbside for acoustic reasons, but also to mitigate against construction difficulties at the crest of the slope down to the MTRC Depot. Construction details will be as previously described for Barrier B, except that to aid visibility for motorists joining the interchange from Wai Tsuen Road, it is proposed that vision panels are provided for the reasons given for Barrier B, refer Figure 9.16.

Barrier P

Barrier P consists of 200m of 4.0m high vertical absorptive barrier situated at the crest of the cut slope on the south side of Route Twisk on the west side of the Tsuen Kam Interchange as shown on Figure 9.1. Details of the barrier are shown on Figure 9.5. Apart from the construction restrictions of the new cut slope the presence of a 300mm diameter gas main below the southern footway of Route Twisk will necessitate careful construction techniques to minimise potential disruption to the main. The foundation proposed is therefore an individual 500mm diameter deep footing which could be excavated by hand augering techniques.

The superstructure construction will be as outlined in Section 9.1, but the absorptive panels required are assumed to be "Coustone" panels, these having been described in that Section. These panels will be fixed to horizontal purlins and therefore additional steelwork costs are involved. In addition, the details shown on Figure 9.5 and the costs provided reflect the provision of steel sheet cladding to the back of the barrier as an aesthetic measure.

Barrier M (Nan Fung Comprehensive Development)

Barrier M consists of 300m of 5.0m high vertical absorptive barrier located on the north side of the Tuen Mun Road south of the Nan Fung Comprehensive Development. Its function is to protect the noise sensitive receivers in the Nan Fung Comprehensive Development. Its location is shown in Figures 4.6 and 9.3. This barrier will be designed and constructed by the developer and the cost is not included in this Report.

The footings for the barrier can be designed so as not to impinge on the 48 inch water main and the footings can be located to avoid the DN914 main.

9.3 Semi-enclosures

Semi-enclosures 3 and 4

Semi-enclosures 3 and 4 are located over Route 5 on the west side of the Tsuen Kam Interchange, extending from the westbound slip road overbridge for a total length of 230m, as shown on Figure 9.1. The semi-enclosures straddle both east and westbound carriageways and are open on their northern faces. Semi-enclosure 3 spans four lanes, two in each direction, whilst semi-enclosure 4 spans six then eight lanes. In this area both semi-enclosures form part of new road work and therefore there are no complications associated with maintaining existing traffic flow. Construction details for the semi-enclosures are shown on Figures 9.7, 9.8, 9.12 and 9.13, which follow the general design/construction proposals given in Section 9.1.

In this area the semi-enclosures bridge merging carriageways resulting in relatively long spans. In order to reduce dead load, structural steel has been proposed for all columns, beams and secondary members. It is considered prudent to clad all columns in concrete, but in order to avoid cladding or concrete formwork to roof structure intumescent paint is proposed for fire protection.

Whilst it is appreciated that central columns located in the carriageway divide will necessitate an increase in the width of the divide with a consequential shift in the position of the road it is considered that financially this would be preferable to providing a much more expensive long span roof structure. The sight distances have been checked assuming central columns and a 70 km/h design speed and slight modifications to the design are required as follows:

Semi-enclosure 3

(i) East-bound carriageway main route verge

To achieve the Transport Department's "Desirable Minimum Visibility" (DMV), of 125m, the clearance required between the edge of the obstruction and the carriageway is circa 2.0m. This should be possible by widening within the verge.

(ii) West-bound carriageway main route central reserve

To achieve the same DMV in this case, the clearance between the obstruction and the edge of the carriageway is also circa 2.0m. It should be possible to accommodate this by local widening of the hard strip, and hence the overall carriageway width.

Semi-enclosure 4

(i) East-bound carriageway strip road verge

The DMV of 125m requires circa 1.5m clearance between the obstruction and the carriageway. This should be possible by widening within the hard strip/verge.

The semi-enclosure will abut the flyover of the westbound slip road from the Interchange and thus consideration will have to be given in the detail design stage to the provision of a matching acoustically sealed structure if possible. Because of the skew flyover crossing, angled main frames will have to be provided in this area.

Semi-enclosure 7

Semi-enclosure 7 is located on the east bound carriageway of Route 5 directly to the west of, and abutting the Sha Tsui Road flyover, as shown on Figure 9.3. The semi-enclosure is 80m long, at its widest point it spans four lanes, and is open on its south side. Construction details are shown on Figure 9.10, and the construction philosophy follows that outlined for semi-enclosures 3 and 4. The semi-enclosure straddles an area of the project where both new roadworks and upgrading of existing roads will take place. As a result, the construction details adopted will allow the contractor to take a flexible approach to planning his work. Foundations and piling work will need to be carefully coordinated with necessary utility diversion and installation work. A new retaining wall is to be constructed on the north side of the semi-enclosure by PM/NTW and it is proposed that the wall forms an integral part of the semi-enclosure foundation. This approach will be much more cost effective than a complex engineering solution involving, for example, a cable stayed enclosure. The semi-

enclosure will join the Sha Tsui Road flyover and thus any joints necessary will have to be acoustically sealed.

With regard to the east-bound carriageway central reserve visibility is restricted but the Absolute Minimum Visibility of 95m can be achieved by moving the east-bound carriageway north-wards about 2.0m and increasing the height of the retaining wall.

Semi-enclosure 8

Semi-enclosure 8 is located on the east bound slip road from Route 5 up to the Tsuen Kam Interchange, as shown on Figure 9.1. Semi-enclosure 8 is 210m long and is open on its north elevation. Construction details are shown on Figures 9.7 and 9.4 and the general philosophy follows that outlined for semi-enclosures 3 and 4. As with semi-enclosures 3 and 4 the semi-enclosure forms part of new work.

Close to the junction with the interchange, the slip road passes close to an existing retaining wall, it is therefore recommended that a cantilever foundation is provided in this position to avoid affecting the existing wall. It is anticipated that the enclosure could abut the wall in which case the acoustic panels could stop at the top of the wall.

For a design speed of 50km/h on this part of the road, it is not possible to achieve the Transport Department's "Desirable Minimum Visibility" of 70m, in the direction of the junction with the roundabout. The difficulty can not be easily overcome by widening the road because of restrictions by the retaining wall to the north and the other slip-road to the south. However, it is possible to move the junction circa 8m further east (as indicated by the broken line in Figure 9.1) and still retain the same basic geometry to comply with Transport Department standards.

Semi-enclosures 10 and 11

Semi-enclosures 10 and 11 are located on the westbound and eastbound two lane slip roads from/to Route 5 or the east side of the Tsuen Kam Interchange as shown on Figure 9.1. Semi-enclosure 10 is 120m long and semi-enclosure 11 is 90m long, both are open on the elevations facing Route 5. Construction details are shown on Figures 9.9, 9.11 and 9.14, and the general philosophy follows that outlined for semi-enclosures 3 and 4, although in this location both slip roads are existing and will be operational during the course of the work. The proposals given therefore reflect the need for partial road/lane closures. In addition, in order to avoid disturbance of the existing retaining walls flanking Route 5, piled balanced cantilever foundations are proposed.

During the detail design process existing utilities and road drainage must be investigated and where necessary the proposed foundations adjusted to suit, or diversion work agreed. In this respect, it should be noted that:

(i) the proposed semi-enclosures are in close proximity to a four-cell box culvert which lies beneath the main carriageway (Figures 9.17, 9.18 and 9.19), and the columns would be located above the culvert in 4 to 6 places. However, this culvert will have been designed to take the far more onerous traffic loadings. Therefore, the columns, with their footings to spread the weight, should not be of any practical significance.

(ii) three groupings of culvert access points have been identified from the "as-constructed" drawings of the culvert, but none of these are in the vicinity of the proposed semi-enclosures.

The eastern limit of the semi-enclosures coincides with the point where the slip roads merge with Route 5, making the provision of columns in this position difficult. It is assumed that the slip road alignment cannot be revised to provide more space for the columns. The end of the semi-enclosure cannot be moved westwards since this would compromise the noise mitigation requirements and result in some properties having to be considered for noise mitigation. Consequently the only option is to span the structures to a series of columns located in the central reservation of Route 5 as shown on Figure 9.9. Roof cladding would only need to extend to the inside kerblines of the slip roads and it is estimated that this wider structure would be required for some 50m.

Foundation construction could be carried out on a lane by lane basis enabling one lane to remain in operation throughout the course of the work. Columns could be erected without disturbance to traffic, and the roof structure could be installed at night during low traffic flows. The installation of roof panelling could be carried out during the day providing sufficient safety measures are in place to protect motorists in the event that a panel falls.

These two semi-enclosures do not appear to present any difficulties with respect to Transport Department's requirements on sightlines.

9.4 Budget Costs

At today's prices and based on the assumptions contained herein, estimated costs for the barriers and semi-enclosures are given in Table 9.3.

The following assumptions have been made in estimating the costs:

1. No demolition/re-instatement of any existing structures is required.

2. Each external and intermediate foundation is supported, respectively, with 3 No. and 2 No. 20m long mini piles of 220mm diameter.

3. Purlins to support the Cloustone panels for Barrier P are of 75mm equal m.s. angles, spaced at 450mm centres.

4. Structural steel of grade 43A.

5. Preliminaries allowance of 15%.

6. Design contingencies allowance of 10%.

Works that are not included in the estimates are:

1. Diversion of utilities etc.
2. Land costs
3. Temporary traffic arrangements
4. Armco barriers
5. Strengthening of supporting structures
6. Mechanical and electrical works
7. Site formation works
8. Re-instatement works
9. Liaison with other contractors
10. Rain water drainage systems

Table 9.3 Estimated costs of the proposed semi-enclosures and barriers for noise mitigation

Semi-enclosure	Length (m)	Cost/m (HK$)	Total Cost (HK$)
3	180	350,133	63,023,940
4	50	481,718	24,085,900
7	80	291,317	23,305,360
8	210	272,968	57,323,280
10	120	272,968	32,756,160
11	90	278,275	25,044,750
Total Cost, all Semi-enclosures =			255,539,390

Barrier Sections	Length (m)	Cost/m (HK$)	Total Cost (HK$)
B: WFCP, 3.35m high VP, 3.35m high	45 25	28,349 29,316	1,275,705 732,900
C: WFCP, 7.2m high	125	43,320	5,415,000
D: WFCP, 3.2m high VP, 3.2m high WFCP, 3.2m high (on embankments)	125 25 70	15,174 16,091 23,820	1,896,750 402,275 1,667,400
H: WFCP, 4.9m high	105	31,796	3,338,580
J: WFCP, 4.3m high VP, 4.3m high	60 40	42,245 38,924	2,534,700 1,556,960
L: WFCP, 2.2m high	120	11,221	1,346,520
N: WFCP, 3.2m high	120	15,174	1,820,880
O: VP, 6.5m high	100	48,247	4,824,700
P: Clustone panels, 4m high	200	68,601	13,720,200
Total Cost, all barriers =			40,532,570

Key : WFCP = Wood fibre concrete panels
VP = Vision panels

Therefore Total Estimated Costs for all Semi-enclosures and all barriers = HK$266 million.

AGREEMENT No. CE 38/92

ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR ROUTE 5 - SECTION BETWEEN SHEK WAI KOK AND CHAI WAN KOK

BRIEF

1. Introduction

This Brief is to be read in conjunction with the Memorandum of Agreement, the General Conditions of Employment for an Investigation Assignment, Special Conditions of Employment (if any) and Schedule of Fees.

2. Description of the Project

2.1 Study Background

Route 5 is the section of the New Territories Circular Road between Shatin and Tsuen Wan. The section of Route 5 between Shek Wai Kok and Shatin was completed and opened to traffic in April 1990. Hong Kong Government now intends to construct the outstanding section of Route 5 between Shek Wai Kok and Chai Wan Kok and requires to engage Consultants to carry out a full environmental impact assessment for the proposed roadworks project.

This extension of Route 5 will pass from Cheung Pei Shan Road through the Tsuen Kam Interchange then westwards at grade, crossing the MTR tracks at Tsuen Wan Station on viaduct near the present China Dyeing Works (CDW) site and descending to join Castle Peak Road at Chai Wan Kok. The planning and design of the route will be carried out in-house by Highways Department.

The leaseholder of the CDW site has applied for permission to redevelop the site and adjoining land as a comprehensive redevelopment area with residential buildings. The section of the Route 5 Flyover within the site will be designed and constructed by the developer who has carried out his own environmental impact assessment which considered, inter-alia, the impact of Route 5 on the development.

2.2 Study Area

The area for this study shall cover broadly the areas between Shek Wai Kok and Chai Wan Kok. The boundaries of the study area are shown on Drawing No. NH20520 at Appendix A of this Brief.

(i) to identify and specify cost-effective mitigatory measures to the ecological, landscape and visual impacts during the construction and operation of the proposed project; and

(j) to identify additional studies where necessary to fulfil the objectives or requirements of this Assignment.

4. Description of the Assignment

The Assignment shall consist of the following :-

(a) **an Initial Assessment Report** which

(i) satisfies the objectives in paragraph 3 (a) and paragraph 3 (b);

(ii) provides an initial assessment and evaluation of the environmental impacts arising from the project, sufficient to identify those issues of key concern during the construction and operation of the project, which are likely to influence decisions on the project;

(iii) defines measurable parameters likely to be affected by the project and identifies any monitoring studies necessary to provide a baseline profile of existing environmental conditions; and

(iv) proposes a detailed programme of investigation and reporting able to meet all other objectives of the Assignment.

(b) **an Environmental Assessment Report** covering in detail those issues of key concern identified through the Initial Assessment Report or the review of the Initial Assessment Report by the Director of Environmental Protection and the Director of Highways;

(c) any revisions or supplements to the above as the Director of Environmental Protection and the Director of Highways might require to be carried out; and

(d) **an Executive Summary Report** for the Reports in (a) and (b) above, in both English and Chinese, fully and fairly detailing the findings of the respective Report, but omitting the non-essential technical details. The Executive Summary Report should at least highlight the major aspects of the project, perceived issues of public concern, recommendations for implementation and their basis, and the implications of those recommendations. It is intended that the information presented therein should assist the Government in undertaking any requirement for public consultation.

will involve placing confidential or non-environmental material in appendices that can be removed prior to public release.

5.6 Reports shall be of A4 size, except that drawings shall be presented in A3 size.

6. Services to be provided by the Consultants

6.1 With due consideration of the technical requirements for the environmental assessment study as detailed in Annex I of this Brief, the Consultants shall:-

(a) assemble information on the background to the project, and on alignments and projected traffic volumes on the proposed roads;

(b) identify all existing and future land uses;

(c) assemble, assess and interpret existing environmental data and practice;

(d) identify the current environmental impact of existing roads on present and future land uses in the area as a basis for determining the environmental impact of the proposed project on existing and proposed developments;

(e) carry out surveys of existing levels of pollution in the area and identify existing effects of such pollution;

(f) derive environmental standards from existing laws of Hong Kong and planning standards (largely from the Hong Kong Planning Standards Guideline (HKPSG), Chapter 9);

(g) define the functional requirements based on environmental standards;

(h) discuss the implications of the proposed project and consider alternative schemes within the ambit of proposing an optimum mitigation package with cost estimates;

(i) carry out or have carried out all necessary surveys, levels and soundings and make such investigations and inquiries as are necessary for the satisfactory completion of the Assignment;

(j) identify the need for any resumption, clearance and reprovisioning and liaise with relevant bodies and assist with negotiations for any resumption, clearance and reprovisioning that may be required;

(k) identify all facilities, installations and existing rights that may be affected by the Assignment;

(l) prepare necessary land requirement plans showing the extent of land requirements for the Assignment;

(m) determine the extent of further ground investigations and surveys and further studies required for detailed design purposes;

(n) prepare preliminary designs, plans, drawings, profiles, sections, specifications and calculations for environmental mitigation measures;

(o) prepare a sketch landscape design;

(p) prepare all necessary documents for the Advisory Committee on the Appearance of Bridges and Associated Structures (ACABAS) submissions;

(q) prepare, supply and present all drawings and display materials required for submissions to District Boards, the Town Planning Board, the Regional Council and the ACABAS, and attend meetings as and when instructed by the Director's Representative; and

(r) prepare and supply discussion papers, technical papers, draft reports and final reports, documents, and drawings as may be reasonably required by the Director's Representative for compliance with the appropriate Statutory Regulations, Government Procedures, Instructions and Circulars in connection with the study.

6.2 The Consultants are expected to communicate and correspond direct with other Government departments, appropriate authorities and private organisations to obtain information in connection with the study, copying such correspondence to the Director's Representative. Any problem in communication or liaison should be referred to the Director's Representative for assistance. In particular, consultation shall be required with but shall not necessarily be limited to the following :-

(a) Agriculture and Fisheries Department
(b) Architectural Services Department
(c) Buildings and Lands Department
(d) Civil Engineering Department
(e) Drainage Services Department
(f) Electrical and Mechanical Services Department
(g) Environmental Protection Department
(h) Fire Services Department
(i) Housing Department
(j) Planning Department
(k) Regional Services Department
(l) Royal Hong Kong Police Force
(m) Social Welfare Department
(n) Transport Department

(o) Water Supplies Department
(p) Project Manager/Tsuen Wan, Territory Development Department
(q) Tsuen Wan District Office
(r) Tsuen Wan District Lands Office
(s) Tsuen Wan District Planning Office
(t) Mass Transit Railway Corporation

7. Response to Queries

The Consultants shall respond to queries under Clause 20 of the General Conditions of Employment raised prior to a date three months after the final submission of the Deliverables required under the Agreement. Such date shall be confirmed in writing to the Consultants by the Director's Representative.

8. Programme of Implementation

8.1 The due date for commencement of the Agreement is 31 August 1993.

8.2 The Consultants shall produce the Programme referred to in Clause 26 of the General Conditions of Employment in draft form within the first two weeks of the Assignment detailing the activities to be carried out, target dates for particular tasks and any decision dates that may be required for the uninterrupted progress of the Assignment. The Consultants shall discuss with the Director's Representative during this period to agree the timing of submissions of reports and plans for each of the main elements of the Assignment, for inclusion in the draft Programme.

8.3 The Initial Assessment Report shall be completed within three weeks from the commencement date of the Agreement.

8.4 The investigation should be completed within four months from the commencement date of the Agreement, working to an agreed work programme. The draft Environment Assessment Report should also be completed within four months from the commencement date of the Agreement.

8.5 The final Environmental Assessment Report and the Executive Summary Report shall be completed within seven months from the commencement date of the Agreement.

8.6 The Consultants shall endeavour to ensure that the Assignment is carried out in accordance with the Programme and shall submit regular programme reviews as part of the progress reports referred to in Clause 9 of this Brief.

9. Progress Reports

The Consultants shall submit to the Director's Representative progress reports at monthly intervals on all aspects of the Services relating progress to the Programme referred to in Clause 8 of this Brief. The reports shall include a list of those parts of the Services the execution of which is behind the Programme together with proposals to expedite progress, so as to complete the work on time. The reports shall also include updated expenditure forecasts in accordance with Clause 10 of this Brief.

10. Financial Management

At monthly intervals or at such other intervals as the Director's Representative may require, the Consultants shall submit a report on the current and forecast expenditure on the Assignment and the fees due to the Consultants, in a form to be agreed by the Director's Representative.

11. Standards and Specifications

The Consultants shall adopt such technical & design standards and specifications as are in current use by the Environmental Protection, Transport, Planning, Civil Engineering, Building and Lands, Drainage Services, Water Supplies and Highways Departments or, if non-existent, British Standard Codes of Practice and Specifications. Should instances arise for which suitable standards or specifications do not exist or for which the current standards or specifications appear to require modification or if by the adoption of current standards the Consultants would incur additional expenses not within reasonable contemplation, the Consultants shall submit recommendations on appropriate alternatives to the Director's Representative for agreement.

12. Director's Representative

The Director's Representative as defined in the General Conditions of Employment shall be the Senior Engineer/Capital Works 4 Highways New Territories Region or such other person as may be authorised by the Director in writing and notified to the Consultants. The Director's Representative may delegate any of the powers and functions vested in him to other officers. If the Consultants are dissatisfied with a decision or instruction of any such officer the matter shall be referred to the Director's Representative for a ruling.

During the course of the Agreement the Consultants shall report direct to the Director's Representative.

13. Control of the Project and Assignment

A Steering Group chaired by the Regional Highway Engineer/New Territories will function during the course of the study and will meet when necessary to monitor progress, provide guidance and consider progress reports. In addition to their duties under Clause 13 of the General Conditions of Employment, the Consultants will be required to attend meetings of a Working Group either chaired by the Chief Highway Engineer(Capital Works)/New Territories Region or the Director of Environmental Protection's representative at approximately bi-weekly intervals and other ad-hoc meetings which may be necessary during the study period. Formal decisions and minutes of meetings of the Steering Group will be advised to the Consultants by the Director's Representative, who will issue to the Consultants all necessary instructions arising out of Steering Group decisions. The Consultants will be responsible for preparing minutes of the Working Group meetings and shall provide the Secretary for such meetings.

14. Information and Facilities Provided by the Employer

All available information relevant to the Assignment will be provided to the Consultants. Relevant documents including reports, drawings and other background materials are listed in Appendix B to this Brief. The Consultants shall indicate for guidance those documents which they currently hold and those of which a copy may be needed, should the Assignment be awarded to them. A copy of each of the documents indicated as needed will be supplied free of charge by the Director's Representative on request from the Consultants, except those currently available from the Sales section of the Information Services Department. In the case of plans and drawings, one transparency and two prints of each plan or drawing shall be provided free of charge if requested by the Consultants.

15. Consultants' Office and Staffing

The Consultants shall maintain for the duration of this Agreement an office in Hong Kong under the control of the Project Director of the Consultants who shall be responsible for the Project. He shall have adequate authority and sufficient professional, technical and administrative support staff in all relevant disciplines to ensure progress to the satisfaction of the Director's Representative.

16. Specialist and Sub-consultant Services

The Consultants shall provide all specialist and sub-consultant services required for the satisfactory completion of the Assignment. No additional fees or expenses for the provision of such services rendered locally or overseas shall be payable by the Employer except as otherwise provided for in the Schedule of Fees.

17. Surveys

One velograph and two prints of topographical mapping at 1:20,000, 1:5,000 and 1:1,000 scales prepared by the Survey and Mapping Office of the Buildings and Lands Department, where available for the area covered by the Project for which the Assignment forms a part, can be obtained free of charge on application to the Director's Representative. All field survey work required for the proper execution of the Assignment shall unless otherwise provided for in the Agreement, be the duty of the Consultants including pollution monitoring, building height and ground level surveys. A copy of field notes, field data and resultant plans arising from these surveys shall be handed over to the Director's Representative upon completion of the Assignment. The accuracy as well as presentation of these surveys shall be of a standard agreed by the Director's Representative. Appendix C specifies the division of responsibility for other surveying between the Consultants, the Lands Administration Office and Survey and Mapping Office as well as the relevant sub-offices at district level of the Buildings and Lands Department.

18. Insurance

The amount of insurance cover to be maintained in accordance with sub-clause (A) of Clause 47 of the General Conditions of Employment shall be HONG KONG Dollars 1,000,000.

AGREEMENT No. CE 38/92

Technical Requirements for Environmental Impact Assessment Study for Route 5 - Section between Shek Wai Kok and Chai Wan Kok

The Environmental Impact Assessment study shall include, but shall not necessarily be limited to the following tasks :-

1. Construction Phase Assessment

1.1 Noise Impact Study

Task 1 : Identification of Representative Sensitive Receivers

Based on the existing and future land uses in the study area, prepare schedules and plans to identify representative noise sensitive receivers. Locations of representative sensitive receivers shall be agreed with the Director of Environmental Protection and the Director of Highways. Noise sensitive receivers (NSRs) should include those described in the Environment Chapter of the Hong Kong Planning Standards & Guidelines (HKPSG). The future land users are those who will occupy the land at the construction stage.

Task 2 : Analysis of Construction Activities

From a knowledge of the likely type, sequence and duration of construction activities required for the project implementation, identify those activities likely to have an impact on the NSRs.

Task 3 : Assessment of Construction Noise Levels

Identify the interactions between the NSRs and construction activities and determine the extent of potentially unacceptable construction noise impacts. The assessment should follow the requirements contained in all the Ordinances & their Regulations governing the control of construction noise currently in force in Hong Kong and the guidelines as advised by the Director of Environmental Protection.

Task 4 : Proposals for Noise Control Measures

Formulate appropriate noise control measures for the inclusion into the contract documents. Where appropriate, compliance monitoring should be proposed.

1.2 Air Pollution Impact Study

Task 1 : Identification of Representative Receptors

From a consideration of existing and future land use in the study area, prepare plans identifying representative receptors in the vicinity of the proposed project (including off-site works areas). The locations shall be agreed with the Director of Environmental Protection and the Director of Highways.

Task 2 : Analysis of Construction Activities

From a knowledge of the likely type, sequence and duration of construction activities required for the project implementation, identify those construction activities likely to cause potential dust (or other air pollutant) problems to the receptors.

Task 3 : Air Pollution Impact Assessment

As far as practical, assess the air pollution level at the receptors due to the proposed project (including construction traffic arising) using a dispersion model to be agreed with the Director of Environmental Protection.

Task 4 : Proposal for Air Pollution Control Measures

Recommend appropriate air pollution control measures for the inclusion into the contract documents. Where appropriate, compliance monitoring should be proposed.

1.3 Water Quality Impact Study

Task 1 : Identification of Sensitive Receivers

Based on the proposed alignments, identify the watercourses/water bodies likely to be affected.

Task 2 : Analysis of Construction Activities

From a knowledge of the likely type, sequences and duration of construction activities required for the project implementation, identify those activities likely to have an impact on the watercourses/water bodies.

Task 3 : Assessment of Water Pollution Problems

Determine the adverse effects of the construction work on the water quality of the watercourses/water bodies.

Task 4 : Proposal for Water Pollution Control Measures

Recommend appropriate control measures for the inclusion into contract documents. Where appropriate, practical mitigation measures and compliance monitoring should be proposed.

1.4 Construction Waste Impact Study

Task 1 : Analysis of Construction Activities

Identify the quantity, quality and timing of the waste and surplus excavated material arisings as a result of the construction activities.

Task 2 : Proposal for Waste Handling and Disposal

Recommend suitable waste handling and disposal measures including the reuse of surplus excavated materials.

2. Operation Phase Assessment

2.1 Traffic Noise Impact Study

Task 1 : Identification of Representative Sensitive Receivers

Identify representative noise sensitive receivers, as described in the Environment Chapter of the Hong Kong Planning Standards & Guideline (HKPSG), for both existing and planned land uses. Locations of representative noise sensitive receivers (NSRs) shall be agreed with the Director of Environmental Protection and the Director of Highways.

Task 2 : Calculation of Future Noise Levels

Calculate the future road traffic noise using methods described in the U.K. Department of the Transport's publication "Calculation of Road Traffic Noise" (1988) published by H.M. Stationery Office. Calculations shall be based on traffic projections for the design year 2011 and the volume of traffic, speed and percentage of heavy vehicles used in the calculation shall be agreed with the Director of Environmental Protection and the Director of Highways.

Future traffic noise shall be calculated at the nearest facade of any existing building classified as a noise sensitive receiver. For planned developments, representative points are to be selected from Draft Plans. Noise levels and contours, where appropriate, in L10(1 hr) at representative level (in m P.D.) of the facades of the NSRs as identified in Task 1 above should be presented

in a form to be agreed by the Director of Environmental Protection and/or the Director of Highways showing the noise sensitive receivers as identified in Task 1 above. Traffic at the hour of peak traffic flow shall be used in the calculation. Quantitative assessment at the identified NSRs for each alignment shall be compared against the criteria set out in the HKPSG. The potential noise impact of each proposed alignment on the existing and planned NSRs shall be quantified by estimating the total number of dwellings and/or classrooms that will be exposed to a level above the HKPSG criteria.

Task 3 : Presentation of Existing Noise Level

Measure the existing noise levels in L10(1 hr), Leq(1 hr) and L90(1 hr) at the identified NSRs at representative level (in m P.D.) and present them on a plan of suitable scale as advised by the Director of Environmental Protection and/or the Director of Highways. This information may be required in the context of Task 5.

Task 4 : Assessment of Needs for Noise Amelioration Measures

Assess the needs for noise amelioration measures in relation to the extent to which an existing or planned building classified as a NSR would be subject to a predicted traffic noise level in the design year which is 1 dB(A) or more in excess of the maxima recommended in the HKPSG and other appropriate criteria as advised by the Director of Environmental Protection. The appropriateness of this criteria is dependant on the results of Task 3 above and the Director of Environmental Protection will advise on it.

Task 5 : Proposals for Noise Amelioration Measures

Propose direct technical remedies in all situation where the predicted traffic noise level exceeds the HKPSG maxima or the appropriate criteria as advised by the Director of Environmental Protection and/or the Director of Highways. In the case where an existing building is already subject to a noise level equal to, or in excess of, the recommended maximum, measures to avoid (as far as possible) deterioration of the existing situation should be put forward. For planned noise sensitive developments, indications of the form of suitable measures to be incorporated in the project should be proposed for further development in the detailed design. In case where direct technical remedies appear impracticable, the report should identify the NSRs which may qualify for indirect technical remedies under the EXCO directive for "Equitable Redress for Persons Exposed to Increases in Noise Resulting from the Use of New Roads" and the associated costs and the implications for such implementation.

2.2 Air Pollution Impact Study

Task 1 : Identification of Representative Receptors

From a consideration of existing and future land use in the study area, prepare plans identifying receptors that would likely be affected by emissions from the tunnel portals, ventilation buildings and approach roads of the project.

Task 2 : Presentation of Background Air Pollution Levels

Background air pollution levels at the study area should be established and used in Task 4.

Task 3 : Air Pollution Impact Assessment

Assess the air pollution levels at the receptors due to the proposed project and the air pollution levels in enclosures using a dispersion model to be agreed with the Director of Environmental Protection.

The report should contain sample calculations and input parameters used in the modelling.

Air pollution Isopleths should be produced as an output of the study.

Task 4 : Proposal of Amelioration Measures

Propose cost effective amelioration measures in situations where the predicted (cumulative) air pollution levels exceed the Hong Kong Air Quality Objectives. However, the air pollution levels within an enclosed structure should not exceed Environmental Protection Department's Air Quality Criteria for tunnels, in terms of concentration by volume as follows:

Carbon monoxide (CO) = < 125 ppm
Nitrogen dioxide (NO_2) = < 1.5 ppm
Nitrogen oxide (NO) = < 7.5-15 ppm (based on 10-20% conversion of NO to NO_2)

2.3 Water Quality Impact Study

Task 1 : Assessment of Water Pollution Impact

Assess the adverse effects, if any, of the traffic and the proposed alignments, infrastructures and facilities on the water quality of the watercourse/water bodies traversed by the alignment. This should include surface runoff and spillage due to accidents. The proposed alignments need to be modelled for water quality impacts on water bodies. The water quality modelling should

be undertaken using models/techniques to be agreed with the Director of Environmental Protection.

Task 2 : Proposals for Amelioration Measures

Recommend appropriate cost effective amelioration measures to minimize any adverse effects identified in Task 1 above.

2.4 Visual and Land Use Impacts

Task 1 : Assessment of Visual Impacts

Assess the visual impacts of the proposed project and recommend amelioration measures as appropriate. The advice from the Advisory Committee on the Appearance of Bridges and Associated Structures (ACABAS) should also be taken into account.

Task 2 : Assessment of the Implication on Land Use

Assess the implications of the development on the land uses in the vicinity of the development (including works areas). Both the long and short term implications should be assessed.

Task 3 : Proposals for Mitigation Measures

Recommend appropriate cost effective mitigation measures such as landscaping, to minimise any adverse effects identified in Tasks 1 and 2 above.

Special attention should be paid to minimise restraints on the development potential of the areas in the vicinity.

3. Monitoring and Post-Project Audit Requirements

3.1 Environmental Monitoring

Define environmental monitoring requirements including any necessary programme for baseline, impact and compliance monitoring.

3.2 Post-Project Audit

Formulate environmental audit requirements including compliance and post-project audit which will review the environmental monitoring data to identify compliance with regulatory requirements, policies and standards and any remedial work required to redress unacceptable consequential or unanticipated

environmental impacts.

4. Ecological Impact Study

4.1 Assess the actual and potential ecological impacts during the construction period and subsequent operation of the project including a baseline survey of existing flora and fauna. The baseline survey shall include the flora and fauna found on site, their abundance, adaptation to environmental changes and any other relevant features. The list of species found within the site should be prepared with special reference to those which are rare, endangered, restricted in distribution or protected under local legislation or international conventions or to the discretion of the Director of Agriculture & Fisheries.

4.2 Assess the actual and potential landuse and landscape impacts including a baseline survey of existing landuse natural and cultural features which should include, but not limited to agricultural land, recreation areas, country parks, special areas and sites of special scientific interest, geographical features, stream course, skyline, villages, graves, fields and other associated features. The visual impact on landscape should also be assessed.

4.3 Suggest mitigatory measures to the ecological, landscape and visual impacts during the construction and subsequent operation of the project. These mitigation measures should include protection of existing natural features, buildings, woodlands, big trees and other special habitats. Outlined landscape planting schemes should form part of the mitigatory measures.

AGREEMENT NO. CE 38/92

Associated Documents Provided by the Employer

Drawings :-

1. Drawing No. NH20539 - Route 5, Section between Shek Wai Kok and Chai Wan Kok - Scope of Works 1:2 000

2. Drawing No. NH20527 - Route 5, Section between Shek Wai Kok and Chai Wan Kok - General Layout (Sheet 1 of 3) 1:1 000
   NH20528 - Route 5, Section between Shek Wai Kok and Chai Wan Kok - General Layout (Sheet 2 of 3) 1:1 000
   NH20529 - Route 5, Section between Shek Wai Kok and Chai Wan Kok - General Layout (Sheet 3 of 3) 1:1 000
   NH20530 - Route 5, Section between Shek Wai Kok and Chai Wan Kok - Longitudinal Profiles (Sheet 1 of 3) 1:1 000
   NH20531 - Route 5, Section between Shek Wai Kok and Chai Wan Kok - Longitudinal Profiles (Sheet 2 of 3) 1:1 000
   NH20532 - Route 5, Section between Shek Wai Kok and Chai Wan Kok - Longitudinal Profiles (Sheet 3 of 3) 1:1 000

3. Tsuen Wan Outline Zoning Plan

4. Tsuen Wan Outline Development Plan

Transport Study :-

1. Tsuen Wan Transport Study - Phase 3, Chapter 3, Study Section 2 - Tsuen Wan North and West, prepared by Wilbur Smith and Associates (August 1983); and

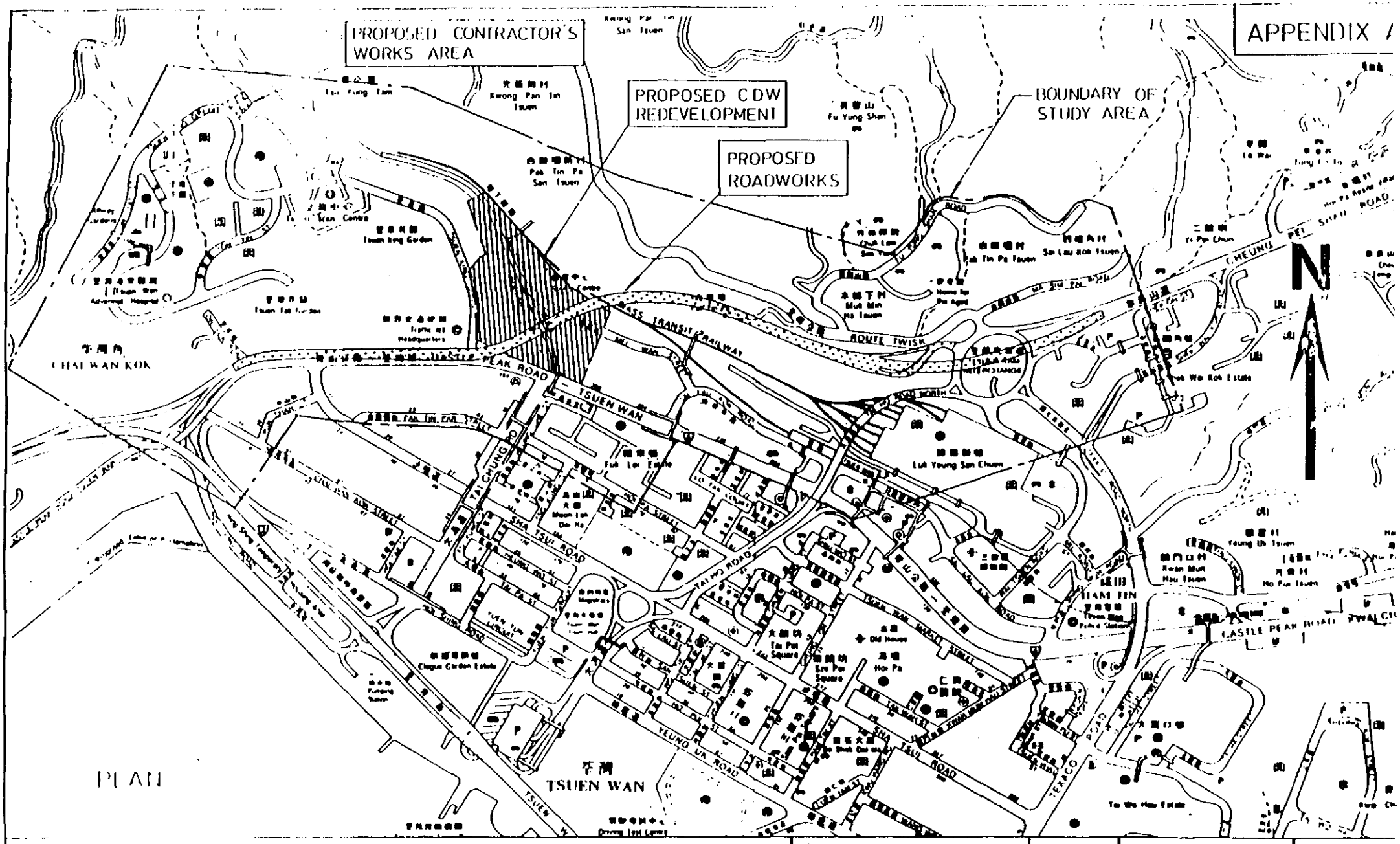
2. Tsuen Wan Transport Study, prepared by Transport Department.

AGREEMENT NO. CE 38/92

Responsibility for Survey Work

The division of responsibility among the Consultants, the Lands Administration Office, and Survey and Mapping Office of the Buildings & Lands Department for surveying required in connection with the Assignment shall be as follows :-

		Task	Responsibility of
(1)	(a)	Provision of basic horizontal and vertical survey control	Survey and Mapping Office
	(b)	Checking of given control point values and establishment of survey control network(s) based on survey control given vide (a)	Consultants
(2)	(a)	Provision of basic mapping (at 1/1000 or other standard mapping relevant to the Assignment)	Survey and Mapping Office (excluding those specified as to be provided by the Consultants in the Contract)
	(b)	Up-dating and verification of accuracy of information shown on plans supplied vide (a) as necessary in relation to the Assignment	Consultants
	(c)	Carrying out detailed surveys for site investigation and for preparation of design and contract documents as necessary in relation to the Assignment	Consultants
(3)		Supply of existing cadastral plans and records and co-ordinate data	District Survey Office
(4)		Computation of detailed dimensioned layouts of road, drainage and WSD reserves, platforms, etc.	Consultants (checked and accepted by District Survey Office)
(5)		Determination of site/lot boundaries, calculation of areas, etc. in connection with the agreed dimensioned layouts	District Survey Office (in liaison with District Lands Office)



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PWP ITEM NO. 52TH –
ROUTE 5, SECTION BETWEEN
SHEK WAI KOK AND CHAI WAN KOK
ENVIRONMENTAL IMPACT ASSESSMENT STUDY AREA

drawn by FANNY CHEUNG	date 22.10.92	drawing no NH 20520	scale 1:10 000
approved	date		
office HIGHWAYS / NT REGION		HIGHWAYS DEPARTMENT HONG KONG	

APPENDIX B1 - SCHEDULE OF CONSTRUCTION ACTIVITIES

Work Segment	:	**Tsuen Kam Interchange**
Working Period	:	April 1996 - September 1998
Working Hours	:	9 hours, 6 days/week
Location	:	Tsuen Kam Interchange
A1	:	**Traffic Diversion Phase 1.**
A1.1	:	Forming an embankment totally 5000m filling.
Duration	:	3 weeks
Equipment	:	Trucks 5
		Excavators 1
		Roller 1
		Loader 1
A1.2	:	Construction of temporary pavement
Duration	:	1 weeks
Equipment	:	Concrete Mixer Truck 1
		Vibrators 1
Remarks	:	Sub-activity A1.1 was assumed for the entire duration of Activity A1 for noise assessment.
A2	:	**New Branch Culvert No.1**
Description	:	Excavation for the formation of culvert total length about 15m, that to be connected to existing DN 1200mm storm water drain.
A2.1	:	Formation
Duration	:	1 weeks
Equipment	:	Excavators 1
		Loader 1
		Trucks 2
A2.2	:	Construction of 15m long single cell box culvert.
Duration	:	2 weeks
Equipment	:	Light crane 1
A2.3	:	Concreting the box culvert
Duration	:	2 weeks
Equipment	:	Concrete Mixer Trucks 1
		Concrete Pump 1
		Vibrators 2
A2.4	:	Backfilling

Duration	:	1 weeks	
Equipment	:	Excavator	1
		Roller	1
		Trucks	2
Remarks	:	Sub-activity A2.1 was assumed for the entire duration of Activity A2 for noise assessment.	
A3	:	**Bridge No. 1**	
A3.1	:	Demolition of the existing road pavement.It shall be completed before activity I.D A.6.	
Duration	:	1 weeks (It follows the activity I.D. A1.)	
Equipment	:	Hydraulic breaker	1
		Loader	1
		Trucks	2
A3.2	:	Excavation for the formation of proposed carriageway.	
Duration	:	1 weeks	
Equipment	:	Excavator	1
		Loader	1
		Trucks	6
A3.3	:	Bored piling for foundations of abutment walls.	
Duration	:	4 weeks	
Equipment	:	Bored piling rigs	3
A3.4	:	Construction of pile caps	
Duration	:	3 weeks	
Equipment	:	Concrete Mixer Trucks 1	
		Concrete Pump	1
		Vibrators	2
A3.5	:	Construction of the abutment walls	
Duration	:	8 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A3.6	:	Backfilling	
Duration	:	2 weeks	
Equipment	:	Excavator	1
		Roller	1
		Trucks	2
A3.7	:	Falsework for 25m by 25m bridge deck	
Duration	:	2 weeks	
Equipment	:	Cranes	2
A3.8	:	Concreting the bridge deck	
Equipment	:	Concrete Mixer Trucks 1	

		Concrete Pump	1
		Vibrators	2
A3.9	:	Applying 40mm thick bituminous course onto the bridge deck	
Equipment	:	Pavers	1
		Rollers	2
		Trucks	3
A3.10	:	Trimming the slopes to final profile.	
Duration	:	1 weeks	
Equipment	:	Excavator	1
		Loader	1
		Trucks	2
Remarks	:	Sub-activities A3.1 and A3.3 were assumed for the entire duration of Activity A3 for noise assessment.	
A4	:	**Demolition of Existing Branch Culvert No. 3**	
Remarks	:	It is assumed to be a single cell box culvert and total length of which is about 20m. It shall be completed before activity I.D A.6.	
A4.1	:	Demolition of box culvert.	
Duration	:	1 weeks	
Equipment	:	Hydraulic breaker	1
		Loader	1
		Trucks	2
A4.2	:	Backfilling	
Duration	:	1 weeks	
Equipment	:	Roller	1
		Trucks	2
		Excavator	1
Remarks	:	Sub-activity A4.1 was assumed for the entire duration of Activity A4 for noise assessment.	
A5	:	**Laying of Foul Water and Storm Water Pipes**	
Remarks	:	Re-locate existing foul water drain and construct 6 nos of manholes including 2 nos of backdrop manholes. Lay 50m long storm water pipes and 1 no of manhole which is connected to the new branch culvert no.1. It shall be completed before activity I.D A.6.	
A5.1	:	Formation of 55m long DN300mm and 130m long DN450mm pipes.	
Duration	:	2 weeks	
Equipment	:	Excavator	1
		Vibrator	1
A5.2	:	Construction of concrete surround for 25m long DN450mm drain.	

Equipment	:	Concrete Mixer Trucks	1
		Vibrators	2
A5.3	:	Construction of manholes	
Duration	:	2 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Vibrators	2
A5.4	:	Backfilling	
Duration	:	2 weeks	
Equipment	:	Excavator	1
		Roller	1
		Trucks	2
Remarks	:	Sub-activity A5.4 was assumed for the entire duration of Activity A5 for noise assessment.	
A6	:	**Traffic Diversion Phase 2**	
A6.1	:	Forming an embankment totally 17200m³ filling. It shall be completed before activity I.D A.7.	
Duration	:	6 weeks	
Equipment	:	Trucks	5
		Excavators	1
		Grader	1
		Roller	1
		Vibrators	1
A6.2	:	Concreting of temporary pavement with uphill gradient of 6%.	
Duration	:	1 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Vibrators	2
Remarks	:	Sub-activity A6.1 was assumed for the entire duration of Activity A6 for noise assessment.	
A7	:	**Branch Culvert No.1**	
A7.1	:	Excavation for the formation of culvert total length about 85m. that to be connected to existing DN 1200mm storm water drain .It shall be completed before activity I.D A.9.	
Duration	:	6 weeks	
Equipment	:	Excavators	1
		Loader	1
		Trucks	2
A7.2	:	Construction of 85m long single cell box culvert.	
Duration	:	12 weeks	
Equipment	:	Light crane	1

A7.3	:	Concreting the box culvert	
Duration	:	12 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A7.4	:	Backfilling	
Duration	:	2 weeks	
Equipment	:	Excavator	1
		Roller	1
		Trucks	2
Remarks	:	Sub-activity A7.1 was assumed for the entire duration of Activity A7 for noise assessment.	
A8	:	**Demolition of Existing Branch Culvert No.2**	
Remarks	:	It is assumed to be a single cell box culvert and total length of which is about 35m. It shall be completed before activity I.D. A10.	
A8.1	:	Demolition of box culvert	
Duration	:	2 weeks	
Equipment	:	Hydraulic breaker	1
		Loader	1
		Trucks	2
A8.2	:	Backfilling	
Duration	:	2 weeks	
Equipment	:	Roller	1
		Trucks	2
		Excavator	1
Remarks	:	Sub-activity A8.1 was assumed for the entire duration of Activity A8 for noise assessment.	
A9	:	**Demolition of Existing Branch Culvert No.1**	
Remarks	:	It is assumed to be a single cell box culvert and total length of which is about 90m. It shall be completed before activity I.D A.10.	
A9.1	:	Demolition of box culvert	
Duration	:	4 weeks	
Equipment	:	Hydraulic breaker	1
		Loader	1
		Trucks	2
A9.2	:	Backfilling	
Duration	:	2 weeks	
Equipment	:	Roller	1
		Trucks	2

		Excavator	1
Remarks	:	Sub-activity A9.1 was assumed for the entire duration of Activity A9 for noise assessment.	
A10	:	**Bridge No. 2**	
A10.1	:	Demolition of the existing road pavement. It shall be completed before activity I.D A.11.	
Duration	:	1 weeks	
Equipment	:	Hydraulic breaker	1
		Loader	1
		Trucks	2
A10.2	:	Excavation for the formation of proposed carriageway.	
Duration	:	2 weeks	
Equipment	:	Excavator	1
		Loader	1
		Trucks	6
A10.3	:	Bored piling for foundations of abutment walls.	
Duration	:	5 weeks	
Equipment	:	Bored piling rigs	3
A10.4	:	Construction of pile caps	
Duration	:	5 weeks	
		(The completion date shall not be earlier than activity I.D. A9)	
Equipment	:	Concrete Mixer Trucks 1	
		Concrete Pump	1
		Vibrators	2
A10.5	:	Construction of the abutment walls	
Duration	:	16 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A10.6	:	Falsework for 33m by 48m bridge deck	
Duration	:	2 weeks	
Equipment	:	Cranes	2
A10.7	:	Concreting the bridge deck	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A10.8	:	Applying 40mm thick bituminous course onto the bridge deck	
Equipment	:	Pavers	1
		Rollers	2
		Trucks	3

A10.9	:	Trimming the slopes to final profile.	
Duration	:	2 weeks	
Equipment	:	Excavator	1
		Loader	1
		Trucks	2
Remarks	:	Sub-activity A10.1 was assumed for the entire duration of Activity A10 for noise assessment.	
A11	:	**Bridge No. 3**	
Remarks	:	Prestressed concrete bridge and viaduct works at the west side of Tsuen Kam Interchange. A total length of about 150m bridge works for 2-lane slip road.	
A11.1	:	Excavation for the formation of proposed carriageway.	
Duration	:	2 weeks	
Equipment	:	Excavator	1
		Loader	1
		Trucks	6
A11.2	:	Bored piling.	
Duration	:	6 weeks	
Equipment	:	Bored piling rigs	3
A11.3	:	Construction of pile caps	
Duration	:	3 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A11.4	:	Backfilling	
Duration	:	1 weeks	
Equipment	:	Excavator	1
		Roller	1
		Trucks	2
A11.5	:	Construction of the abutment walls	
Duration	:	4 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A11.6	:	Backfilling	
Duration	:	1 weeks	
Equipment	:	Excavator	1
		Roller	1
		Trucks	2
A11.7	:	Falsework for 160m by 13m bridge deck.	
Duration	:	5 weeks	

Equipment	:	Cranes	2
A11.8	:	Concreting and prestressing the bridge deck	
Duration	:	40 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A11.9	:	Applying 40mm thick friction course onto the bridge deck	
Duration	:	1 week	
Equipment	:	Pavers	1
		Rollers	2
		Trucks	3
A11.10	:	Trimming the slopes to final profile.	
Equipment	:	Excavator	1
		Loader	1
		Trucks	2
Remarks	:	Sub-activity A11.2 was assumed for the entire duration of Activity A11 for noise assessment.	
A12	:	**Footbridge**	
Remarks	:	It is expected to be steel structure and its span is 40m. An embankment will be formed at south side. It shall not be started early than the completion of activity I.D A.5.	
A12.1	:	Embankment	
Duration	:	4 weeks	
Equipment	:	Excavator	1
		Loader	1
		Trucks	5
		Roller	1
A12.2	:	Construction of the abutment walls	
Duration	:	4 weeks	
Equipment	:	Concrete Mixer Trucks	1
		Concrete Pump	1
		Vibrators	2
A12.3	:	Backfilling	
Duration	:	1 weeks	
Equipment	:	Excavator	1
		Roller	1
		Trucks	2
A12.4	:	Erection of footbridge	
Duration	:	2 weeks	
Equipment	:	Cranes	2

Remarks	:	Sub-activity A12.1 was assumed for the entire duration of Activity A12 for noise assessment.
A13.	:	**A13 Demolition of the temporary embankment.**
A13.1	:	It shall be started after completion of activity I.D A.10.
Duration	:	3 weeks
Equipment	:	Hydraulic breaker 1 Excavator 2 Loader 2 Trucks 10
Remarks	:	Sub-activity A13.1 was assumed for the entire duration of Activity A13 for noise assessment.

Work Segment	:	**At-grade Carriageway**
Working Period	:	April 1996 - March 1999
Working Hours	:	9 hours, 6 days/week
Location	:	Between Tsuen Kam Interchange and Bridge 4 (MTR Crossing)
B1	:	**At-grade Carriageway**
Remarks	:	It is expected that asphalt pavement is to be used which composes of 40mm wearing course, 70mm base course, 300mm roadbase and 300mm of sub-base. The total surface including slip roads is about 26220m². The quantities of earthwork for forming the road embankment are 50220cu.m and 59950 cu.m for cutting and filling respectively.
B1.1	:	Formation (cut and fill) and stabilization works for slope.
Duration	:	2 years
Equipment	:	Excavator 4 Loader 3 Trucks 8 Roller 2 Hydraulic breaker 1 Grader 1
B1.2	:	Pavement
Duration	:	18 weeks
Equipment	:	Paver 1 Roller 2 Trucks 10
Remarks	:	Sub-activities B1.1 and B1.2 were assumed for the duration of Activity B1 for noise assessment.
B2	:	**Subway**
Description	:	Typical 2.5m by 24m subway arrangement in which the thickness of wall and headroom are to be 600mm and 2.75m respectively.
B2.1	:	Formation
Duration	:	8 weeks
Equipment	:	Excavators 1 Loaders 1 Trucks 4 Roller 1
Remarks	:	It is expected that no rock excavation will be involved
B2.2	:	Falsework
Equipment	:	Light crane 1 Lorries 1

B2.3	:	Concreting	
Remarks	:	It is assumed that total concrete involved is about 600 cu.m.	
Equipment	:	Vibrator	2
		Concrete mixer truck	1
		Concrete pump	1
B2.4	:	Backfilling	
Duration	:	2 weeks	
Equipment	:	Roller	1
		Trucks	3

Remarks : Sub-activities B2.1 and B2.3 were assumed for the duration of Activity B1 for noise assessment.

Work Segment	:	**MTR Crossing**	
Working Period	:	**April 1996 - September 1998**	
Working Hours	:	**9 hours, 6 days/week**	
Location	:	**MTR Depot, Tsuen Wan**	
C1	:	**Working Platform**	
Description	:	Cutting of 58,000 cu.m soil and rock mixture to form the temporary contractor's working area.	
Duration	:	20 weeks	
Equipment	:	Excavator	3
		Loader	2
		Trucks	8
		Hydraulic breaker	3
C2	:	**Foundation**	
Description	:	Two bored foundation to support the flyover, which has about 55m of span length over MTR's tracks. It is assumed that the total quantities of concrete involved is about 1500 cu.m for sub-structure.	
C2.1	:	Piling	
Duration	:	18 weeks	
Equipment	:	Bored piling Rigs	2
C2.2	:	Concreting for piles	
Duration	:	1 week	
Equipment	:	Concrete Pumps	1
		Vibrators	4
		Concrete mixer trucks	2
C2.3	:	Excavation	
Duration	:	3 weeks	
Description	:	It is assumed that the quantity of earthwork is about 800 cu.m per pile cap.	
Equipment	:	Excavator	2
		Hydraulic breaker	1 (stand-by)
		Trucks	6
C2.4	:	Falsework for pile caps	
Duration	:	6 weeks	
Equipment	:	Lorries	2
C2.5	:	Concreting for pile caps	
Duration	:	1 week	
Equipment	:	Concrete Pumps	1
		Vibrators	4
		Concrete mixer trucks	2

C2.6	:	Backfilling	
Duration	:	1 week	
Equipment	:	Roller	1
		Trucks	2
Remarks	:	Sub-activity C2.1 was assumed for the duration of Activity C2 for noise assessment.	
C3	:	**Falsework**	
Description	:	A temporary working platform provides to construct the flyover and isolates the MTR's high voltage overhead cables during construction. It is expected that the size of platform is 30m by 70m approximately.	
C3.1	:	Erection of Supports	
Description	:	Falsework supports are erected along the sides of the existing MTR tracks.	
Duration	:	6 weeks	
Equipment	:	Excavators	1
		Loaders	1
		Trucks	5
C3.2	:	Working Platform	
Description	:	A work platform is laid onto the supports by cranes stationed on the slope side. The platform will have about 25m span over the tracks.	
Duration	:	3 nights	
Equipment	:	Mobile Crane	1
		Heavy lorries	2
Remarks	:	Since any disruption of normal train operation is prohibited, the works is only allowed to carry out at night and the working hours is limited by MTR.	
Remarks	:	Sub-activity C3.1 was assumed for the duration of Activity C3 for daytime noise assessment.	
C4	:	**Superstructure**	
Description	:	A total length of about 100m bridge works for dual 2-lane carriageway. It is assumed that the total quantities of concrete involved is about 3500 cu.m for the viaduct.	
C4.1	:	Falsework for superstructure	
Duration	:	8 weeks	
Equipment	:	Lorries	2
C4.2	:	Concreting for superstructure and prestressing	
Duration	:	50 weeks	
Equipment	:	Concrete Pumps	1
		Vibrators	4
		Concrete mixer trucks	2

Remarks	:	Sub-activity C4.2 was assumed for the duration of Activity C4 for daytime noise assessment.	
C5	:	**Finishes**	
Description	:	Carriageway finishes.	
Duration	:	5 weeks	
Equipment	:	Small cranes	2
		Trucks	2
		Light trucks	1
C6	:	**Falsework Removal**	
C6.1	:	Demolition of the working platform.	
Duration	:	2 nights	
Equipment	:	Mobile cranes	1
		Heavy lorries	2
Remarks	:	It is expected that this works will be carried out at night.	
C6.2	:	Demolition of the supports	
Duration	:	1 weeks	
Equipment	:	Mobile cranes	2
		Heavy lorries	2
Remarks	:	Sub-activity C6.1 was assumed for the duration of Activity C6 for daytime noise assessment.	
C7	:	**Backfilling**	
Description	:	It is assumed that the quantity of fill is about 58,000 cu.m.	
Duration	:	52 weeks	
Equipment	:	Roller	1
		Excavators	1
		Trucks	8
		Loader	1

Work Segment	:	**Tuen Mun Road Flyover and Underpass, West Contract**
Working Period	:	June 1997 - May 2002
Working Hours	:	9 hours, 6 days/week
Location	:	Tuen Mun Road and Castle Peak Road junction.
Remarks	:	For keeping of existing traffic flow at Tuen Mun Road and Castle Peak Road during construction period, whole traffic diversion scheme to be involved will have 9 phrases. Those noise-sensitive activities are listed below:
D1	:	**Demolition of Factory (Phase 1)**
Description	:	Demolish a five-storey building.
Equipment	:	Hydraulic breaker 2 Excavators 2 Trucks 6
D2	:	**Construction of Haul Road for Traffic Diversion**
Description	:	Form a temporary 2-lane carriageway in front of Nan Fung Textile, totally about 230m concrete pavement.
D2.1	:	Formation
Equipment	:	Hydraulic breaker 1 Excavator 1 Trucks 3
D2.2	:	Pavement
Equipment	:	Concrete mixer truck 1 Vibrators 2
D3	:	**Temporary Deck No. 1**
Description	:	Construct a temporary bridge for traffic diversion. It is expected that the bridge is to be steel structure and has 2-lane width by 100m long. It is situated at the outer side lane of east bound of Tuen Mun Road and merged with at somewhere of existing Tuen Mun Road west bound carriageway.
D3.1	:	Sub-structure of temporary deck no. 1
Description	:	It is expected that the temporary pile caps are exposed structure.
Equipment	:	Concrete mixer truck 1 Vibrators 2
D3.2	:	Superstructure of temporary deck
Description	:	It is expected that the temporary deck is to be steel structure.

Equipment	:	Mobile cranes	1	
		Heavy lorries	2	
		Generator	1	
Remarks	:	It is expected that 2 night work will be required for merging of temporary deck to existing flyover.		
Remarks	:	Sub-activity D2.1 was assumed for the whole duration of Activity D1-D3 for noise assessment.		
D4	:	**Demolition of Existing Abutment of Flyover and Decked Nullah (Phase 2)**		
Description	:	Demolish the existing abutment of west bound carriageway of Tuen Mun Road, 220m pavement of Castle Peak Road and about 10m of decked nullah in phases. The material generated by demolition is about 3500 cu.m for abutment including about 700 cu.m of concrete.		
D4.1	:	Demolish the existing pavement of Castle Peak Road.		
Description	:	The material generated by demolition is assumed about 1,500 cu.m.		
Equipment	:	Excavator	2	
		Loader	2	
		Trucks	5	
		Hydraulic breaker	2	
D4.2	:	Demolition of existing abutment of flyover.		
Equipment	:	Hydraulic breakers	1	
		Excavators	1	
		Trucks	4	
D4.3	:	Demolition of section of decked nullah.		
Equipment	:	Hydraulic breakers	1	
		Excavators	1	
		Trucks	4	
D5	:	**Decked Nullah**		
Description	:	Construct box culvert instead of demolished section of decked nullah.		
D5.1	:	Formation		
Equipment	:	Excavator	1	
		Loader	1	
		Trucks	2	
		Hydraulic breaker	1	(stand by)
D5.2	:	Falsework		
Equipment	:	Light lorries	2	
D5.3	:	Concreting		
Equipment	:	Concrete pump	1	
		Vibrator	2	

		Concrete mixer trucks	1
D5.4	:	Backfilling	
Equipment	:	Roller	1
		Excavator	1
		Trucks	2
D6	:	**At-grade Carriageway**	
Description	:	Construct a portion of Castle Peak Road, between existing roundabout and the start of Tuen Mun Road, that is a 2-lane bituminous carriageway.	
D6.1	:	Formation	
Equipment	:	Excavator	1
		Loader	1
		Trucks	3
		Roller	1
D6.2	:	Pavement	
Equipment	:	Paver	1
		Roller	2
		Trucks	8
Remarks	:	Sub-activity D4.1 was assumed for the whole duration for noise assessment.	Activity D4-D6
D7	:	**Bridge No. 6 (Phase 3)**	
Description	:	Typical bridge and viaduct construction, totally about 150m flyover.	
D7.1	:	Piling for viaduct	
Description	:	It is assumed that 6 bored piles is to be used, each pile is to be 1.5m diameter and will be penetrated into 30m below ground.	
Equipment	:	Bored piling rigs	3
D7.2	:	Concreting of piles	
Equipment	:	Concrete pump	1
		Vibrator	2
		Concrete mixer trucks	1
D7.3	:	Formation for pile caps	
Description	:	It is assumed that the quantity of earthwork involved is about 300 cu.m per pile cap.	
Equipment	:	Excavator	2
		Trucks	6
		Hydraulic breaker	1 (stand by)
D7.4	:	Falsework for viaduct	
Equipment	:	Mobile cranes	2
		Lorries	2

D7.5	:	Concerting of viaduct	
Description	:	It is assumed that the quantity of concrete involved is about 650 cu.m.	
Equipment	:	Concrete pump	1
		Vibrator	2
		Concrete mixer trucks	1
Remarks	:	Sub-activity D7.1 was assumed for the whole duration of Activity D7 for noise assessment.	
D8	:	**Temporary Deck No. 2 (Phase 4)**	
Description	:	Construct single-lane bridge to connect newly formed viaduct of bridge no. 6. Once the temporary deck no. 2 completed, the construction of abutment for Bridge 6 will be commenced.	
D8.1	:	Sub-structure of temporary deck no. 2	
Description	:	It is expected that the temporary pile caps are exposed structure.	
Equipment	:	Concrete mixer truck	1
		Vibrators	2
D8.2	:	Superstructure of temporary deck no. 2	
Description	:	It is expected that the temporary deck is to be steel structure.	
Equipment	:	Mobile cranes	1
		Heavy lorries	2
		Generator	1
D9	:	**Construction of abutment wall for Bridge No. 6**	
Description	:	General structure arrangement for abutment.	
D9.1	:	Formation	
Description	:	It is assumed that 1000 cu.m of earthwork will be involved.	
Equipment	:	Excavator	1
		Loader	1
		Trucks	2
D9.2	:	Falsework for abutment wall	
Equipment	:	Crane	1
		Light Lorries	2
D9.3	:	Concreting	
Description	:	It is assumed that 620 cu.m of concrete will be used.	
D9.4	:	Backfilling	
Equipment	:	Roller	1
		Trucks	2
D9.5	:	Pavement	

Description	:	40mm bituminous material will be applied onto the surface of deck.	
Equipment	:	Paver	1
		Roller	2
		Trucks	5
Remarks	:	Sub-activity D8.2 was assumed for the whole duration of Activity D8-D9 for noise assessment.	
D10	:	**Demolition of Temporary Deck 2 (Phase 5)**	
D10.1	:	Demolition of temporary deck	
Equipment	:	Mobile cranes	1
		Heavy lorries	1
		Generator	1
D10.2	:	Demolition of footings for temporary deck	
Equipment	:	Hydraulic breaker	1
		Trucks	2
		Loader	1
D11	:	**Modification of Temporary Deck No.1 to Connect to Kowloon Bound Carriageway of Tuen Mun Road.**	
Description	:	Form new haul road from east bound carriageway of Tuen Mun Road to Castle Peak Road. This haul road involves modified temporary deck no.1 and concrete pavement laying on rock slope.	
D11.1	:	Demolish portion of temporary deck no. 1	
Description	:	Demolish temporary deck totally about 100m structure.	
D11.2	:	Demolition of temporary deck	
Equipment	:	Mobile cranes	1
		Heavy lorries	1
		Generator	1
D11.3	:	Demolition of footings for temporary deck	
Equipment	:	Hydraulic breaker	1
		Trucks	2
		Loader	1
D11.4	:	Extend the temporary deck no. 1 to the east-bound carriageway of Tuen Mun Road.	
Description	:	The extended deck is about length of 80m. This activity consists of footings and superstructure components.	
Equipment	:	Mobile cranes	1
		Heavy lorries	2
		Generator	1
		Vibrators	2
		Concrete mixer trucks	1
D11.5	:	Formation of temporary access	

Description	:	Form a haul road linking the newly extended deck and carriageway of Tuen Mun Road. Rock excavation, 500 cu.m, will be involved.	
Equipment	:	Hydraulic breaker	1
		Excavator	1
		Trucks	3
D11.6	:	Pavement of temporary access	
Description	:	Form a temporary 2-lane concrete carriageway.	
Equipment	:	Concrete mixer truck	1
		Vibrator	2
D12	:	**Retaining Wall**	
Description	:	Length of retaining wall and its maximum height are about 30m and 8m respectively. Form of retaining structure has been assumed that cantilever retaining wall with piles will be used.	
D12.1	:	Piling	
Equipment	:	Bored piling rigs	2
D12.2	:	Formation of pile caps	
Description	:	It is assumed that the quantity of earthwork involved is about 600 cu.m.	
Equipment	:	Excavator	1
		Loader	1
		Trucks	3
		Hydraulic breaker	1
Remarks	:	It is expected that rock excavation will be required to form a formation.	
D12.3	:	Falsework for pile caps	
Equipment	:	Light lorries	2
D12.4	:	Concreting	
Description	:	The volume of concrete used in pile caps is about 160 cu.m.	
Equipment	:	Concrete pump	1
		Vibrators	2
		Compactor	1
D12.5	:	Falsework for wall	
Description	:	The total area of falsework is about 1,000 sq.m.	
Equipment	:	Light crane	1
		Lorries	2
D12.6	:	Concreting of retaining wall	
Description	:	The total volume of concrete is about 230 cu.m.	
Equipment	:	Concrete pump	1
		Vibrator	2
		Concrete mixer trucks	1
D13	:	**Embankment and Pavement**	
Description	:	General fill and 350m carriageway construction is under ...ess at the	

east bound carriageway of Tuen Mun Road. It is a 3-lane carriageway forming on an embankment, of which the normal fill height is 6m. The material generated by demolition is assumed about 3,700 cu.m. Totally about 1,600 sq.m of pavement surface is executed to be completed in Phase 5.

D13.1	:	Demolish the existing pavement	
Equipment	:	Excavator	2
		Loader	2
		Trucks	5
		Hydraulic breaker	2
D13.2	:	Filling	
Equipment	:	Roller	2
		Dozer	1
		Trucks	4
D13.3	:	Pavement	
Equipment	:	Paver	1
		Roller	2
		Trucks	10

Remarks : Sub-activity D10.2 or D12.2 was assumed for the whole duration of Activity D10-D13 for noise assessment.

D14 : **Underpass (Phase 6)**

Description : The 60m long underpass is to be 5.5m carriageway with 1m verge. The range of wall thickness is about 600mm to 800mm. It is expected that rock excavation will be required.

D14.1	:	Formation	
Equipment	:	Hydraulic breaker	3
		Excavator	3
		Loader	1
		Trucks	4
D14.2	:	Falsework	
Equipment	:	Crane	1
		Light lorries	2
D14.3	:	Concreting	
Equipment	:	Concrete pump	1
		Vibrators	2
		Concrete mixer truck	1
D14.4	:	Backfilling	
Equipment	:	Roller	1
		Dozer	1
		Trucks	4

D15	:	**Construction of Pavement at the east-bound carriageway of Castle Peak Road.**	
Description	:	General fill and 220m carriageway construction is under progress at the east bound carriageway of Castle Peak Road. It is a 2-lane. The material generated by demolition is assumed about 2,500 cu.m.	
D15.1	:	Demolish the existing pavement	
Equipment	:	Excavator	2
		Loader	2
		Trucks	5
		Hydraulic breaker	2
D15.2	:	Backfilling	
Equipment	:	Roller	2
		Dozer	1
		Trucks	4
D15.3	:	Pavement	
Equipment	:	Paver	1
		Roller	2
		Trucks	10
Remarks	:	Sub-activity D14.1 or D15.1 was assumed for the whole duration of Activity D14-D15 for noise assessment.	
D16	:	**Embankment and Pavement**	
Description	:	Carry on the remaining pavement works, 2,100 sq.m of pavement surface, at the east bound carriageway of Tuen Mun Road. Totally about 200 sq.m, 500 sq.m, 600 sq.m and 800 sq.m of pavement surface is executed to be completed in Phase 6, Phase 7, Phase 8 and Phase 9 respectively.	
D16.1	:	Demolish the existing pavement	
Equipment	:	Excavator	2
		Loader	2
		Trucks	5
		Hydraulic breaker	2
D16.2	:	Filling	
Equipment	:	Roller	2
		Dozer	1
		Trucks	4
D16.3	:	Pavement	
Equipment	:	Paver	1
		Roller	2
		Trucks	10
D17	:	**Stabilization Works for Rock Slope**	

Description	:	Typical preventive measures for rock slopes. Slope surface is about 500 sq.m.	
Equipment	:	Air compressor	1
	:	Shotcreting machine	1
		Concrete mixer truck	1
Remarks	:	Sub-activity D16.1 was assumed for the whole duration of Activity D16-D17 for noise assessment.	

Work Segment	:	**Caisson Wall, Advance Contract**
Working Period	:	September 1996 - August 1997
Working Hours	:	9 hours, 6 days/week
Location	:	Between Tsuen King Circuit and Kam Fung Garden
E1	:	**Caisson Wall**
Description	:	Typical cantilever wall retaining structure. The total length and maximum height are about 200m and 16m respectively. Its location is between Kam Fung Garden and old Police HQ, in front of Tang Clan Ancestral Grave.
E1.1	:	Caisson Works
Description	:	The wall will have about 55 nos of 3mϕ caisson in 4.5m c/c
Equipment	:	Pneumatic drills 6 Pneumatic breakers 6 Compressors 2 Vibrators 2
E1.2	:	E1.2 Concreting for caisson
Description	:	It is assumed that the quantity of concrete involved is about 1,500cu.m.
Equipment	:	Mobile cranes 1 Vibrators 2 Concrete mixer truck 1
E1.3	:	Excavation in front of the wall and filling the panels between individual caissons.
Description	:	The quantities of cut and concrete involved are assumed 13,000cu.m and 1,800cu.m respectively. It is also assumed that 3,300sq.m falsework will be involved.
Equipment	:	Excavator 2 Loader 1 Trucks 5 Crane 2 Lorries 2 Mobile cranes 1 Vibrators 2 Concrete mixer truck 1
E1.5	:	Wall finish
Description	:	It is assumed that the surface of wall is about 1,500sq.m.
Equipment	:	Mobile cranes 1
Remarks	:	Sub-activity E1.1 was assumed for the whole duration of Activity E for noise assessment.

Work Segment	:	**Castle Peak Road Widening and Bridge 5, West Contract**
Working Period	:	April 1998 - May 2002
Working Hours	:	9 hours, 6 days/week
Location	:	Between Kam Fung Garden and China Dyeing Re-development Site
Remarks	:	It is expected that a 4-phase traffic diversion scheme is required to maintain the existing traffic flow along Castle Peak Road for the utilities diversion and bridge works.
F1	:	**Demolition of Old Police HQ (Phase 1)**
Description	:	Low rise building.
Duration	:	4 weeks
Equipment	:	Loaders 1 Hydraulic Breakers 1 Trucks 2
F2	:	**Formation for Widened Carriageway**
Description	:	Excavation of existing foothills to form the reserve for future widened carriageway. Total surface area to be formed is estimated to be 6,000 sq.m. and the total quantity of excavated materials is 5,000 cu.m. The commencing day is same as F1.
F2.1	:	Demolition of existing pavement
Duration	:	8 weeks
Equipment	:	Hydraulic breaker 2 Excavator 2 Loader 2 Trucks 10
F2.2	:	Formation
Duration	:	16 weeks
Equipment	:	Grader 1 Roller 1 Excavator 1 Trucks 2
Remarks	:	Sub-activity F2.1 was assumed for the whole duration of Activity F2 for noise assessment.
F3	:	**Utilities and Drainage Diversions**
Description	:	Diversion works mainly at Castle Peak Road. One of the major diversion works is one section of 48" fresh water trunk main, 300m long with 1.5m normal cover along Castle Peak Road.

F3.1	:	Formation for 48" fresh water main.	
Duration	:	16 weeks	
Equipment	:	Excavators	1
		Trucks	2
F3.2	:	Pipe laying	
Duration	:	16 weeks	
Equipment	:	Mobile crane	1
Remarks	:	It is expected that the completion day is to be 4 weeks later than F3.2.	
F3.3	:	Concreting for thrust blocks	
Duration	:	1 week	
Equipment	:	Concrete mixer truck	1
		Vibrator	2
F3.4	:	Backfilling	
Duration	:	2 weeks	
Equipment	:	Roller	1
		Excavator	1
		Trucks	2
Remarks	:	Sub-activity F3.4 was assumed for the whole duration of Activity F3 for noise assessment.	
F4	:	**Pavement**	
Description	:	A 6,000 sq.m of flexible pavement is to be formed.	
Duration	:	4 weeks	
Equipment	:	Paver	1
		Roller	2
		Trucks	10
F5.	:	**Carriageway at the Existing Road Surface of Tsuen King Circuit (Phase 2)**	
Description	:	Lowering of smaller sized watermains and other utilities along and across Tsuen King Circuit is required. 2,100 cu.m of existing carriageway has to be reconstructed to the finished level.	
F5.1	:	Demolition of existing pavement	
Duration	:	4 weeks	
Equipment	:	Hydraulic breaker	1
		Excavator	2
		Loader	1
		Trucks	10
F5.2	:	Formation	
Duration	:	10 weeks	
Equipment	:	Grader	1
		Roller	1

		Excavator	1
		Trucks	2
F5.3	:	Formation for 48" fresh water main.	
Duration	:	3 weeks	
Description	:	A 50m of water main will be laid.	
Equipment	:	Excavators	1
		Trucks	2
F5.4	:	Pipe laying	
Duration	:	4 weeks	
Equipment	:	Mobile crane	1
F5.5	:	Concreting for thrust blocks	
Duration	:	1 week	
Equipment	:	Concrete mixer truck	1
		Vibrator	2
F5.6	:	Backfilling	
Duration	:	1 week	
Equipment	:	Roller	1
		Excavator	1
		Trucks	2
F5.7	:	Pavement	
Description	:	A 2,100 sq.m of flexible pavement is to be formed.	
Duration	:	3 weeks	
Equipment	:	Paver	1
		Roller	2
		Trucks	10
Remarks	:	Sub-activity F5.1 was assumed for the whole duration of Activity F5 for noise assessment.	
F6	:	**Forming of Temporary Pavement for Traffic Diversion (Phase 3)**	
Description	:	In order to maintain the right turn traffic movement from Castle Peak Road to Tsuen King Circuit, it is necessary to construct 20m by 15m temporary concrete carriageway for the right-turn pocket.	
F6.1	:	Formation	
Duration	:	1 week	
Equipment	:	Roller	1
		Excavator	1
		Trucks	2
F6.2	:	Pavement	
Duration	:	1 week	
Equipment	:	Concrete mixer truck	1
		Vibrator	2

Remarks	:	Sub-activity F6.1 was assumed for the whole duration of Activity F6 for noise assessment.	
F7	:	**Re-construction of West-Bound Carriageway of Castle Peak Road to the Design Finished Level.**	
F7.1	:	Demolition of existing pavement	
Description	:	It is assumed that the material generated by demolition is about 6,700 cu.m.	
Duration	:	8 weeks	
Equipment	:	Hydraulic breaker	2
		Excavator	2
		Loader	2
		Trucks	10
F7.2.	:	Formation	
Description	:	The surface of formation to be formed is about 4,500sq.m.	
Duration	:	23 weeks	
Equipment	:	Grader	1
		Roller	1
		Excavator	1
		Trucks	2
F7.3	:	Pavement	
Description	:	A 4,500 sq.m of flexible pavement is to be formed.	
Duration	:	6 weeks	
Equipment	:	Paver	1
		Roller	2
		Trucks	10
Remarks	:	Sub-activity F7.1 was assumed for the whole duration of Activity F7 for noise assessment.	
F8	:	**Bridge 5 (Phase 4)**	
Description	:	Bridge 5 is a 25m wide, 160m long prestressed concrete cellular structure with approximate 40m span. It is assumed that the total quantities of concrete involved is about 1500 cu.m for sub-structure.	
F8.1	:	Piling and abutment	
Duration	:	12 weeks	
Equipment	:	Bored piling Rigs	2
		Hydraulic breaker	1
		Excavator	2
		Loader	1
		Trucks	5
F8.2	:	Concreting for piling	
Duration	:	1 week	
Equipment	:	Concrete Pumps	1

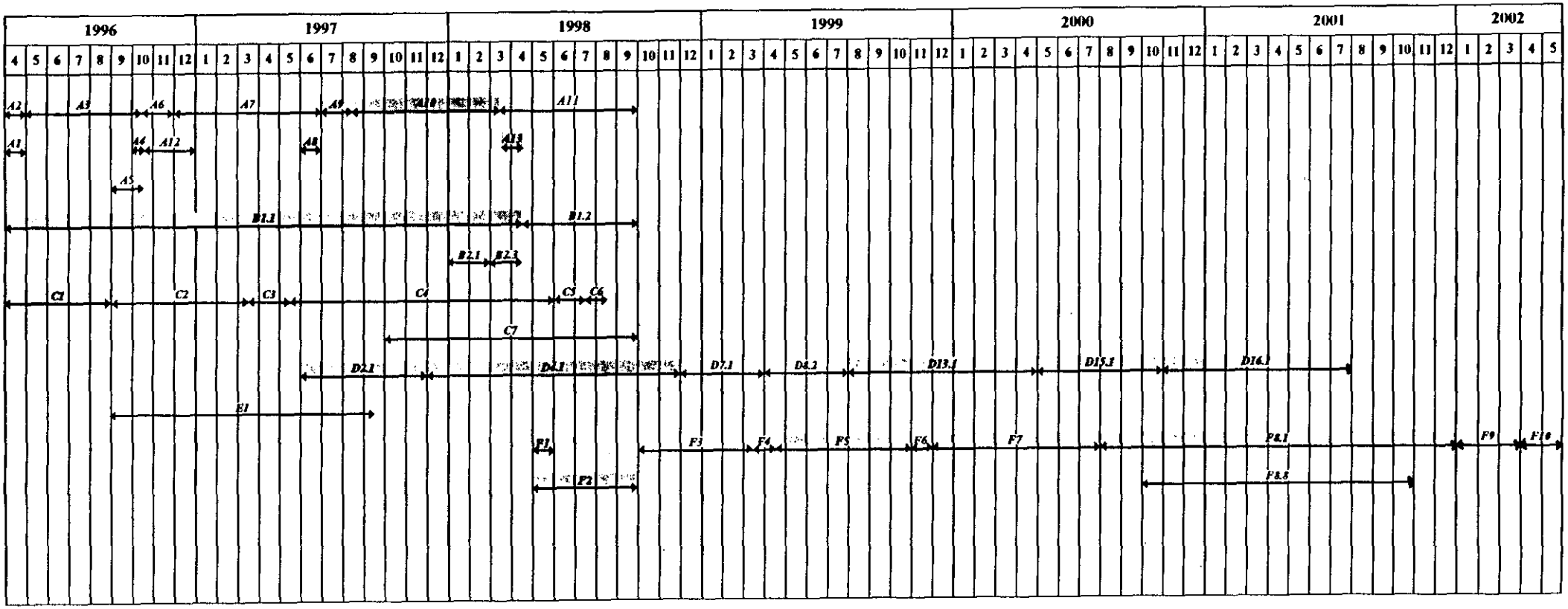
		Vibrators	4
		Concrete mixer trucks	2
F8.3	:	Excavation	
Description	:	It is assumed that the quantity of earthwork is about 800 cu.m per pile cap.	
Duration	:	2 weeks	
Equipment	:	Excavator	2
		Hydraulic breaker	1 (stand-by)
		Trucks	6
F8.4	:	Falsework for pile caps and abutment	
Duration	:	6 weeks	
Equipment	:	Lorries	2
	:	Concreting for pile cap and abutment	
Description	:	It is assumed that the quantity of concrete involved is about 450 cu.m.	
Duration	:	4 week	
Equipment	:	Concrete Pumps	1
		Vibrators	4
		Concrete mixer trucks	2
F8.6	:	Backfilling	
Duration	:	1 week	
Equipment	:	Roller	1
		Trucks	2
F8.7	:	Falsework for superstructure.	
Duration	:	11 weeks	
Equipment	:	Lorries	2
F8.8	:	Concreting for superstructure and prestressing.	
Duration	:	50 weeks	
Description	:	It is assumed that the quantity of concrete involved is about 4,050 cu.m.	
Equipment	:	Concrete Pumps	1
		Vibrators	4
		Concrete mixer trucks	2
F8.9	:	Finishes	
Duration	:	5 weeks	
Description	:	Carriageway finishes.	
Equipment	:	Small cranes	2
		Trucks	2
		Light trucks	1
F8.10	:	Falsework Removal	
Duration	:	1 week	
Equipment	:	Mobile cranes	1
		Lorries	2
Remarks	:	Sub-activities F8.2 and F8.8 were assumed for the duration of activity F8 for noise assessment.	

F9	:	**Diversion of Watermain at Castle Peak Road**	
Description	:	Complete the diversion of 48" diameter trunk water main carriageway of Castle Peak Road. The length of this portion is about 30m.	
F9.1	:	Formation for 48" fresh water main.	
Duration	:	2 weeks	
Equipment	:	Excavators	1
		Trucks	2
F9.2	:	Pipe laying	
Duration	:	4 weeks	
Equipment	:	Mobile crane	1
F9.3	:	Concreting for thrust blocks	
Duration	:	1 week	
Equipment	:	Concrete mixer truck	1
		Vibrator	2
F9.4	:	Backfilling	
Duration	:	1 weeks	
Equipment	:	Roller	1
		Excavator	1
		Trucks	2
Remarks	:	Sub-activities F9.4 was assumed for the duration of Activity F9 for noise assessment.	
F10	:	**Re-construction of Existing Carriageway of Castle Peak Road.**	
Description	:	The pavement surface is about 3,000 sq.m.	
F10.1	:	Demolition of existing pavement	
Duration	:	4 weeks	
Equipment	:	Hydraulic breaker	1
		Excavator	2
		Loader	1
		Trucks	10
F10.2	:	Formation	
Duration	:	4 weeks	
Equipment	:	Grader	1
		Roller	1
		Excavator	1
		Trucks	2
F10.3	:	Pavement	
Duration	:	4 weeks	
Equipment	:	Paver	1
		Roller	2

	Trucks	10

Remarks : Sub-activities F10.1 was assumed for the duration of Activity F10 for noise assessment.

Figure C3.1 Construction activities assumed for operational noise assessment



Activity involving the operation of drills or breakers

APPENDIX C2 - SOUND POWER LEVEL OF EQUIPMENT EMPLOYED

ITEM	SOUND POWER LEVEL dB(A)
Air compressor	102
Breaker (hydraulic)	122
Bulldozer	117
Compactor	105
Concrete Mixer Truck	109
Concrete Pump	109
Crane (mobile)	112
Crane (Derrick)	112
Crane (small)	95
Crane	112
Drill (pneumatic)	128
Excavator	112
Generator	108
Grader	113
Loader	112
Lorry	112
Lorry (heavy)	117
Paver	109
Piling (large diameter bored)	115
Roller	108
Truck	112
Truck (heavy)	117
Truck (light)	109
Vibrator	108

Figure C1.1 : Noise Level at Shek Wai Kok Estate
Shek To House

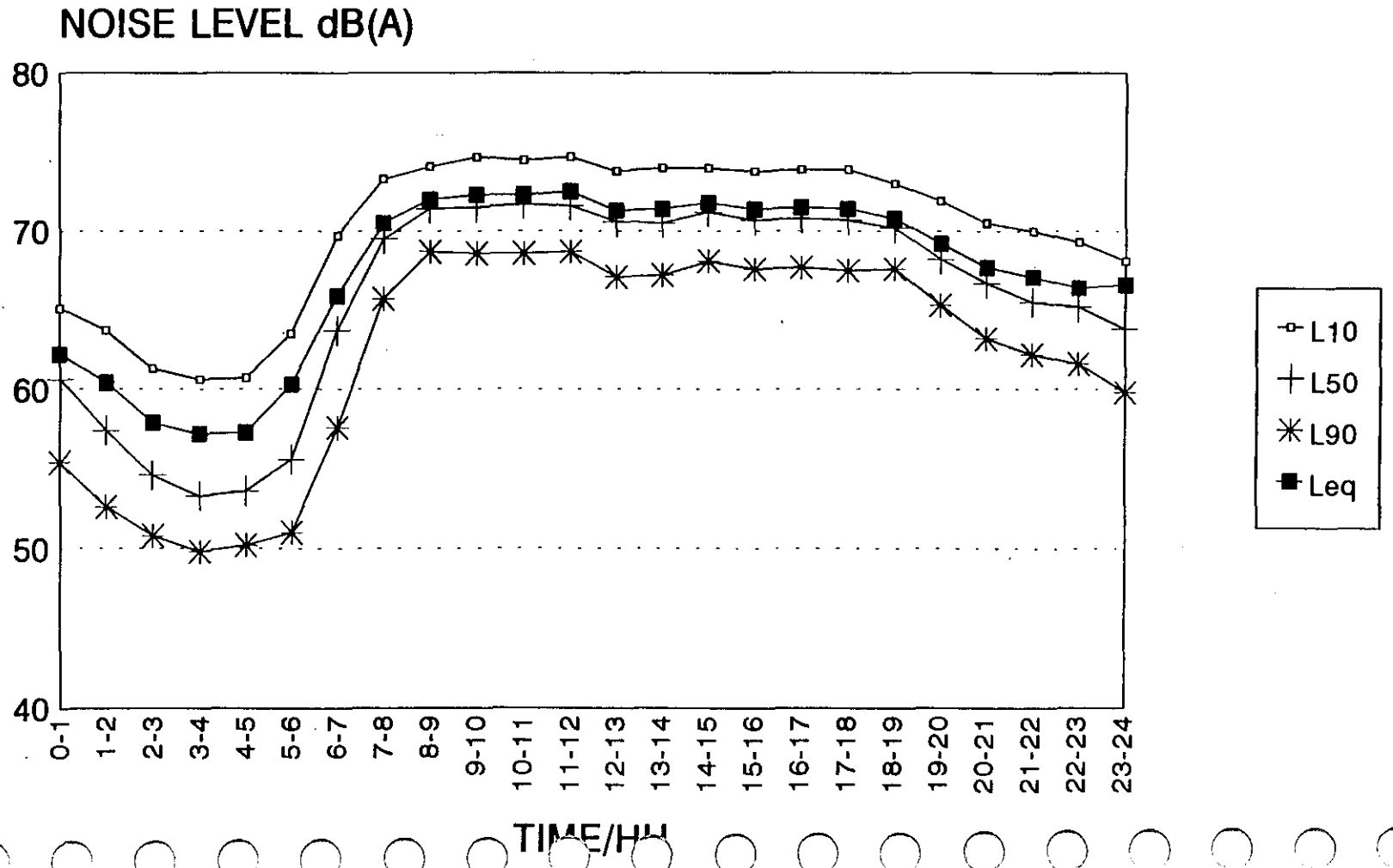


Figure C1.2 : Noise Level at Luk Yeung Sun Chuen Block 1

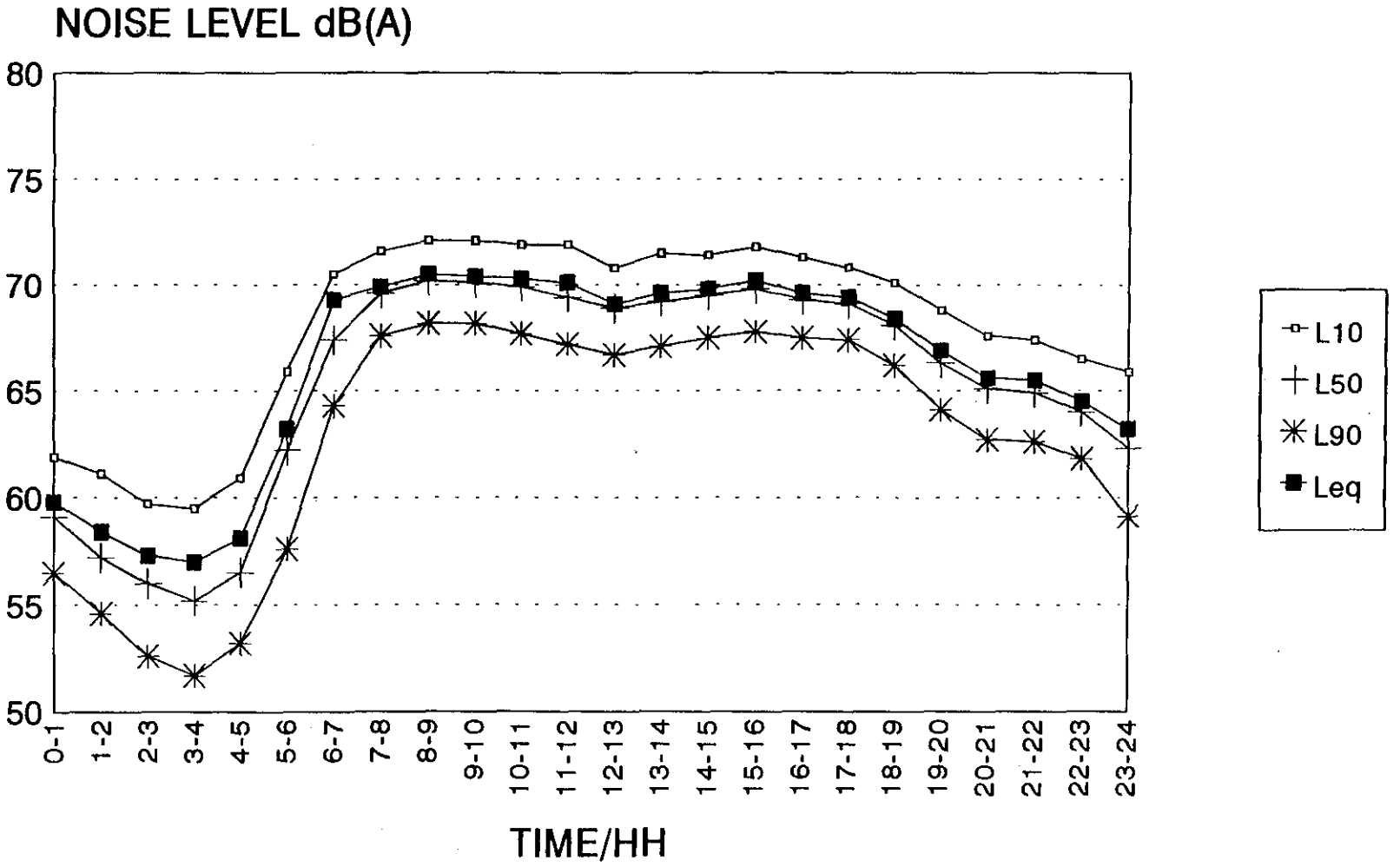


Figure C1.3 : Noise Level at Pak Tin Pa Tsuen

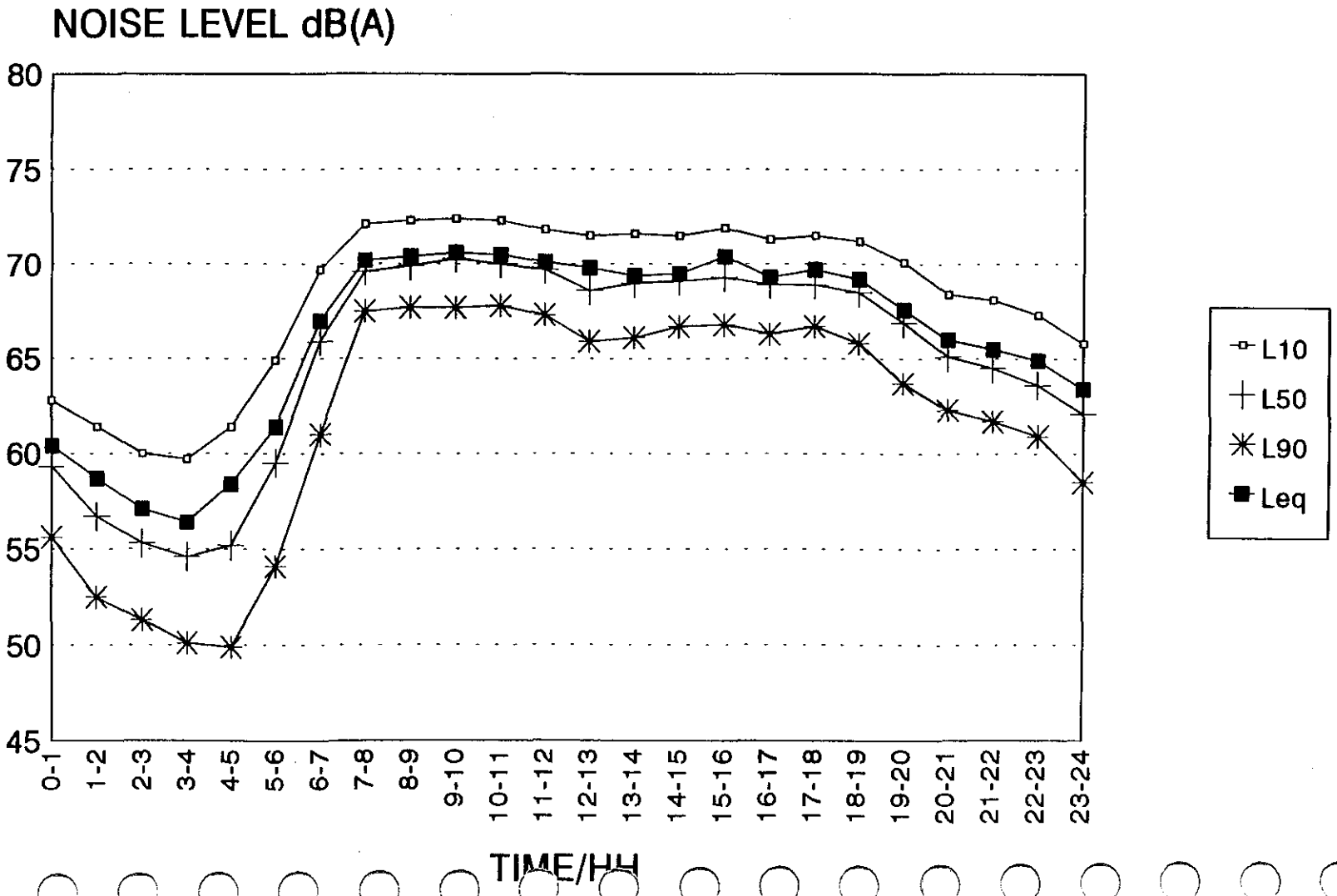


Figure C1.4 : Noise Level at Tung Lam Home for the Aged

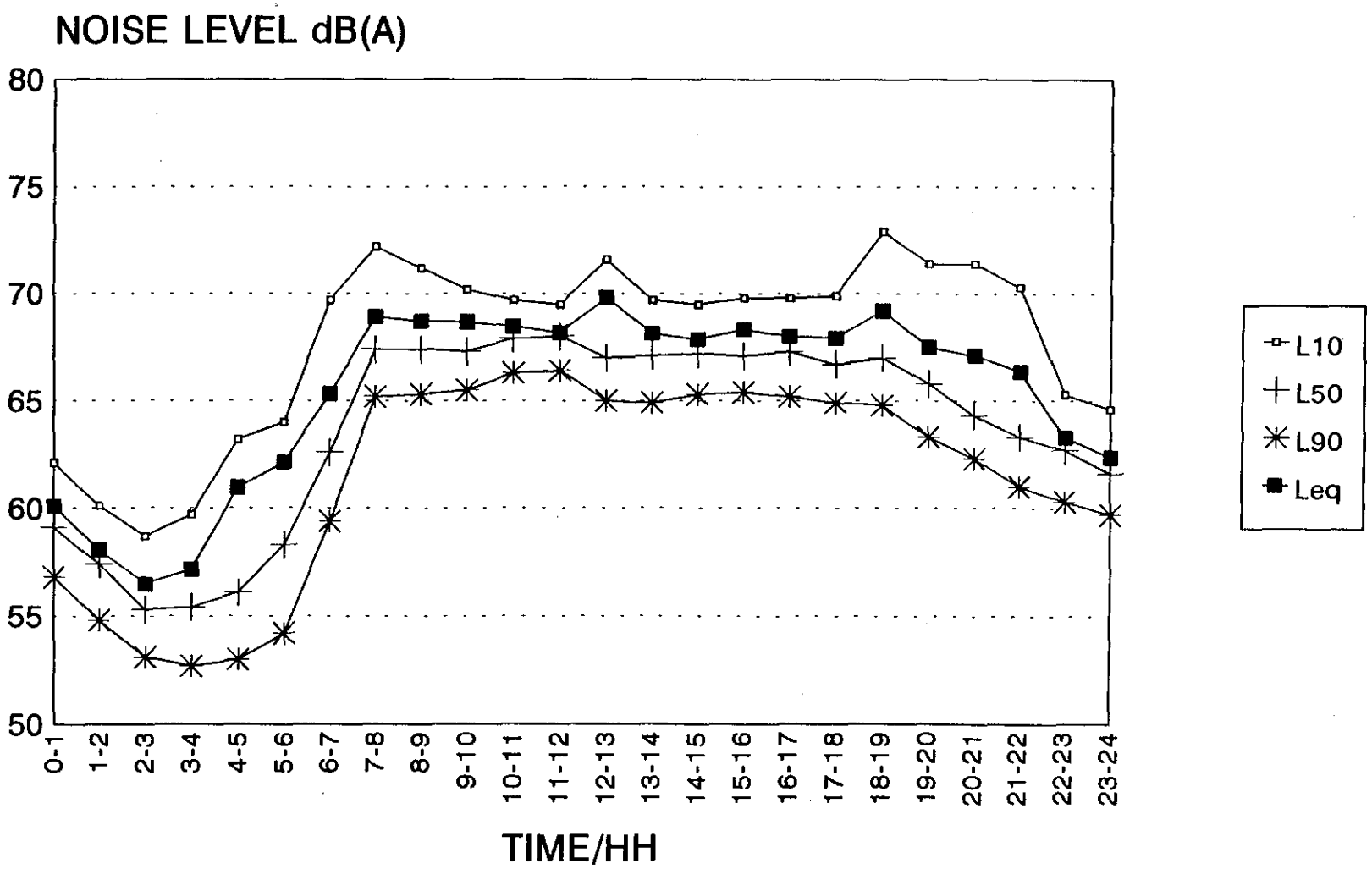


Figure C1.5 : Noise Level at Muk Min Ha Tsuen

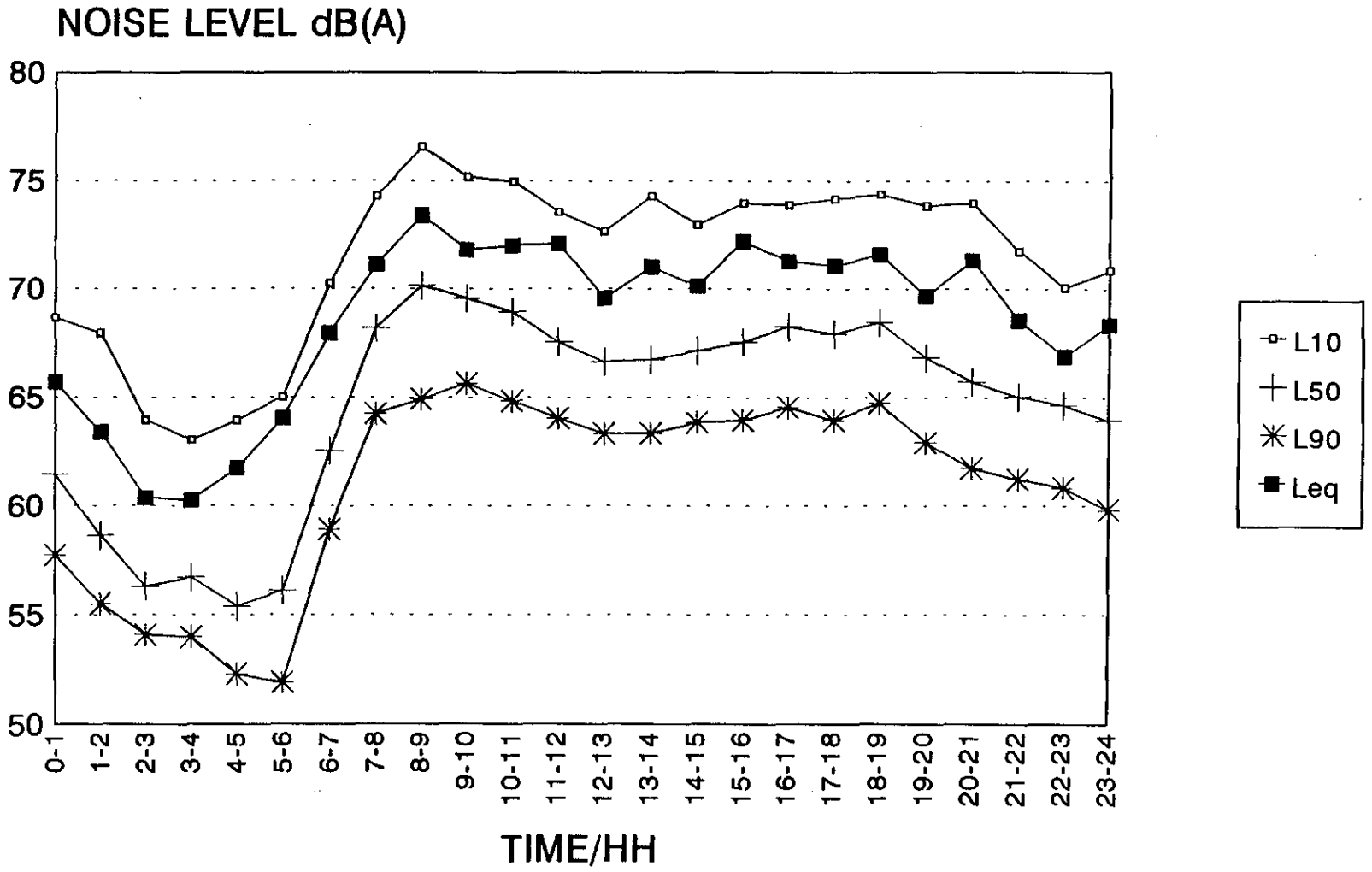


Figure C1.6 : Noise Level at Tsuen Kam Centre Block A

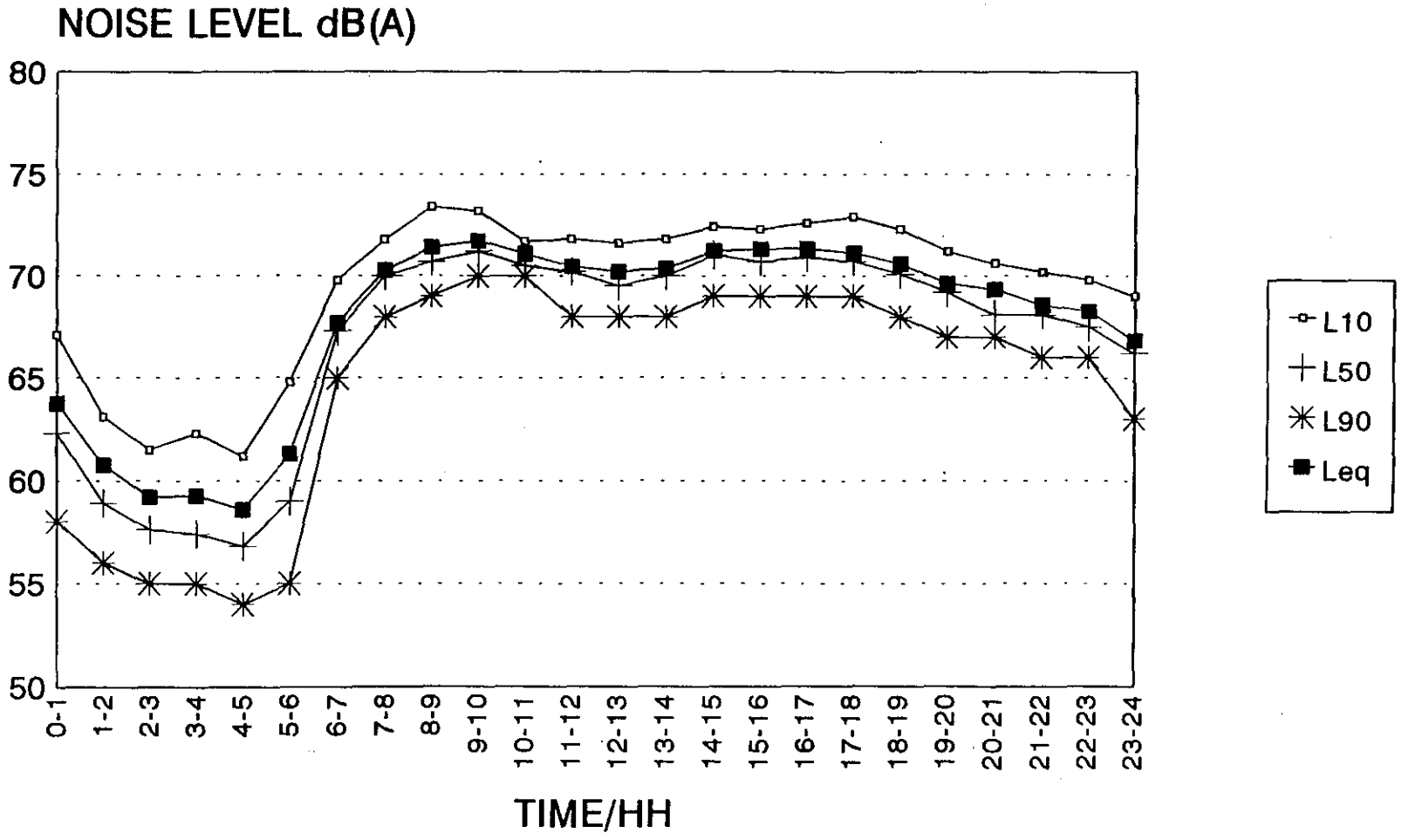


Figure C1.7 : Noise Level at Fok Loi Estate Wing Hong House

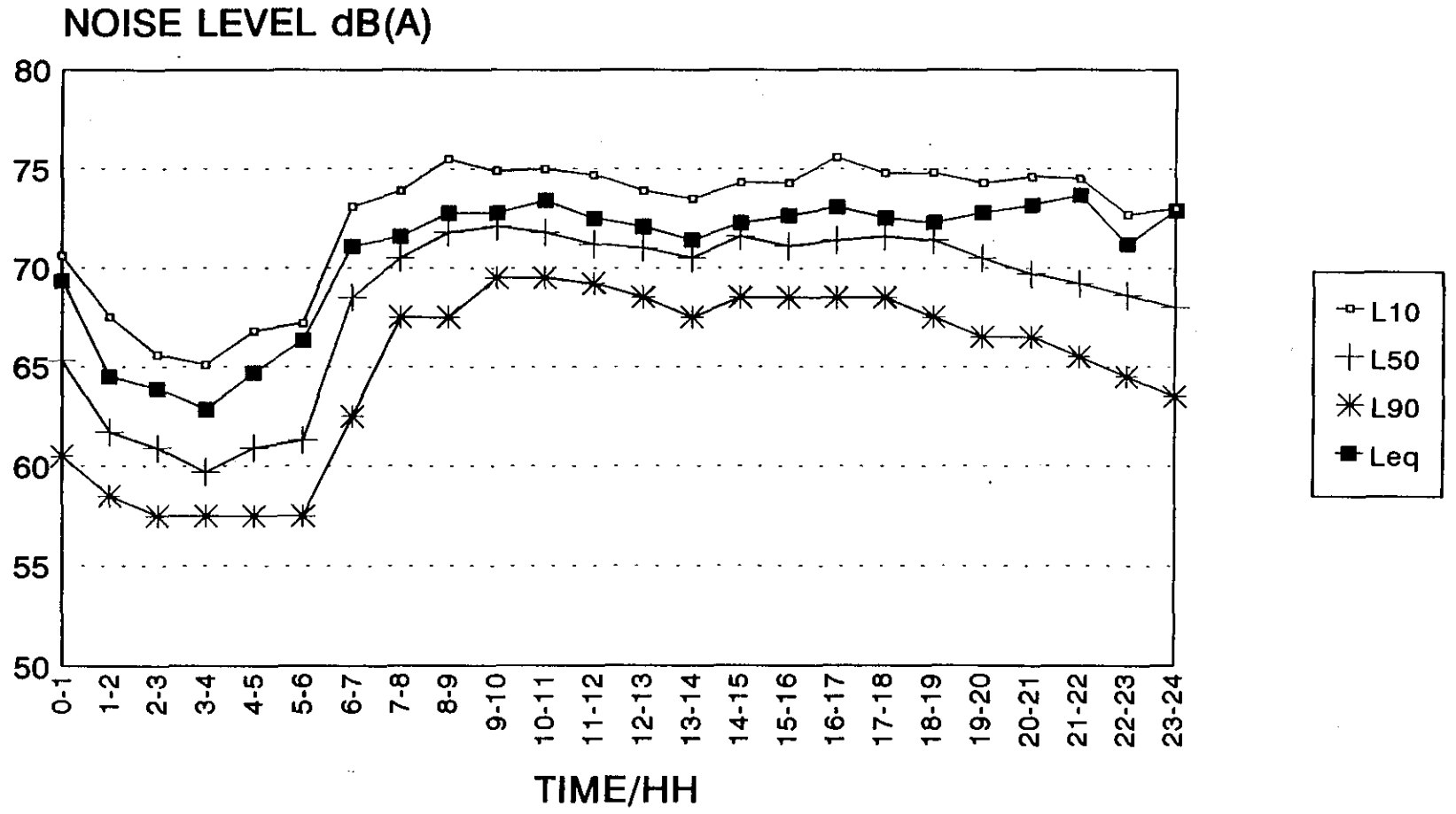


Figure C1.8 : Noise Level at Kam Fung Garden Block 1

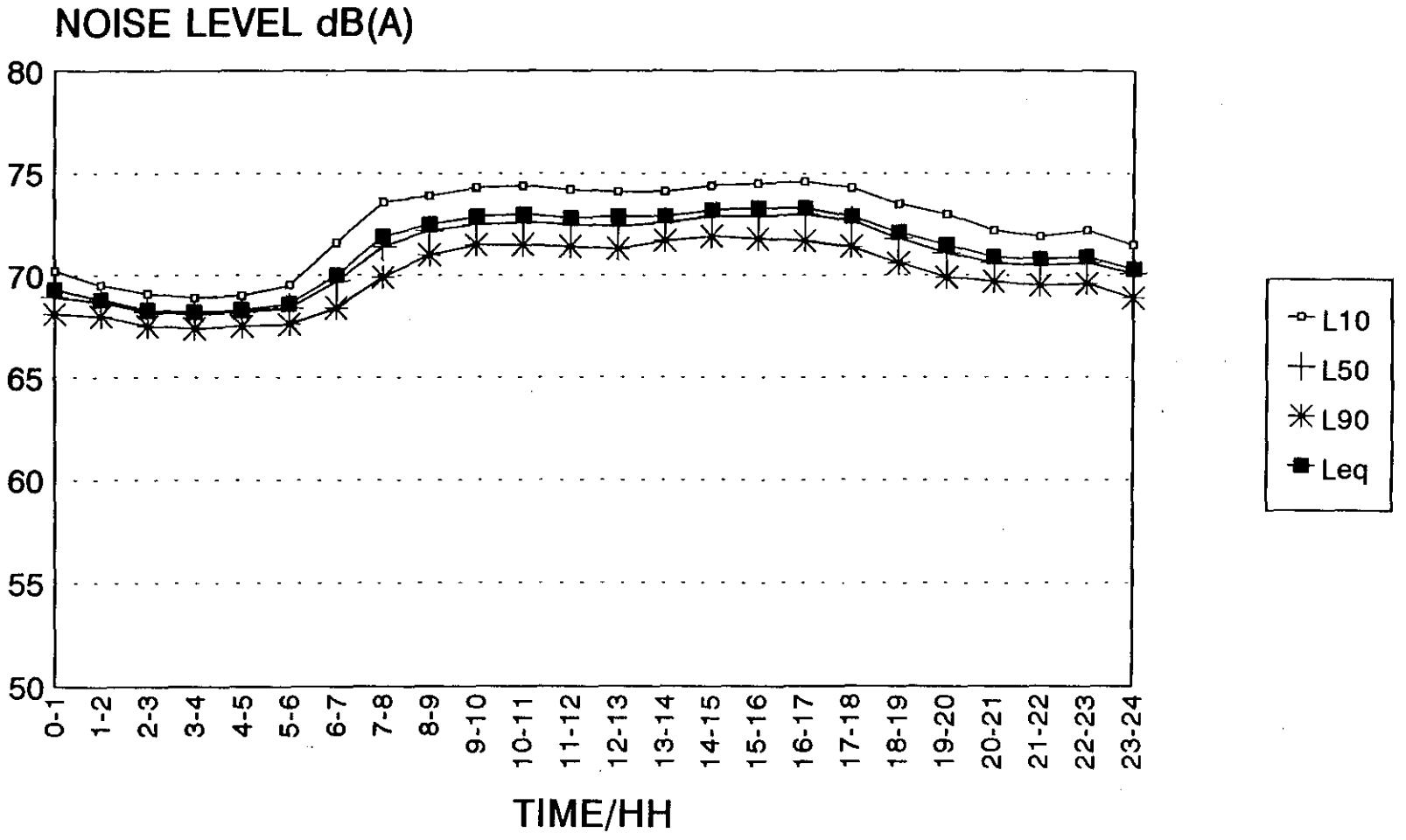


Figure C4.1 : Predicted construction noise levels at Shek Wai Kok Estate

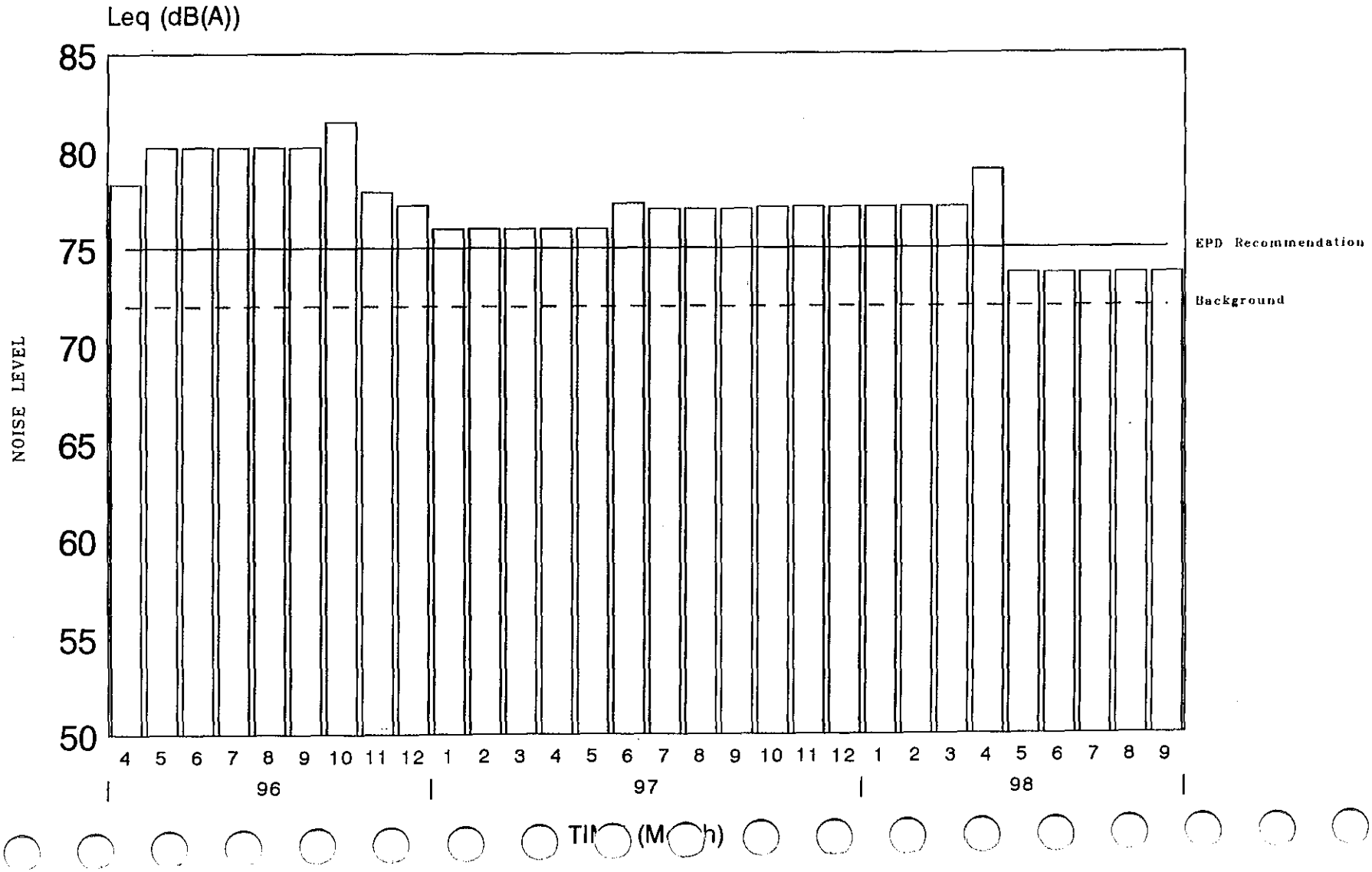


Figure C4.2 : Predicted Construction Noise Levels at Fairview Gardens

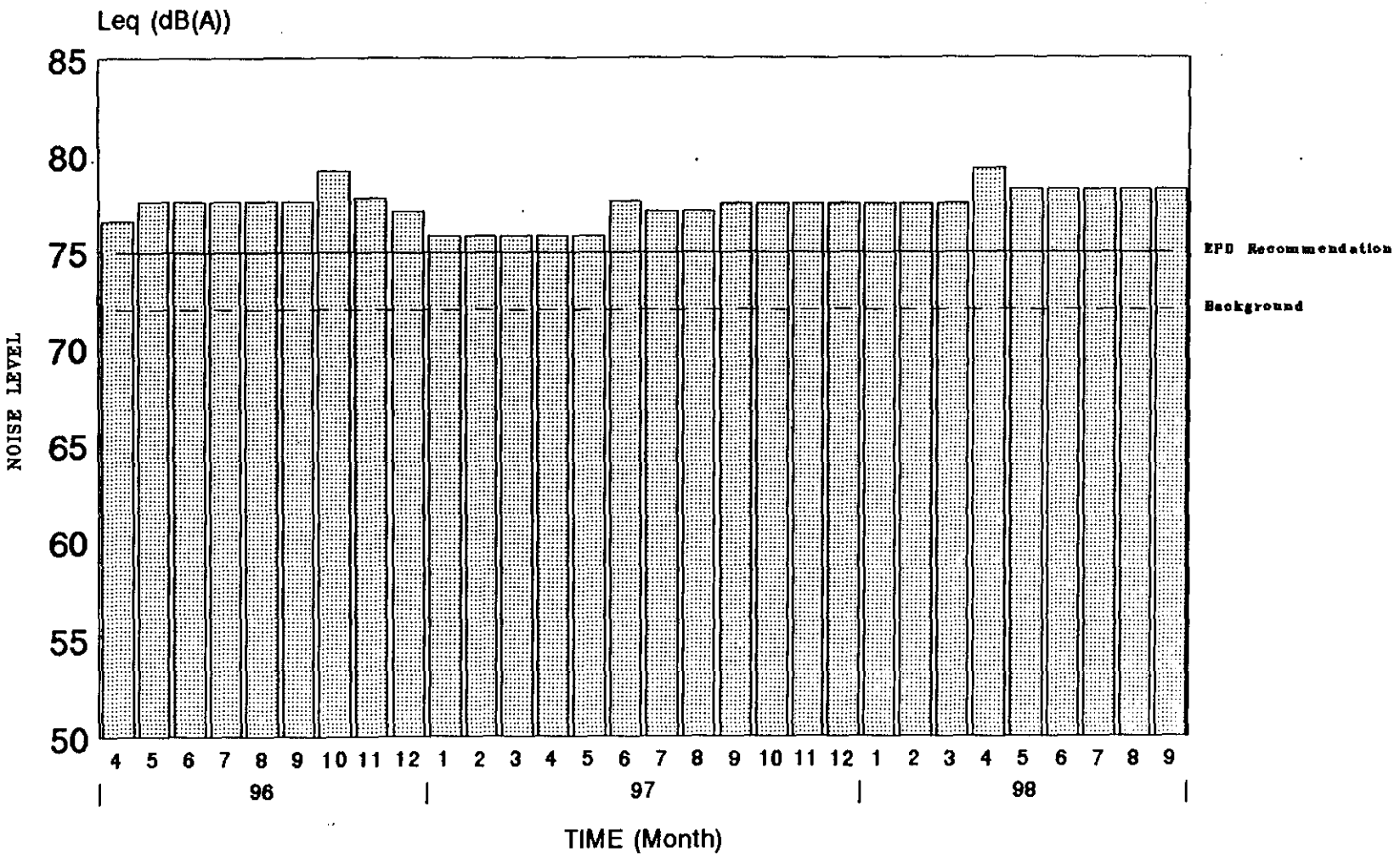


Figure C4.3 :Predicted construction noise levels at Kwai Ming Wu School

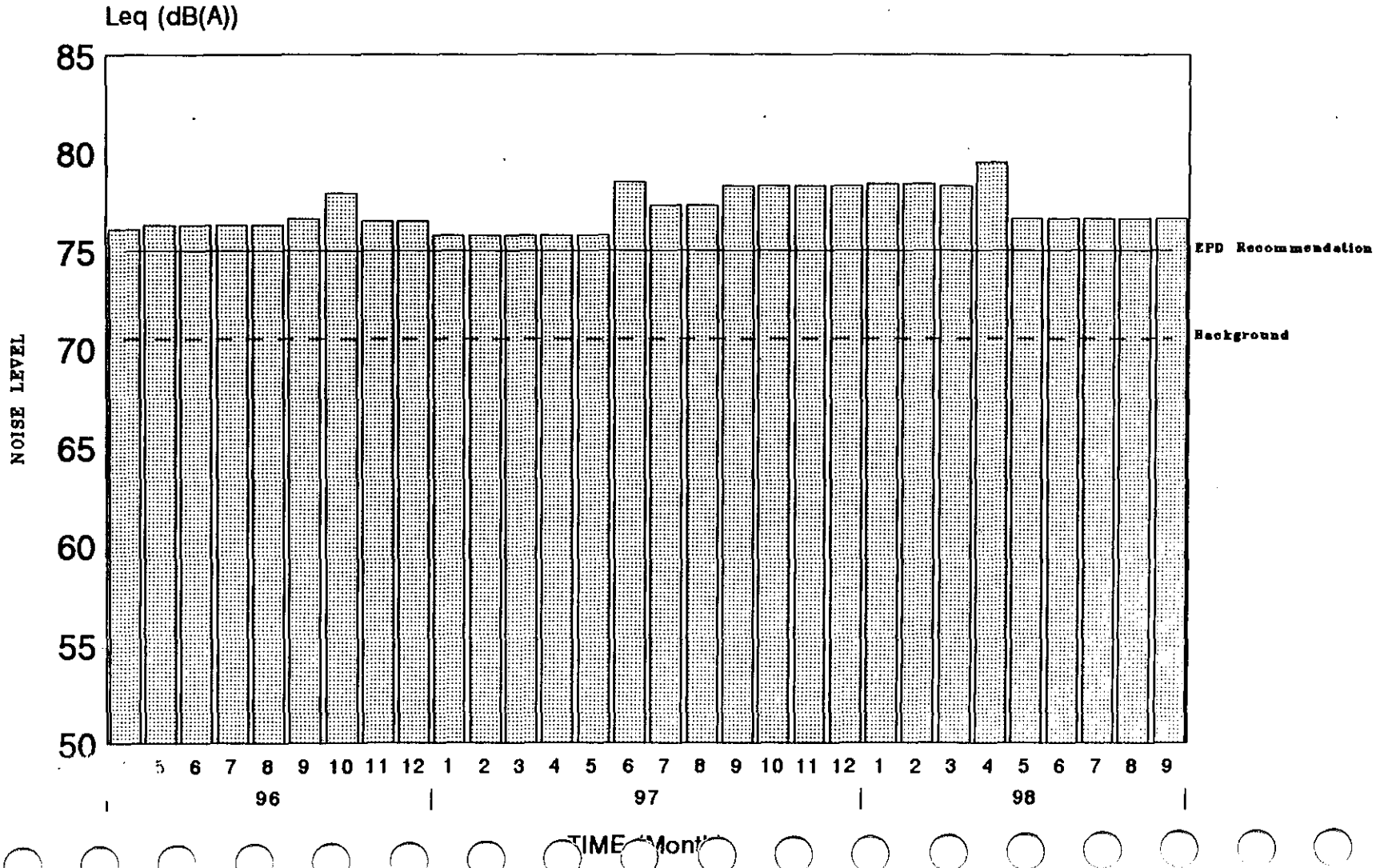


Figure C4.4 : Predicted construction noise levels at Luk Yeung Sun Chuen Block A north

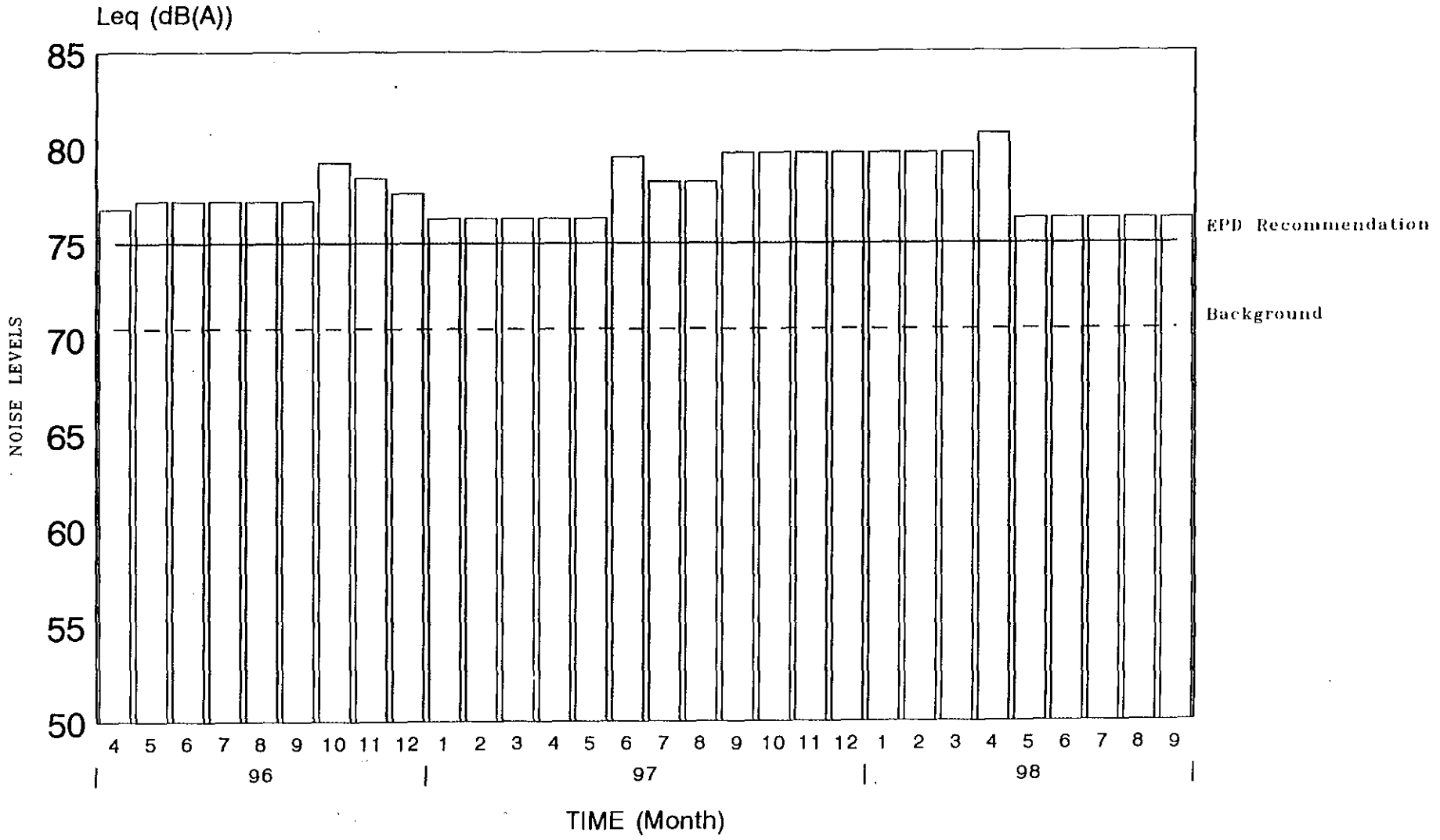


Figure C4.5 : Predicted construction noise levels at Luk Yeung Sun Chuen Block A west

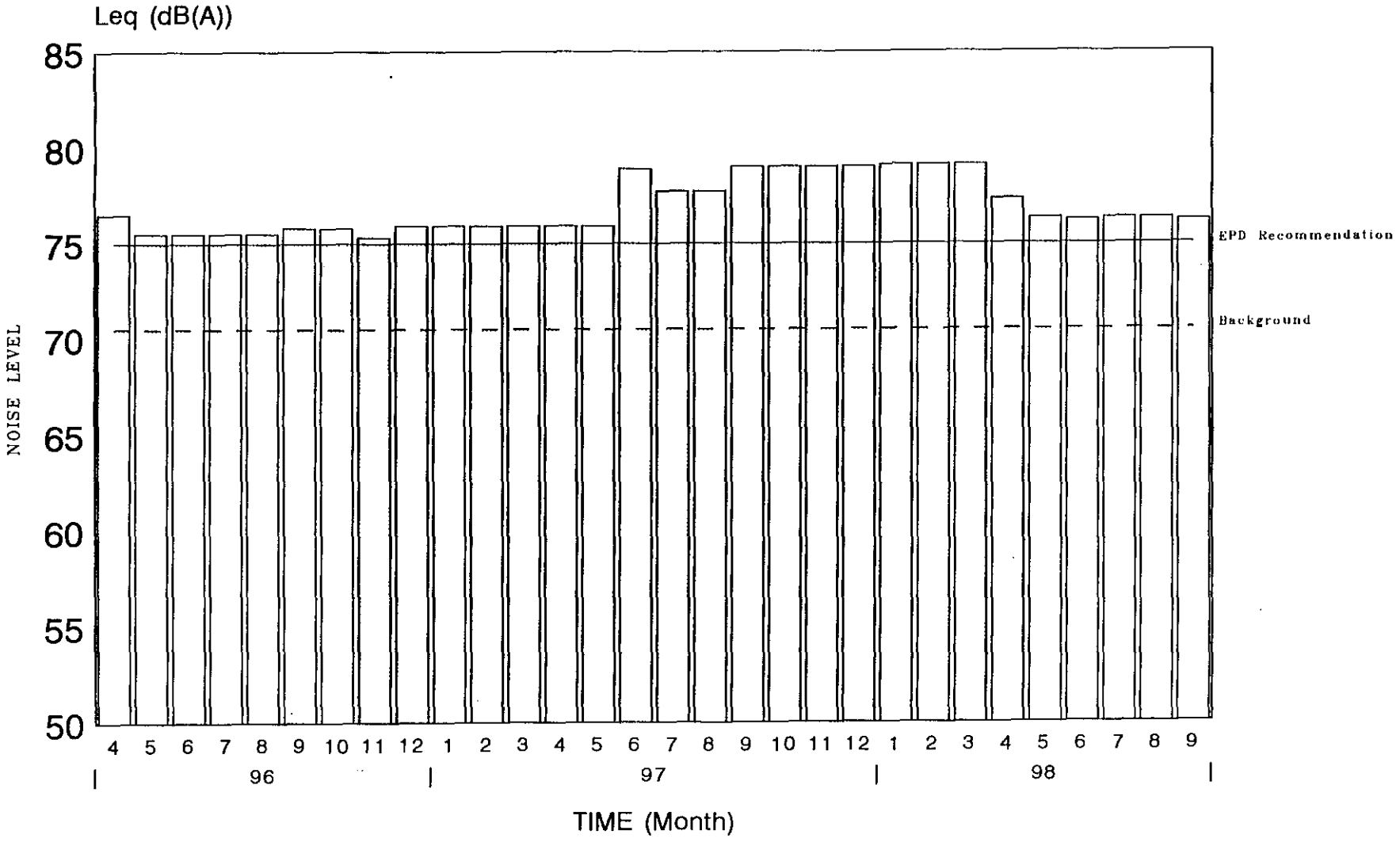


Figure C4.6 : Predicted construction noise levels at Luk Yeung Sun Chuen Block F north

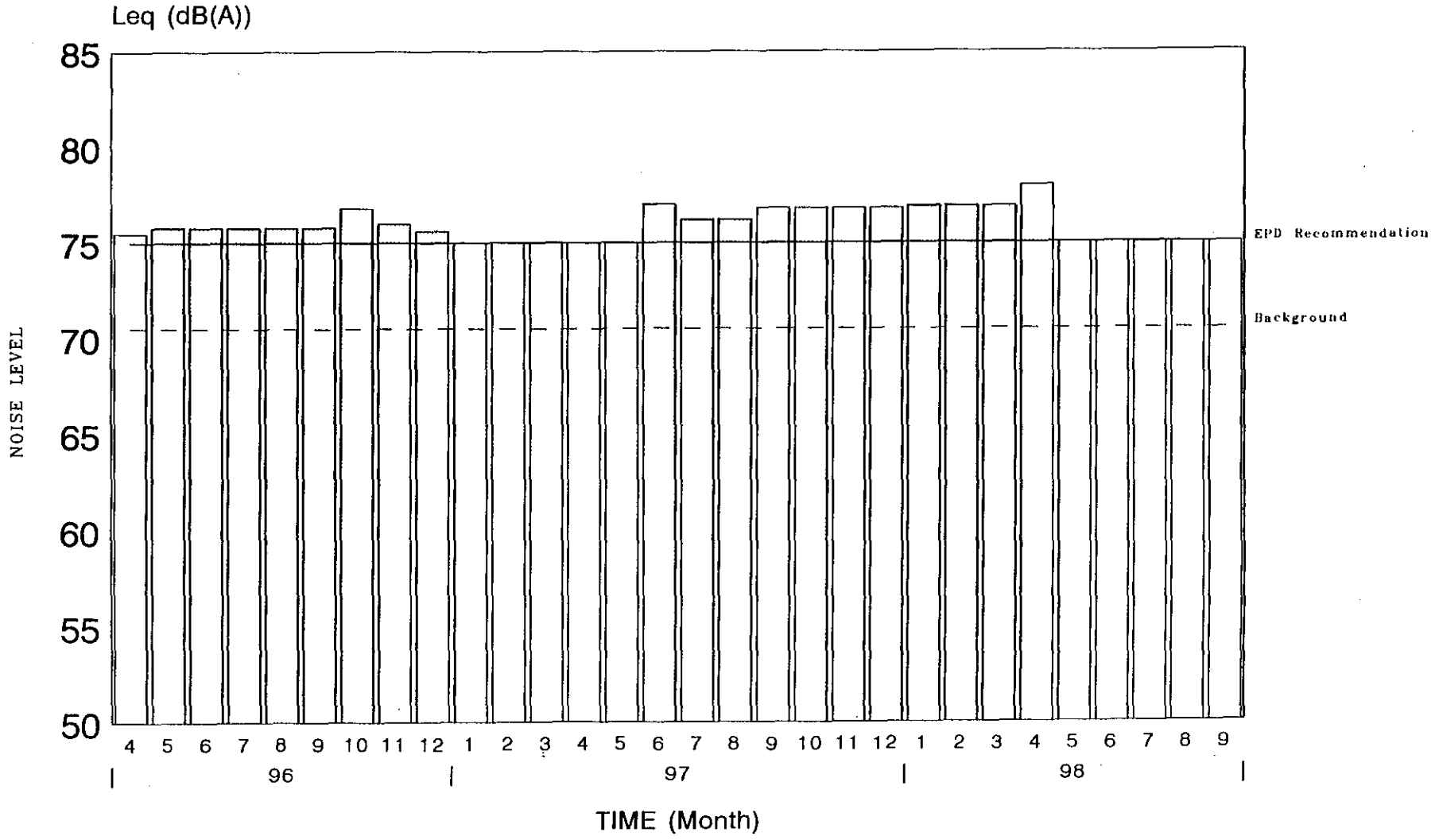


Figure C4.7 : Predicted construction noise levels at Luk Yeung Sun Chuen Block F west

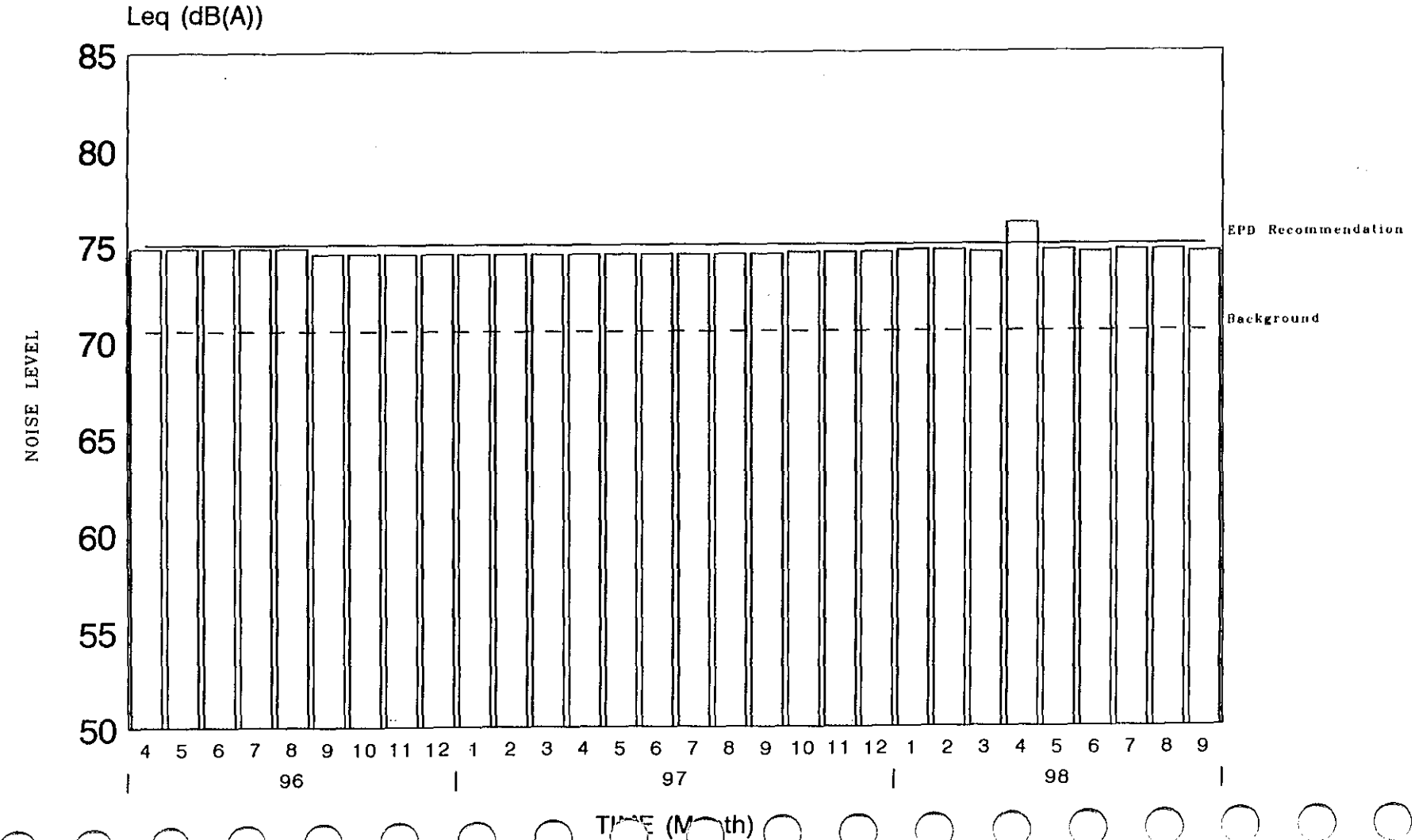


Figure C4.8 : Predicted construction noise levels at Pak Tin Pa Tsuen, Hoi Pa Village ST

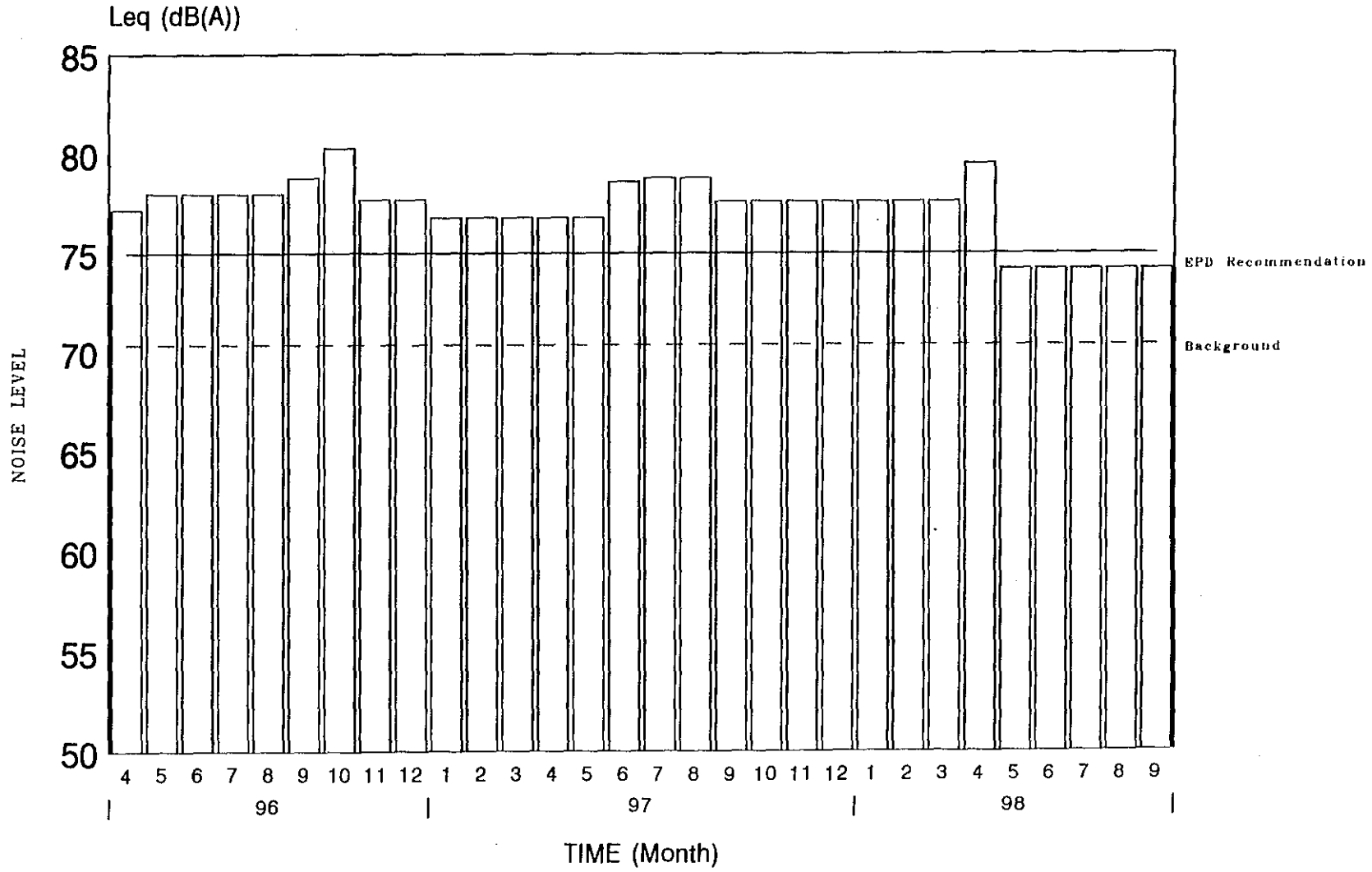


Figure C4.9 : Predicted construction noise levels at Tung Lam Home for the Aged

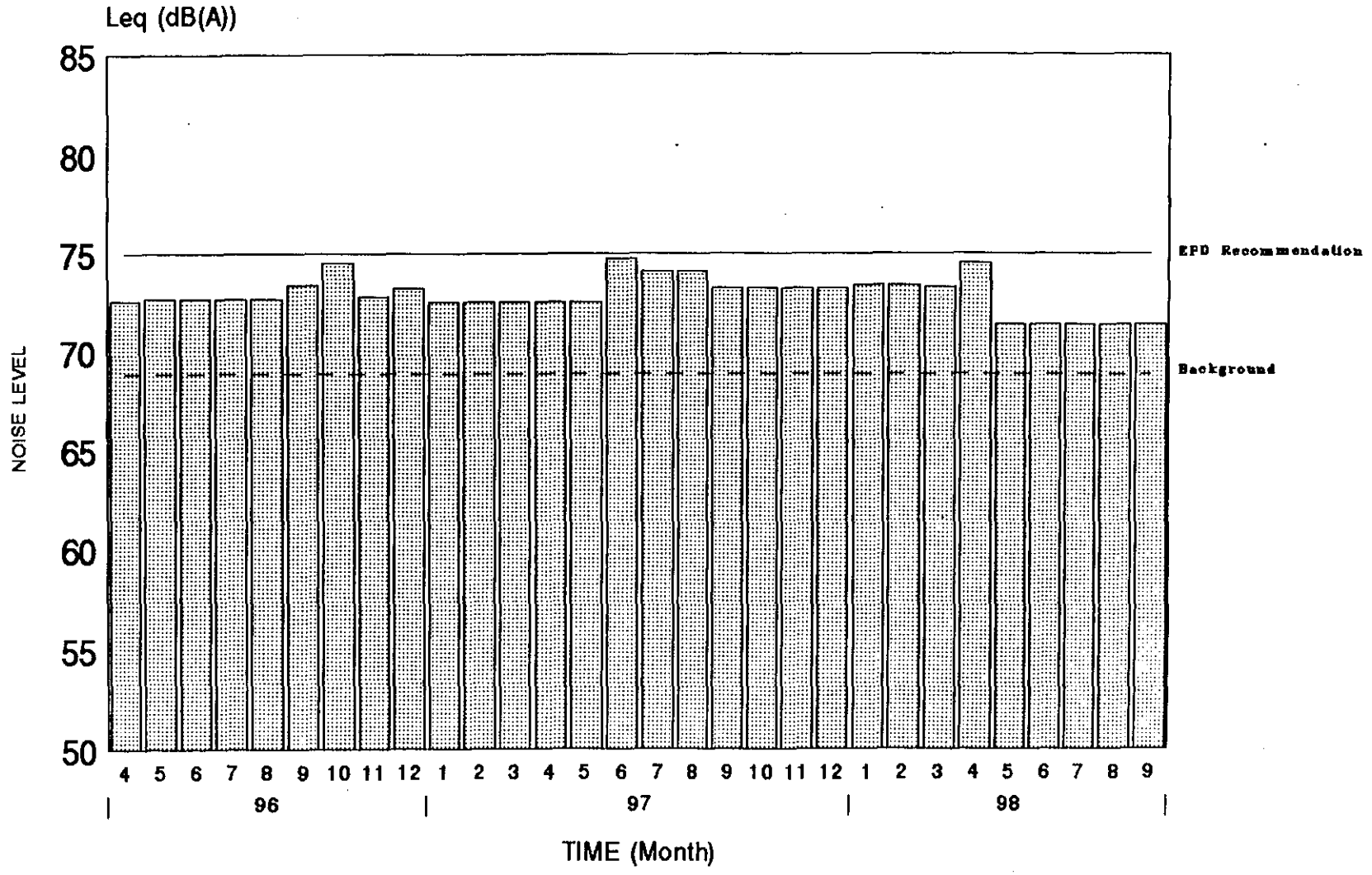


Figure C4.10 : Predicted construction noise levels at Muk Min Ha 1

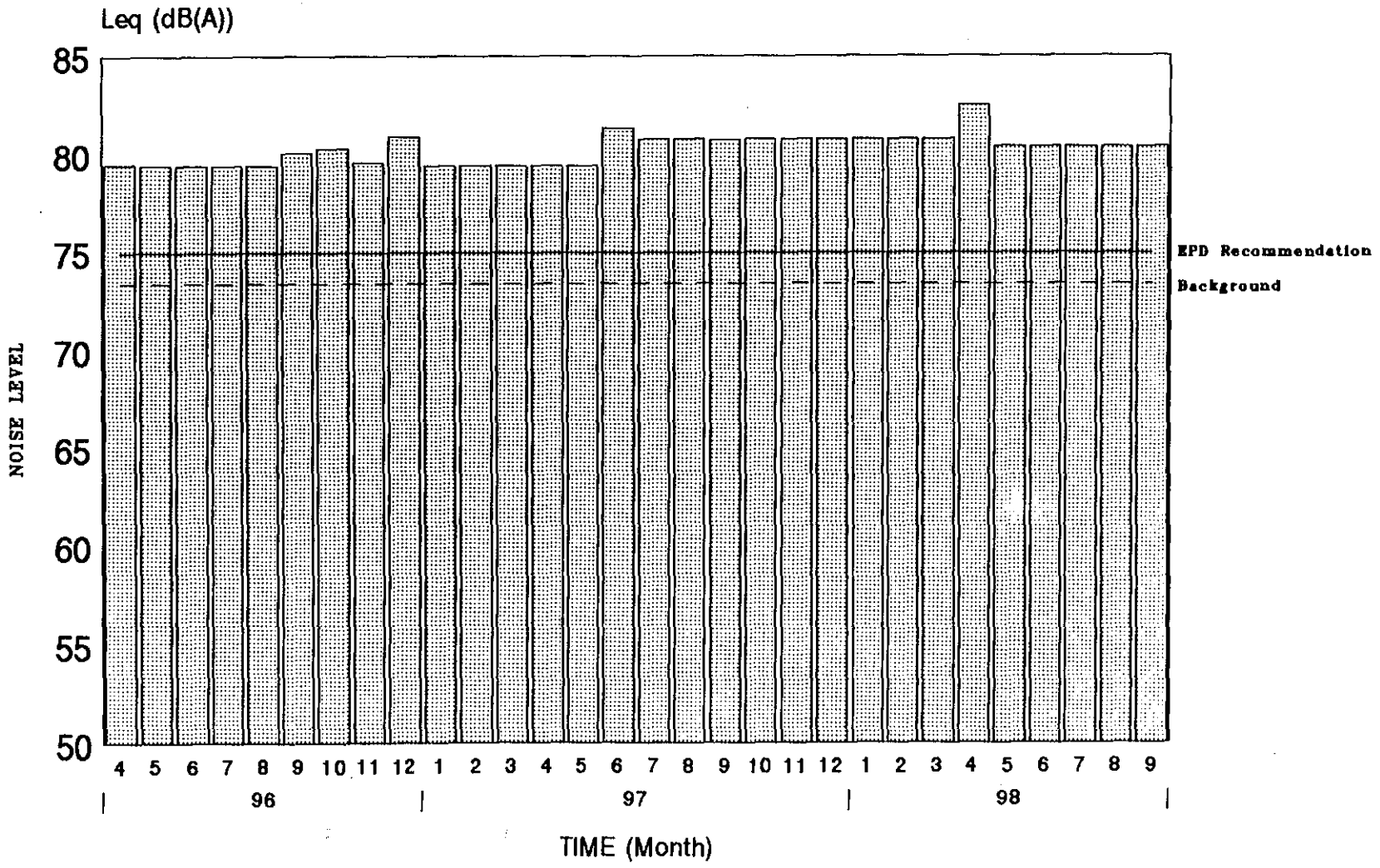


Figure C4.11 : Predicted construction noise levels at Muk Min Ha 16

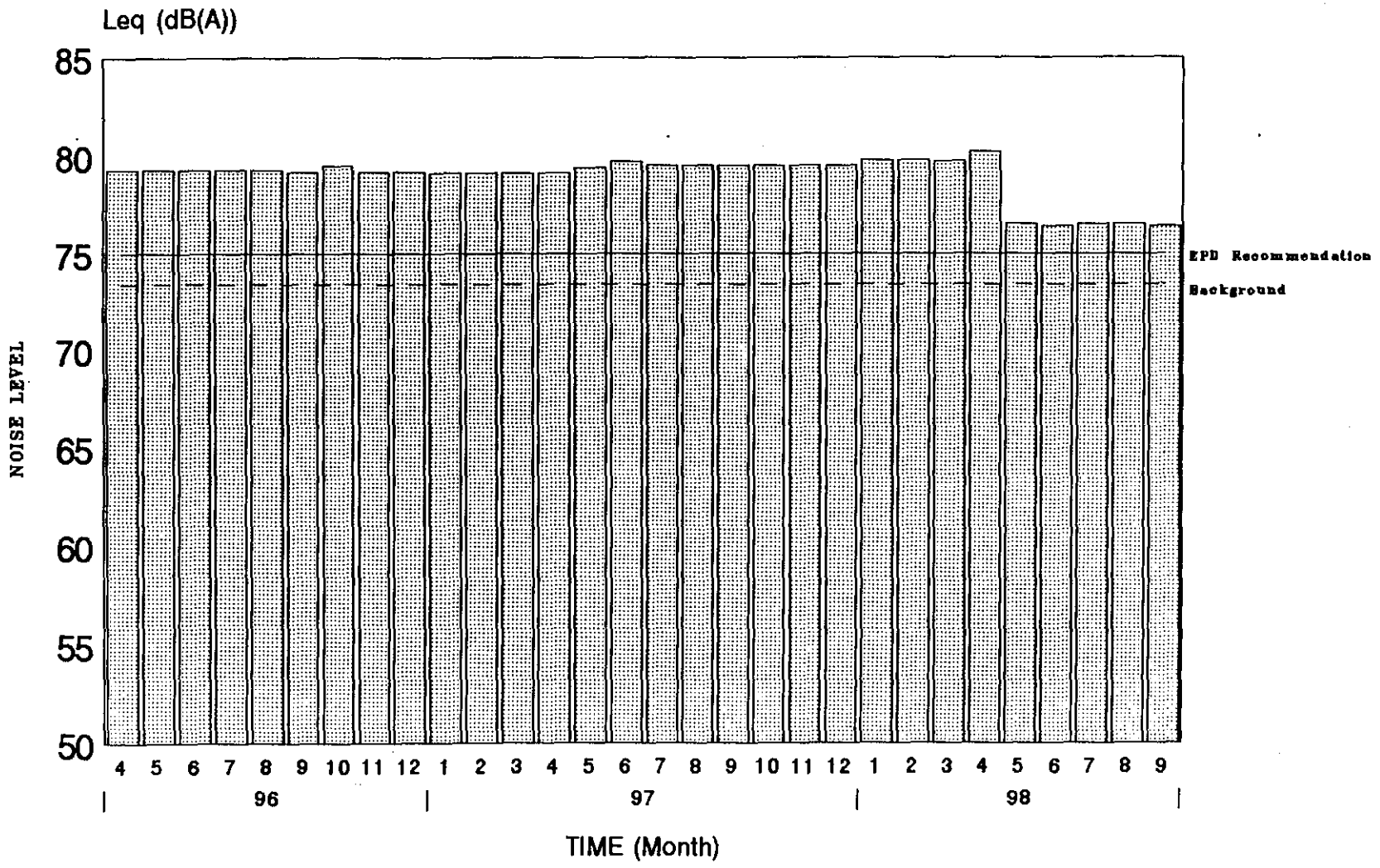


Figure C4.12 : Predicted construction noise levels at Pak Tin Pa

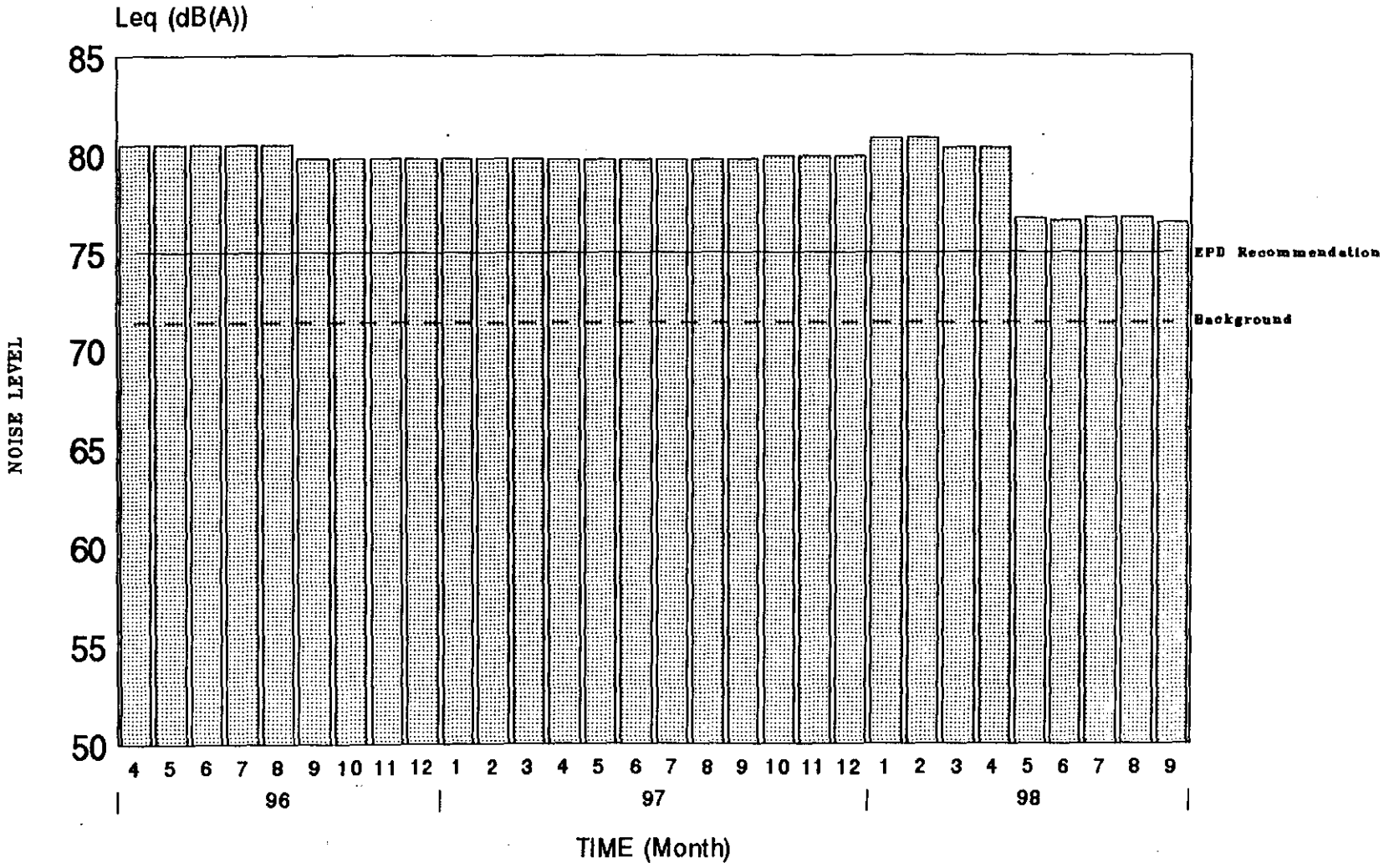


Figure C4.13 : Predicted construction noise at Tsuen Kam Centre 1

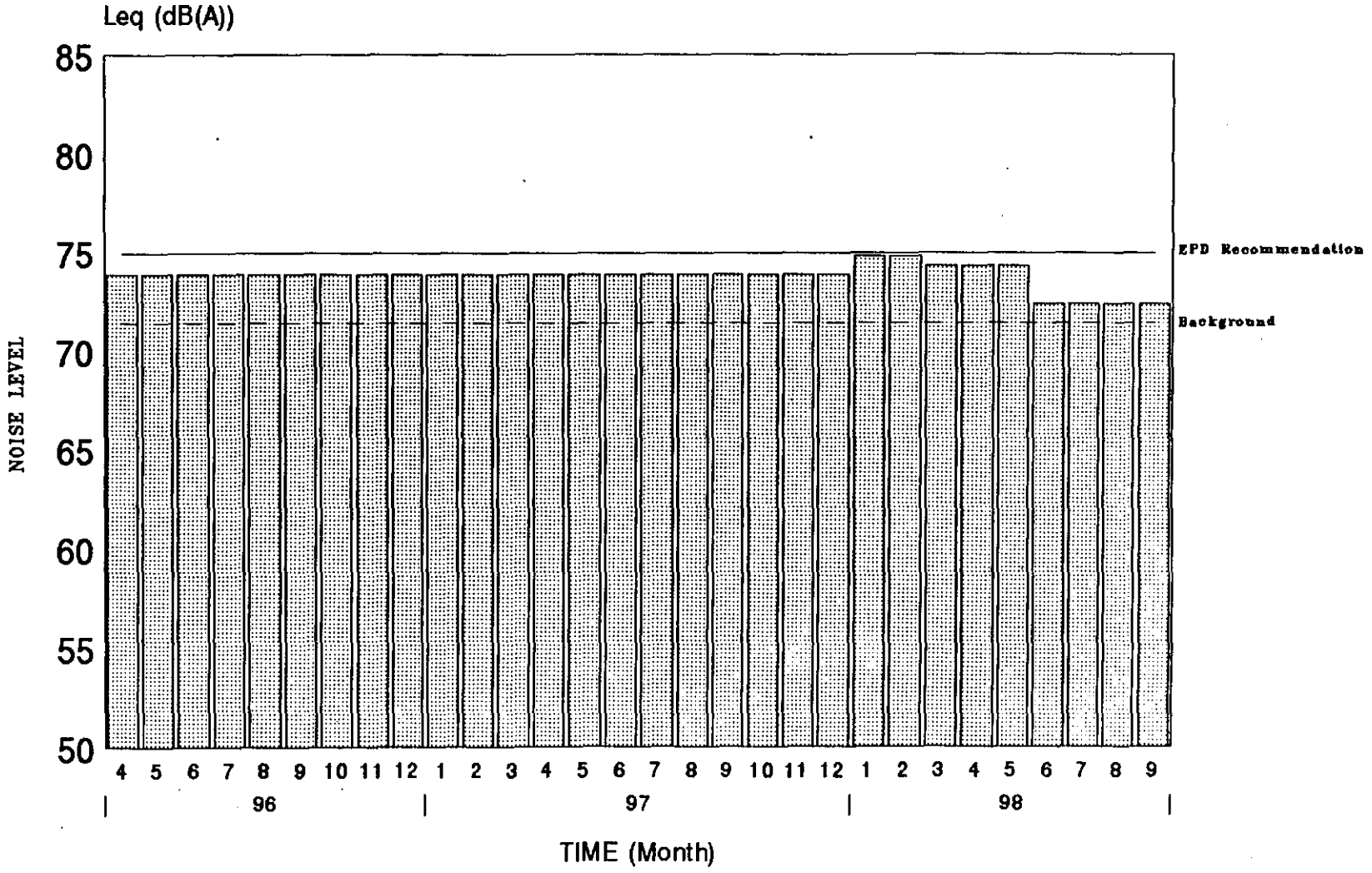


Figure C4.14 : Predicted construction noise level at Tsuen Kam Centre 2

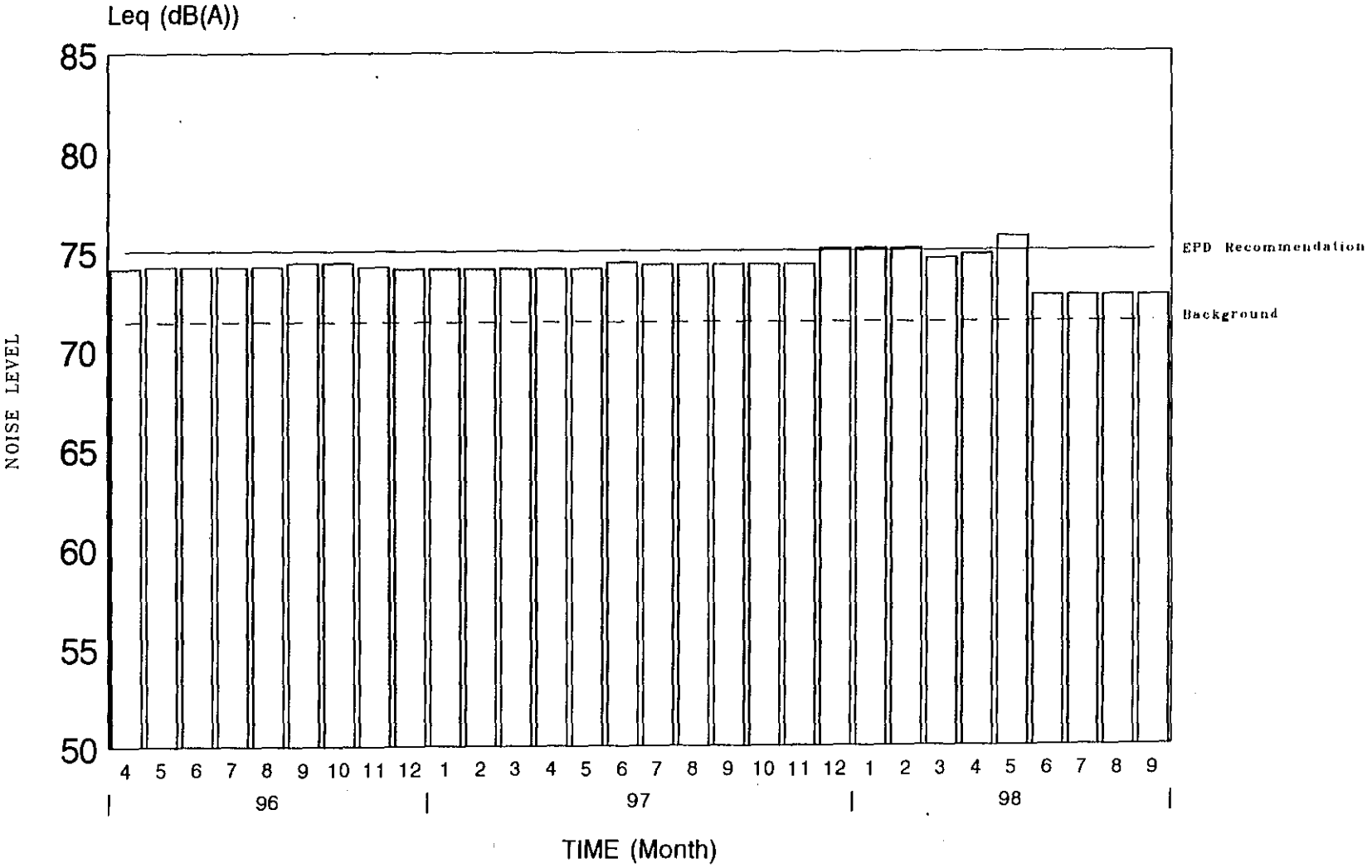


Figure C4.15 : Predicted construction noise levels at Fuk Loi Centre

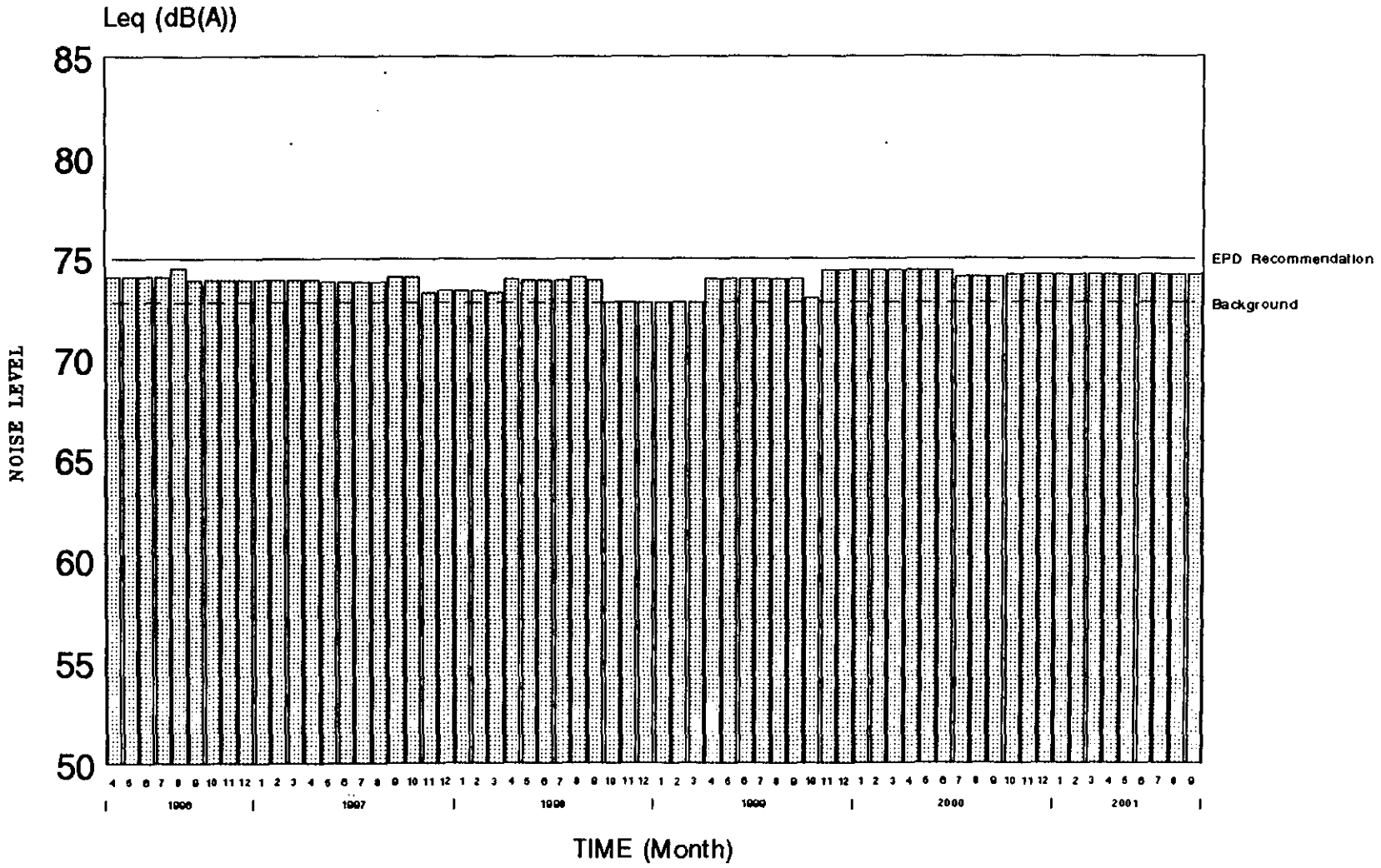


Figure C4.16 : Predicted construction noise levels at Pak Tin Pa San Tsuen

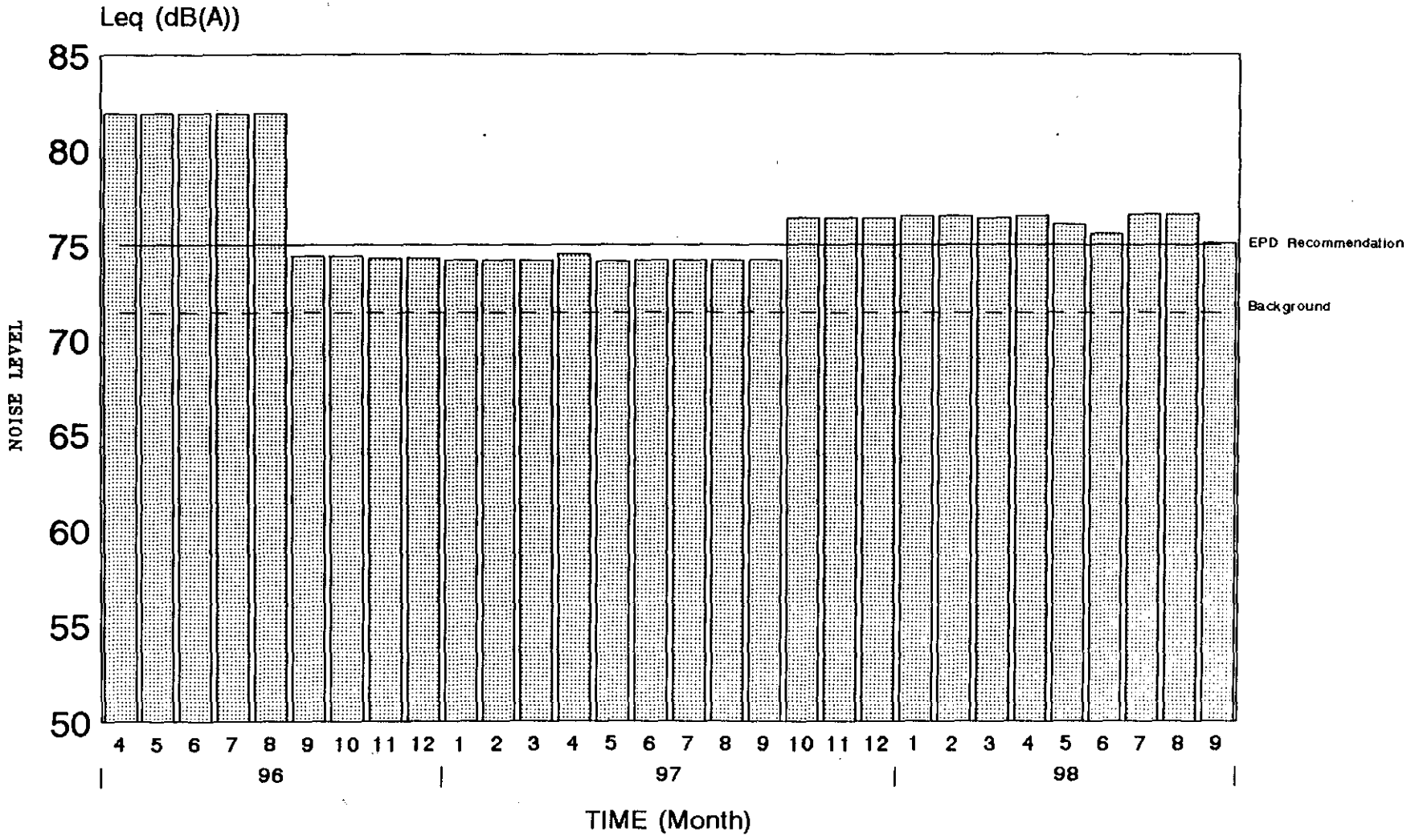


Figure C4.17 : Predicted construction noise levels at China Dyeing Works Block 8

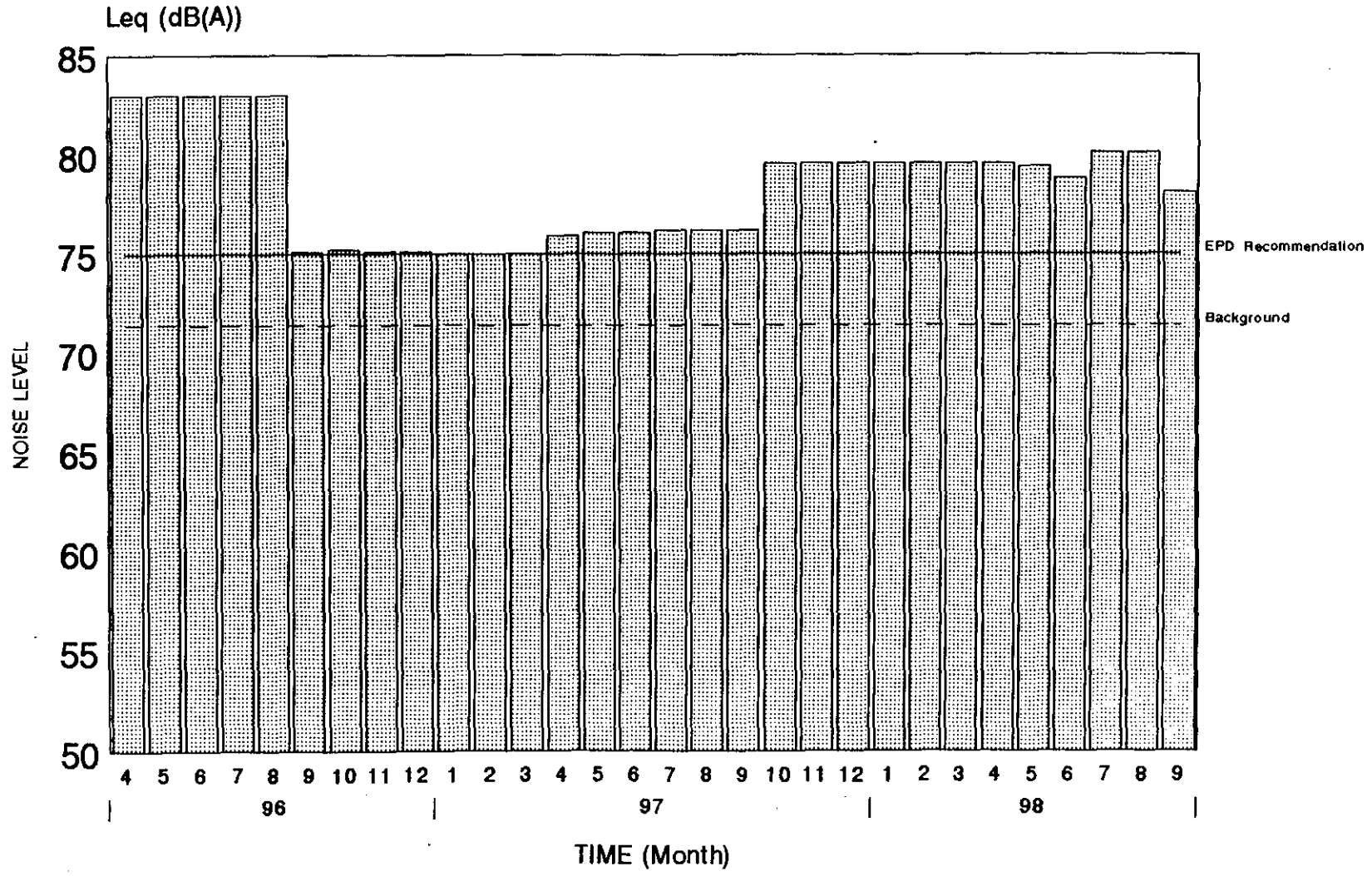


Figure C4.18 : Predicted construction noise levels at China Dyeing Works Block 9

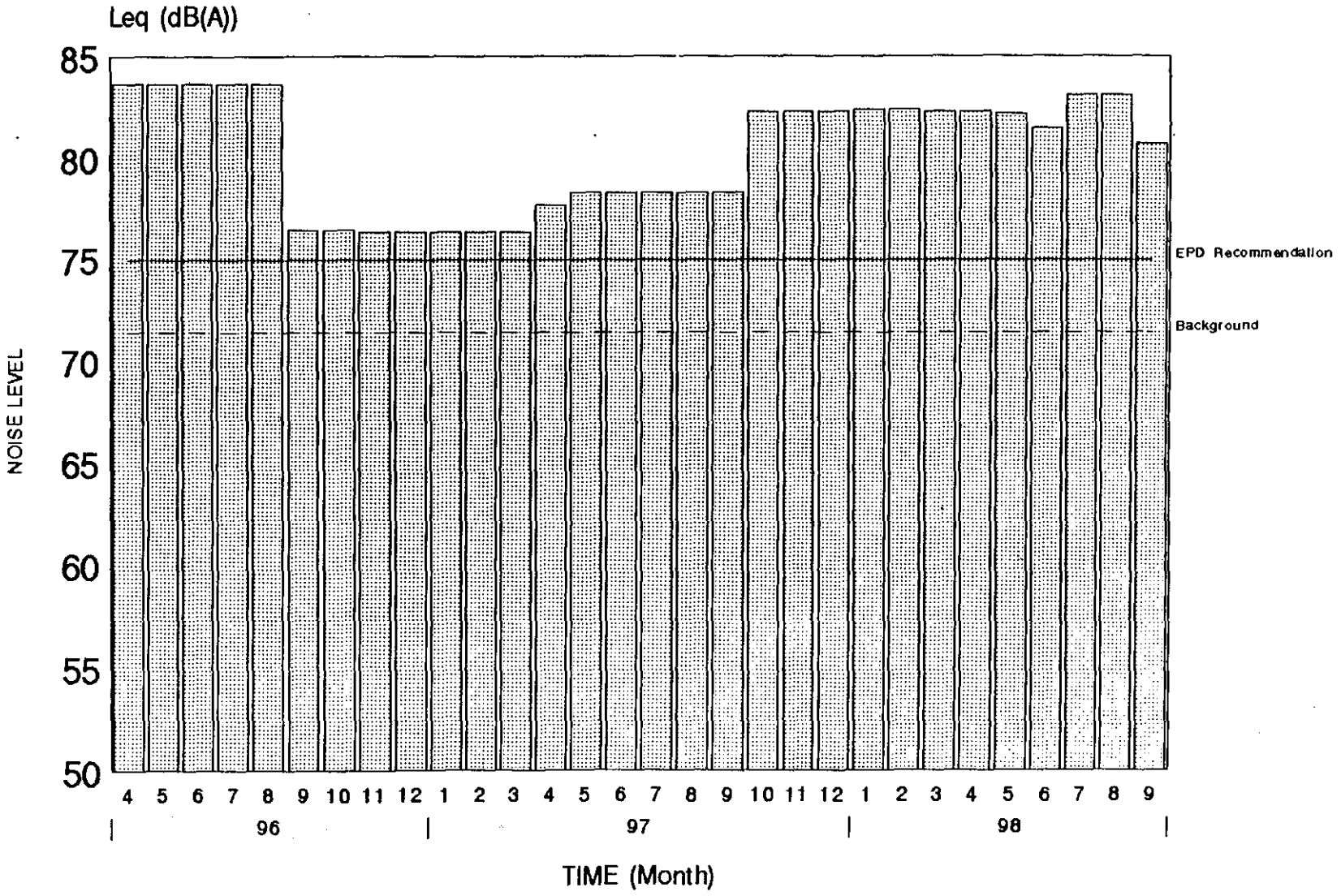


Figure C4.19 : Predicted construction noise levels at China Dyeing Works Block 4

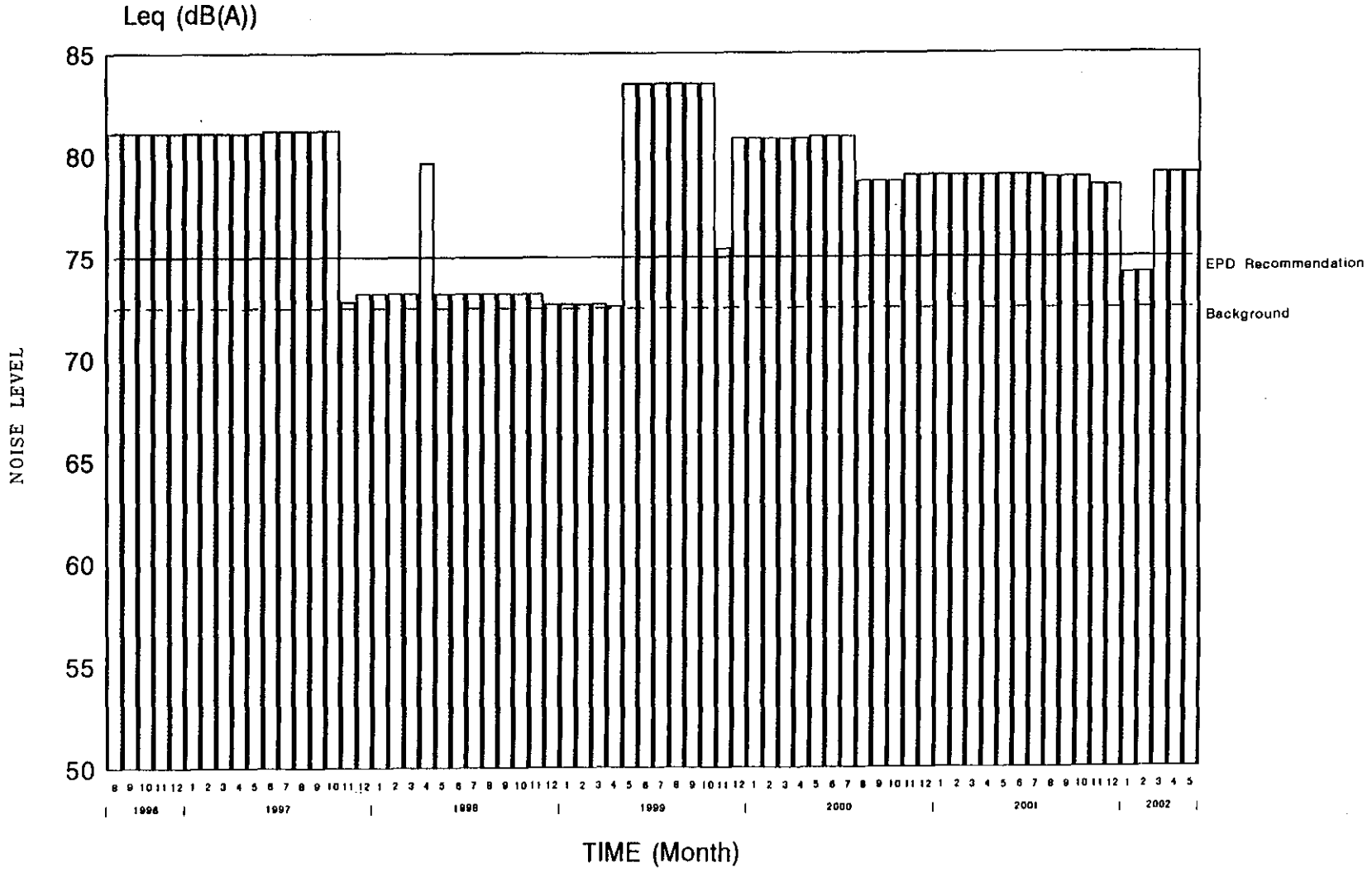


Figure C4.20 : Predicted construction noise levels at China Dyeing Works Block 2

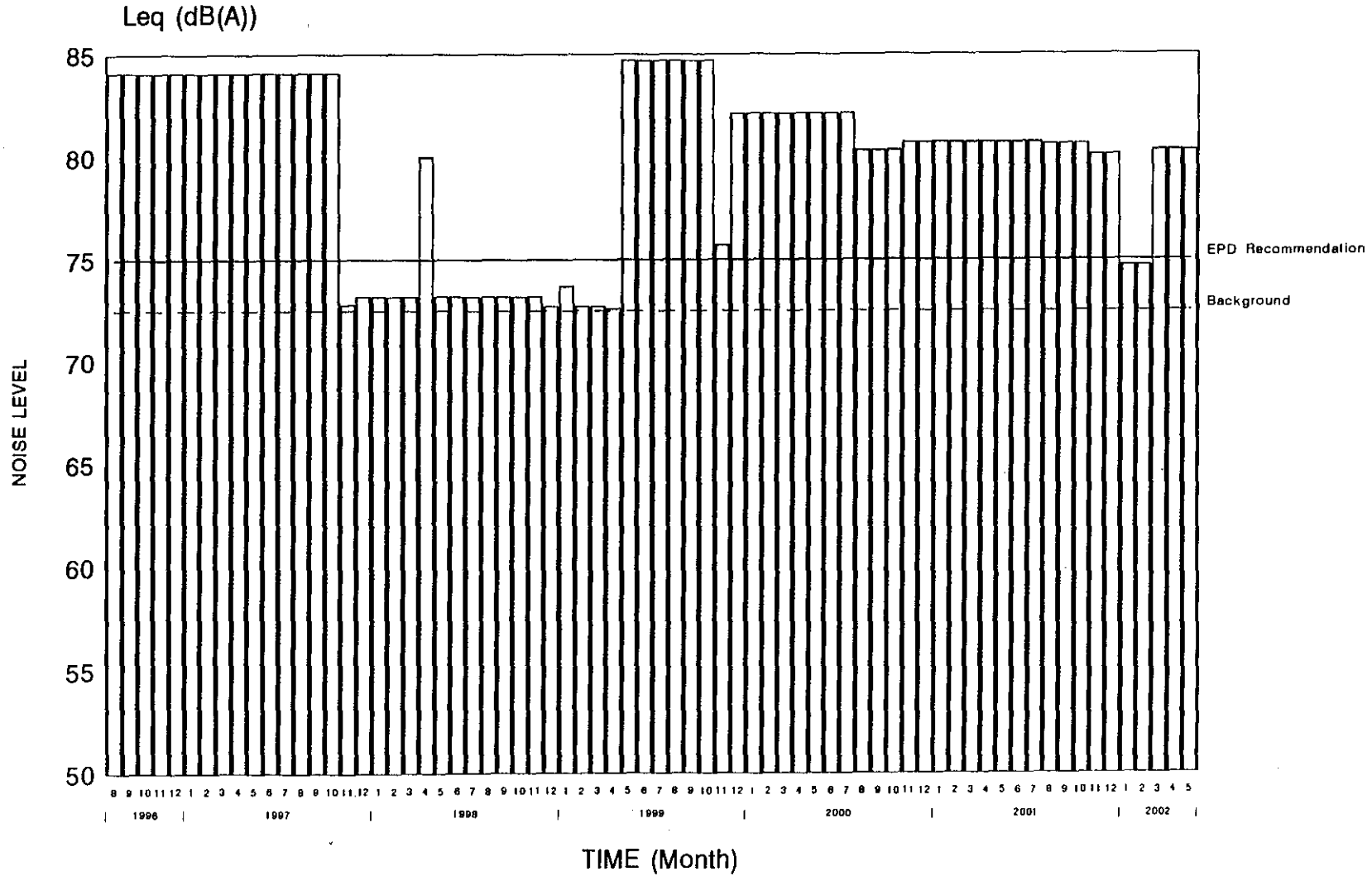


Figure C4.21 : Predicted construction noise levels at China Dyeing Works Block 1

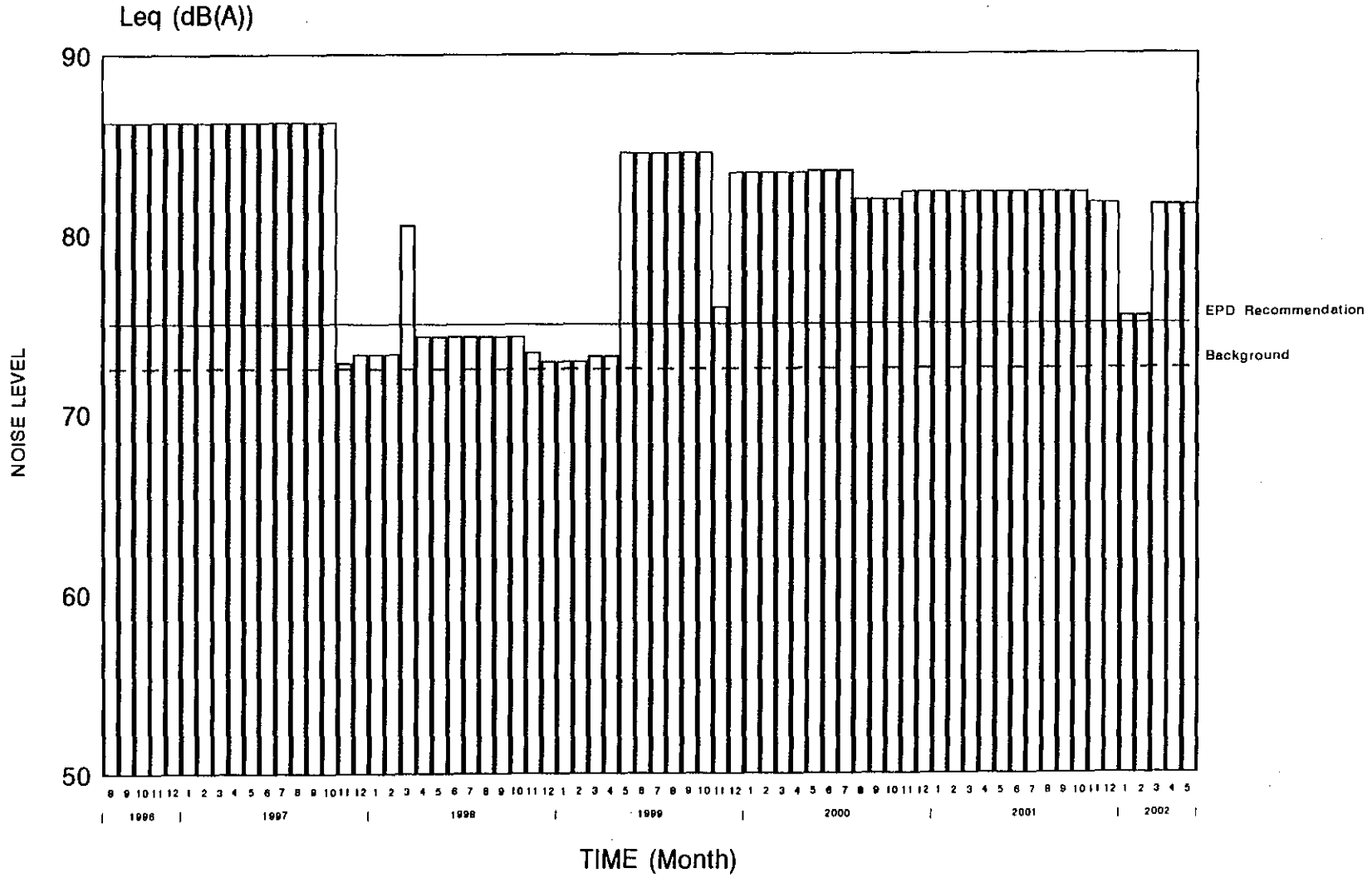


Figure C4.22 : Predicted construction noise levels at Tsuen King Garden

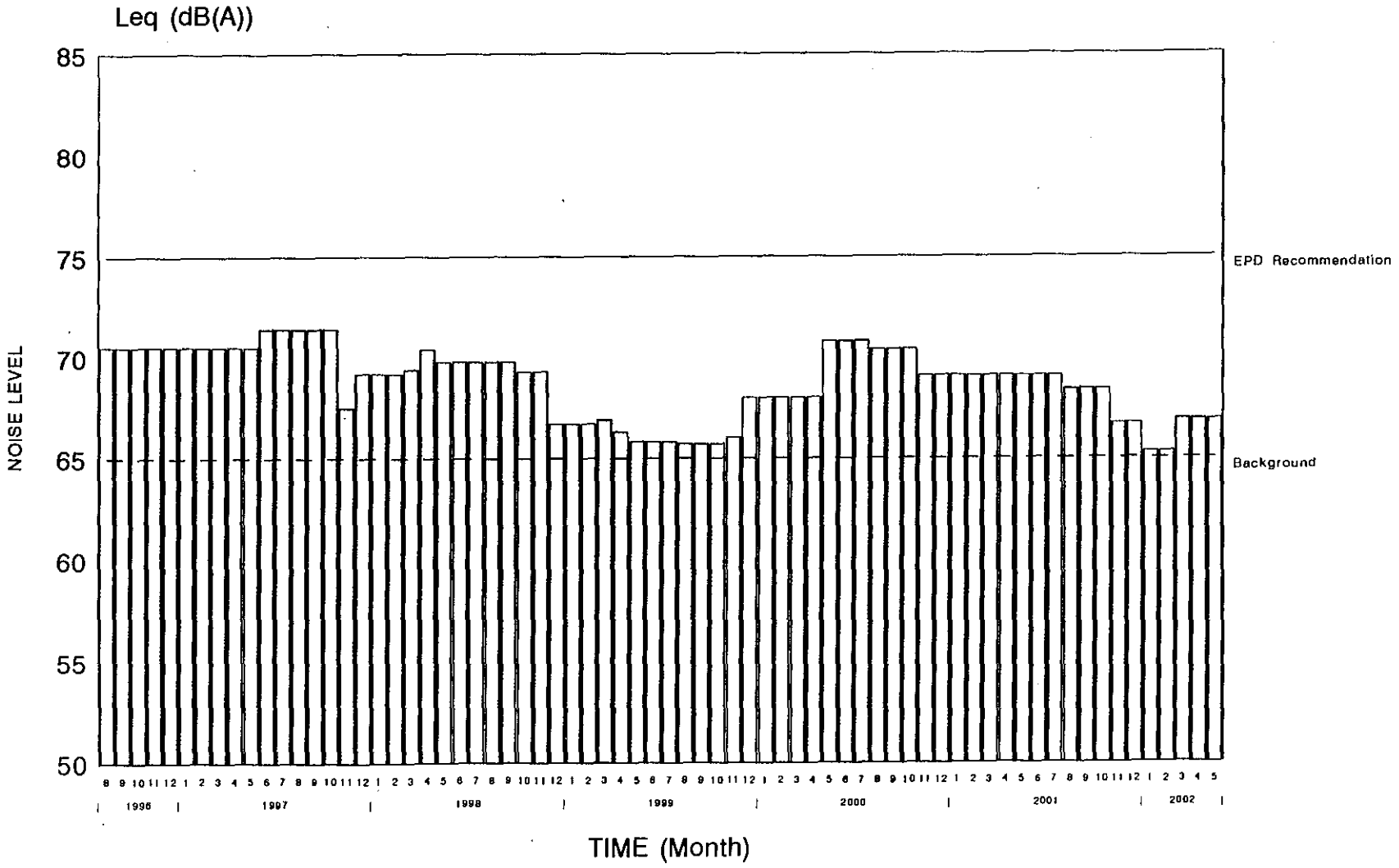


Figure C4.23 : Predicted construction noise levels at Kam Fung Garden

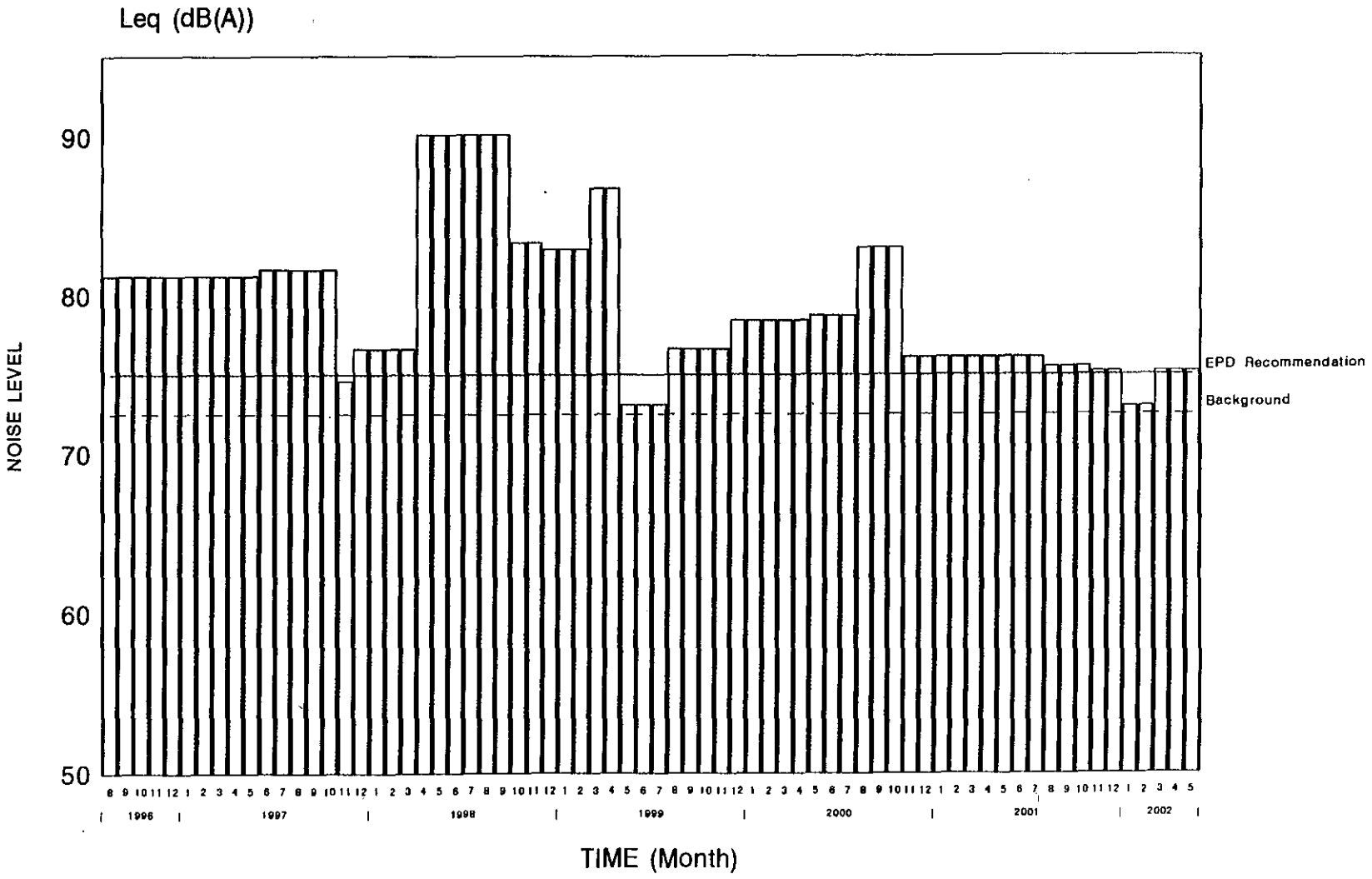


Figure C4.24 : Predicted construction noise levels at Tsuen Tak Garden

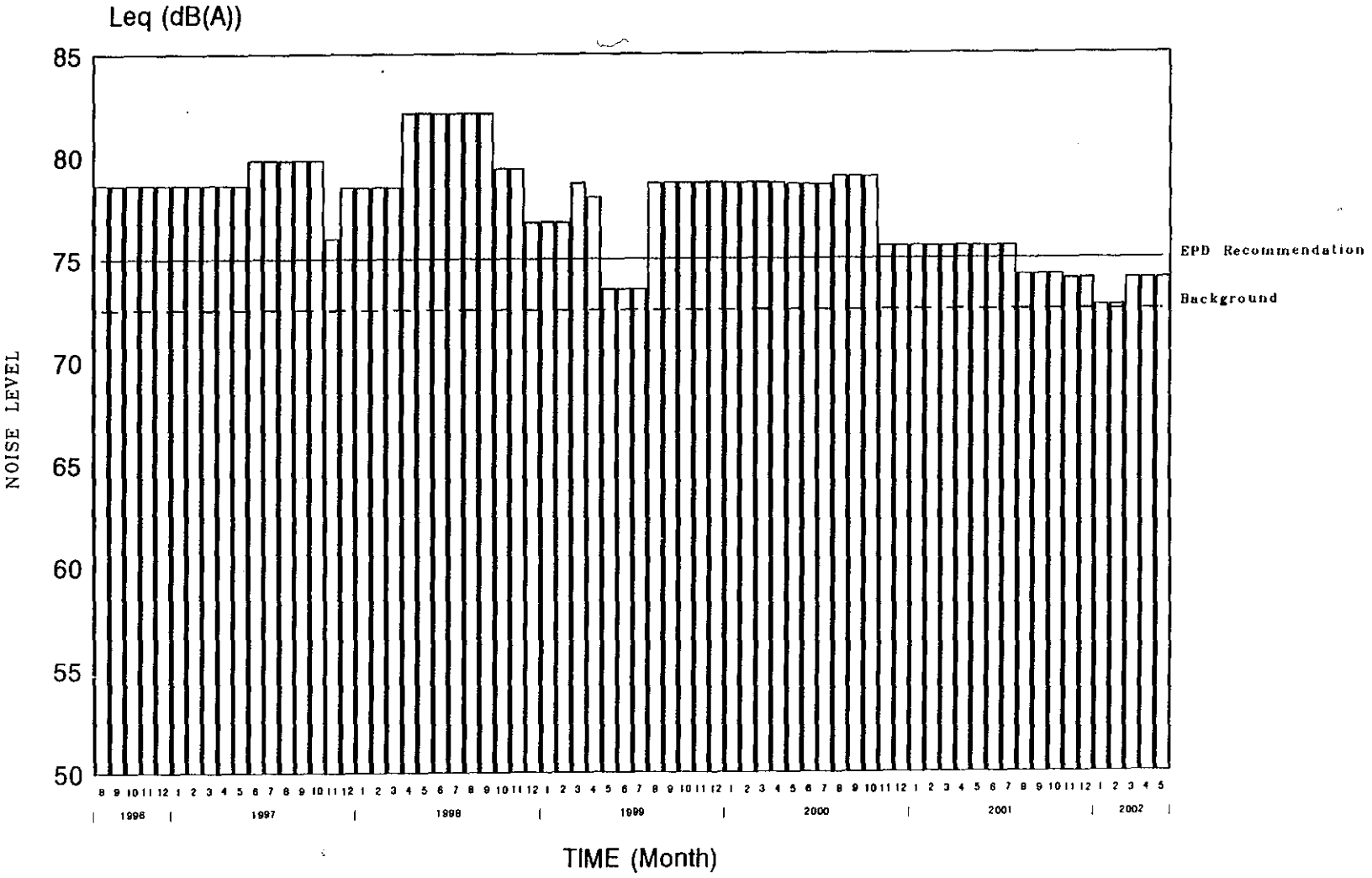


Figure C4.25 : Predicted construction noise levels at Joyful Garden

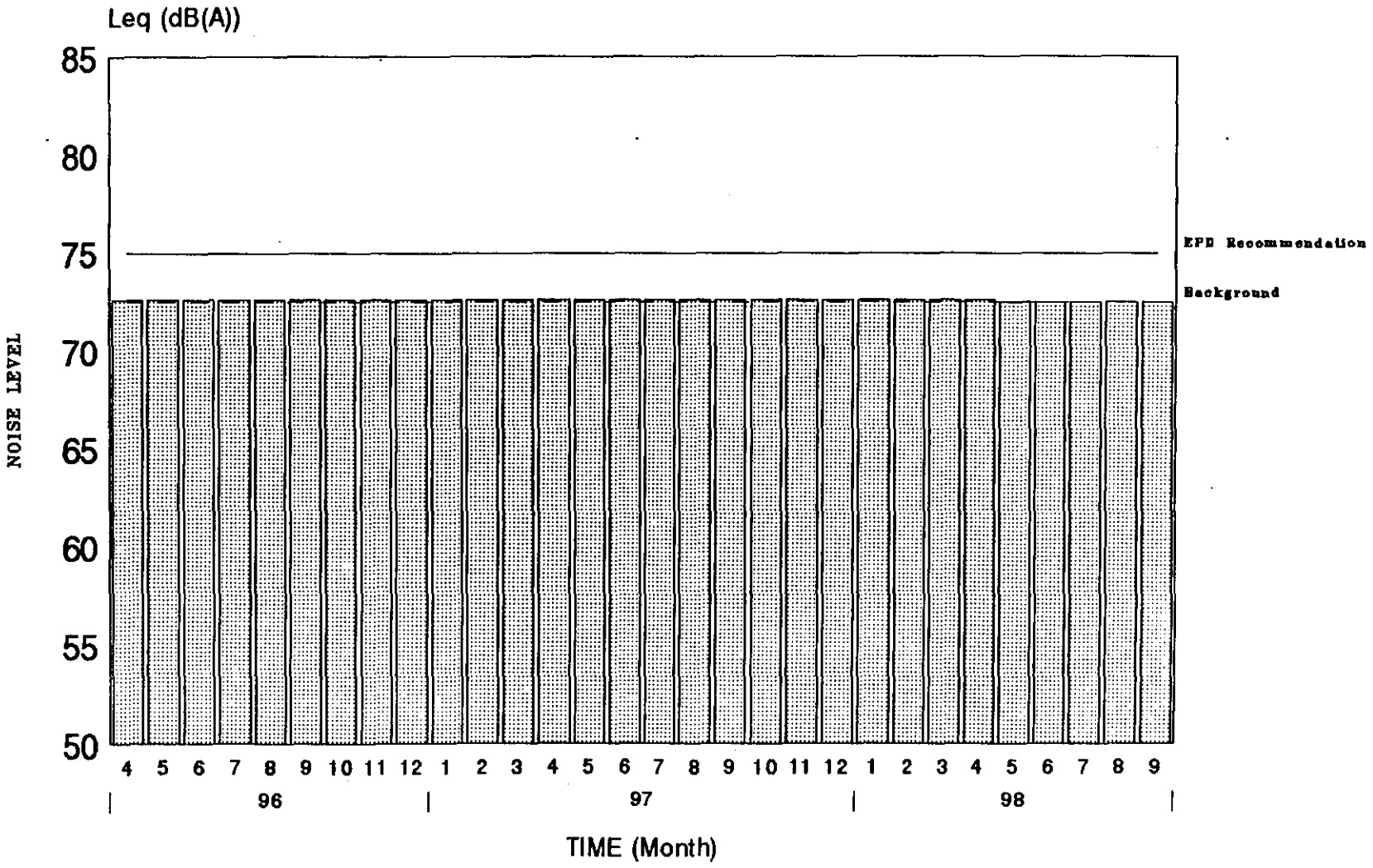


Figure C4.26 : Predicted construction noise levels at Tsuen Wan Area 3 Block 1

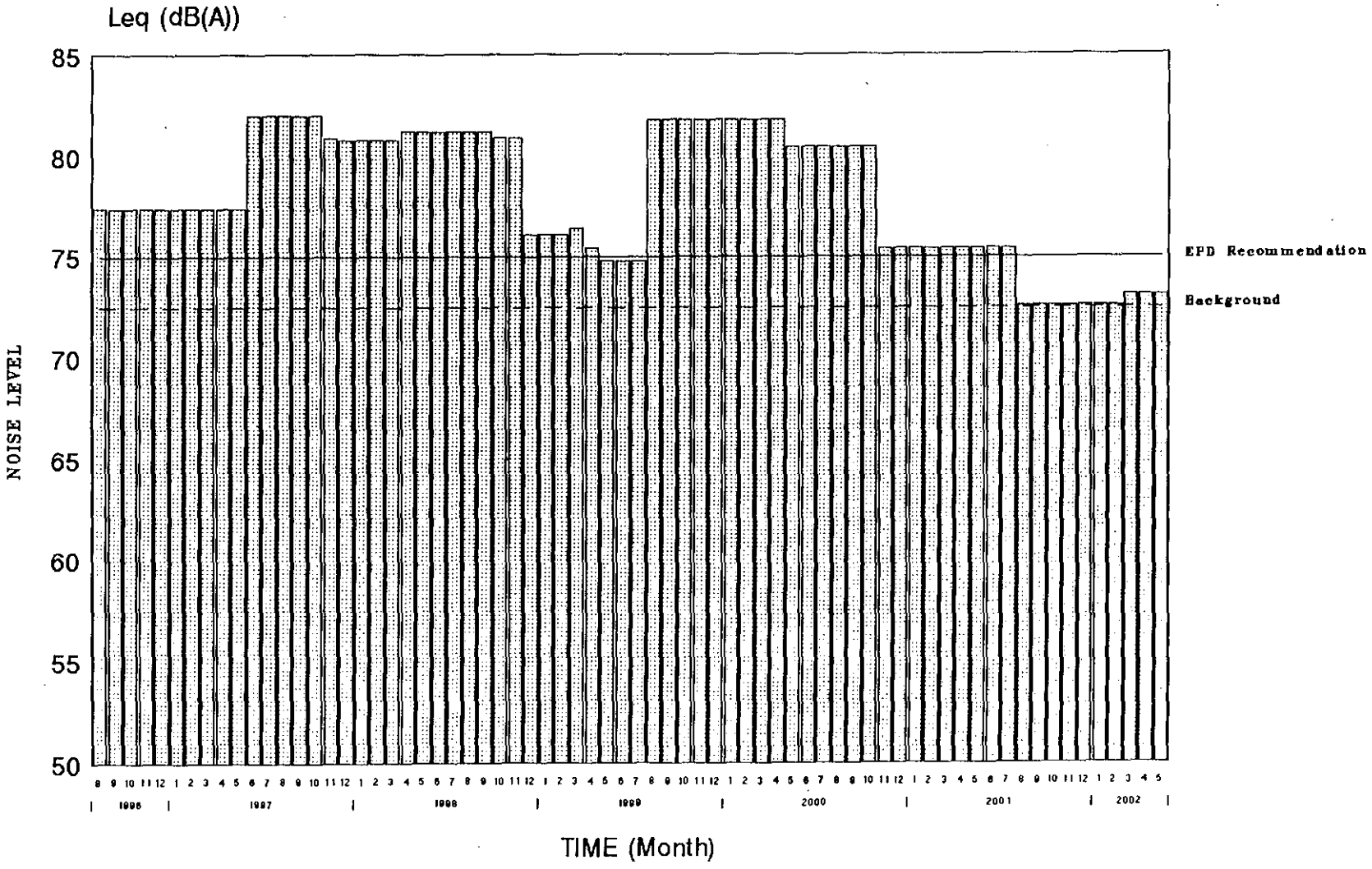
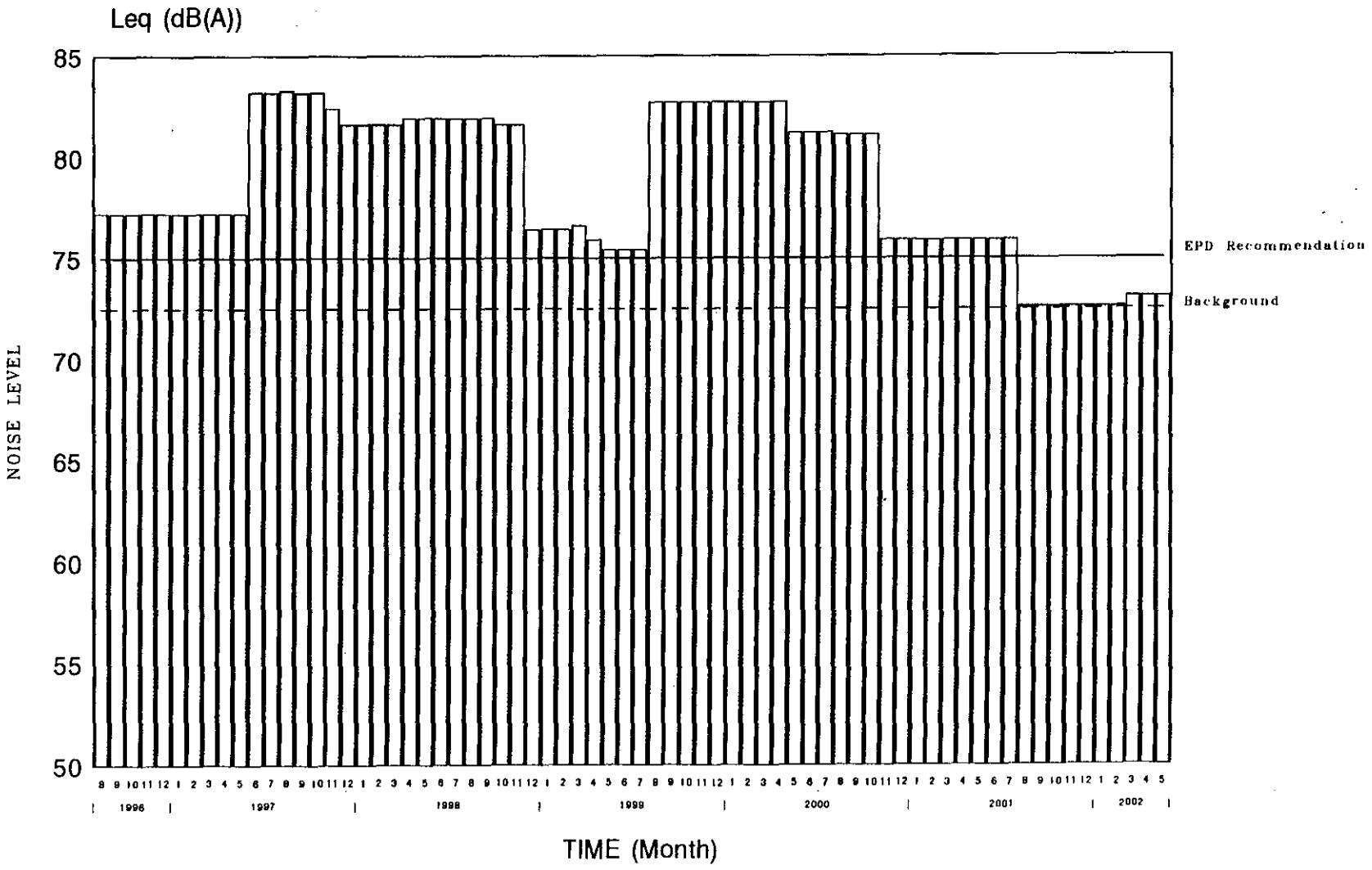


Figure C4.27 : Predicted construction noise levels at Tsuen Wan Area 3 Block 4



No Mitigation

Location	Floor	Height	Predicted Noise Level, dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'A	L'B	RNL	(dB(A))	1	2	3
Shek Wai Kok West Facade	1	31.5	67.8	75.4	76.1	71.6	6	4.5	0.7
	5	42.7	71.4	77.8	78.7	74.7	9	4.0	0.9
	10	56.7	72.4	77.4	78.6	74.3	9	4.3	1.2
	12	62.3	72.5	77.2	78.5	74.1	8	4.4	1.3
	14	67.9	72.5	77.1	78.4	74	8	4.4	1.3
	16	73.5	72.4	76.9	78.2	73.8	8	4.4	1.3
	18	79.1	72.3	76.7	78.1	73.6	8	4.5	1.4
	20	84.7	72.2	76.6	77.9	73.5	8	4.4	1.3
Shek Wai Kok North Facade	1	31.5	72.0	74.7	76.6	78.8	7	-2.2	1.9
	5	42.7	73.6	74.7	77.2	77.6	7	-0.4	2.5
	10	56.7	73.2	76.8	78.4	76.4	8	2.0	1.6
	14	67.9	72.8	77.6	78.8	75.7	9	3.1	1.2
	16	73.5	72.6	77.3	78.6	75.3	9	3.3	1.3
	18	79.1	72.3	77	78.3	75	8	3.3	1.3
	20	84.7	72.1	76.7	78.0	74.7	8	3.3	1.3
Fairview Garden	1	24.4	67.3	76.6	76.9	79.2	9	-0.3	0.3
	10	49.6	71.4	77.5	78.5	76.9	8	1.6	1.0
	18	72	71.8	76.6	77.8	75.4	8	2.4	1.2
	20	77.6	71.7	76.4	77.7	75.1	8	2.6	1.3
	22	83.2	71.8	76.2	77.5	74.9	8	2.6	1.3
	24	88.8	71.8	76.1	77.5	74.6	7	2.9	1.4
	26	94.4	71.7	75.9	77.3	74.4	7	2.9	1.4
Luk Yeung Sun Chuen Block A, North	1	20.8	64.8	72.1	72.6	69.5	3	3.3	0.7
	10	46	74.4	79.1	80.4	76.1	10	4.3	1.3
	20	74	74.1	78	79.5	75.1	9	4.4	1.5
	23	79.6	74.1	77.8	79.3	74.8	9	4.5	1.5
	25	85.2	74.0	77.7	79.2	74.6	9	4.6	1.5
	27	90.8	73.8	77.5	79.0	74.5	9	4.5	1.5
	29	96.4	73.6	77.3	78.8	74.3	9	4.5	1.5
	31	102	73.4	77	78.6	74.1	9	4.5	1.6
Luk Yeung Sun Chuen Block A, West	1	20.8	65.7	73.1	73.8	71.3	4	2.5	0.7
	10	46	73.9	76.1	78.2	72.5	8	5.7	2.1
	20	74	73.6	75.5	77.7	71.9	8	5.8	2.2
	23	79.6	73.6	75.3	77.5	71.7	8	5.8	2.2
	25	85.2	73.5	75.2	77.4	71.5	7	5.9	2.2
	27	90.8	73.3	75	77.3	71.4	7	5.9	2.3
	29	96.4	73.2	74.9	77.1	71.2	7	5.9	2.2
	31	102	73.1	74.8	76.9	71.1	7	5.8	2.3
Luk Yeung Sun Chuen Block F, North	1	20.8	64.4	63.8	67.1	58.4	-3	8.7	3.3
	10	46	70.0	68.7	72.4	71.6	2	0.8	3.7
	20	74	74.2	74.6	77.4	71.1	7	6.3	2.8
	23	79.6	74.1	74.5	77.3	71	7	6.3	2.8
	25	85.2	74.0	74.4	77.2	70.9	7	6.3	2.8
	27	90.8	74.0	74.3	77.2	70.8	7	6.4	2.9
	29	96.4	73.9	74.2	77.1	70.7	7	6.4	2.9
	31	102	73.8	74	76.9	70.6	7	6.3	2.9
Luk Yeung Sun Chuen Block F, West	1	20.8	67.7	68.7	71.2	64.1	1	7.1	2.5
	10	46	72.6	73	75.8	70.6	6	5.2	2.8
	20	74	73.7	73.6	76.7	70.5	7	6.2	3.1
	23	79.6	73.6	73.5	76.6	70.4	7	6.2	3.1
	25	85.2	73.5	73.4	76.5	70.3	6	6.2	3.1
	27	90.8	73.5	73.3	76.4	70.2	6	6.2	3.1
	29	96.4	73.4	73.2	76.3	70	6	6.3	3.1
	31	102	73.3	73	76.2	69.9	6	6.3	3.2
Kwai Ming Wu School	1	21	69.5	75	76.1	71.5	11	4.6	1.1
	4	31.2	75.1	77.1	79.2	73.5	14	5.7	2.1
	7	41.4	75.4	77.4	79.5	73.9	15	5.6	2.1
Muk Min Ha Tsuen, No 1	1	39	75.7	84.7	85.2	78.7	15	6.5	0.5
	3	45	80.6	83.6	85.4	77.7	15	7.7	1.8
Muk Min Ha Tsuen, No 16	1	39	73.6	82.6	83.1	76.5	13	6.6	0.5
	3	45	80.0	82.1	84.2	76	14	8.2	2.1
Tung Lam Home for Aged	1	57	63.5	70.0	70.9	66.5	16	4.4	0.9
	2	60	67.5	72.3	73.5	69.2	19	4.3	1.2
Hoi Pa Village	1	35	73.2	81.9	82.4	76.7	12	5.7	0.5
	3	41	73.8	81.7	82.4	76.6	12	5.8	0.7
Pak Tin Pa Tsuen	1	50	70.9	77.9	78.7	69.9	9	8.8	0.8
	2	56	71.6	77.7	78.7	72.2	9	6.5	1.0
China Dyeing Works Development Block 8	1	41.5	77.8	71.3	78.7	59.2	9	19.5	7.4
	10	66.7	75.4	71.4	76.9	59.9	7	17.0	5.5
	20	91.9	73.9	71.4	75.8	60.1	6	15.7	4.4
	30	117.1	72.7	71.3	75.1	60.4	5	14.7	3.8
	40	142.3	71.8	71	74.4	60.4	4	14.0	3.4
China Dyeing Works Development Block 9	1	41.5	79.6	71.8	80.3	60.7	10	19.6	8.5
	10	66.7	77.7	71.9	78.7	61.3	9	17.4	6.8
	20	91.9	76.3	71.9	77.7	61.4	8	16.3	5.8
	30	117.1	75.2	72.1	76.9	64.3	7	12.6	4.8
	40	142.3	74.3	72.2	76.4	65.4	6	11.0	4.2
Tsuen Kam Centre Block 1	1	21.5	60.9	61.5	64.2	53.6	-6	10.6	2.7
	10	60	71.7	69.1	73.6	60.6	4	13.0	4.5
	20	85.2	71.6	69.1	73.5	60.7	4	12.8	4.4
	30	105.5	72.8	70.8	74.9	64	5	10.9	4.1
Tsuen Kam Centre	1	21.5	54.0	55.6	57.9	52.6	-12	5.3	2.3
	10	60	71.6	69.2	73.6	64.3	4	9.3	4.4
	20	85.2	71.5	69.3	73.6	64.4	4	9.2	4.3
	30	105.5	71.5	70.3	73.9	64.4	4	9.5	3.6
Pak Tin Pa San Tsuen	1	41.5	69.8	71	73.4	60.4	3	13.0	2.4
Pak Tin Pa	1	58.3	78.5	85.2	86.0	78.9	16	7.1	0.8
Fuk Loi Estate	1	13.5	63.0	80.1	80.2	74.1	10	6.1	0.1
	10	38.7	67.7	77.6	78.0	75.6	8	2.4	0.4
	18	52.7	68.4	76.5	77.1	75.4	7	1.7	0.6

Notes:

PNL : Prevailing Noise Level
RNL : Relevant Noise Level, (L'A+L'B)
CRTN Criteria (1) RNL – HKPSG
(2) RNL – PNL
(3) RNL – L'B

Mitigation Measures: Low Noise Surfacing

Location	Floor	Height	Predicted Noise Level, dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'A	L'B	RNL	(dB(A))	1	2	3
Shek Wai Kok	1	31.5	66.4	75.4	75.9	71.6	6	4.3	0.5
West Facade	5	42.7	69.5	77.8	78.4	74.7	8	3.7	0.6
	10	56.7	70.4	77.4	78.2	74.3	8	3.9	0.8
	12	62.3	70.4	77.2	78.0	74.1	8	3.9	0.8
	14	67.9	70.4	77.1	77.9	74	8	3.9	0.8
	16	73.5	70.3	76.9	77.8	73.8	8	4.0	0.9
	18	79.1	70.2	76.7	77.6	73.6	8	4.0	0.9
	20	84.7	70.0	76.6	77.5	73.5	7	4.0	0.9
Shek Wai Kok	1	31.5	69.5	74.7	75.8	78.8	6	−3.0	1.1
North Facade	5	42.7	71.1	74.7	76.3	77.6	6	−1.3	1.6
	10	56.7	70.7	76.8	77.8	76.4	8	1.4	1.0
	14	67.9	70.3	77.6	78.3	75.7	8	2.6	0.7
	16	73.5	70.1	77.3	78.1	75.3	8	2.8	0.8
	18	79.1	69.8	77	77.8	75	8	2.8	0.8
	20	84.7	69.6	76.7	77.5	74.7	7	2.8	0.8
Fairview Garden	1	24.4	66.2	76.6	76.8	79.2	9	−0.4	0.2
	10	49.6	69.9	77.5	78.2	76.9	8	1.3	0.7
	18	72	70.2	76.6	77.5	75.4	7	2.1	0.9
	20	77.6	70.2	76.4	77.3	75.1	7	2.2	0.9
	22	83.2	70.2	76.2	77.2	74.9	7	2.3	1.0
	24	88.8	70.1	76.1	77.1	74.6	7	2.5	1.0
	26	94.4	70.1	75.9	76.9	74.4	7	2.5	1.0
Luk Yeung Sun Chuen	1	20.8	63.7	72.1	72.7	69.5	3	3.2	0.6
Block A, North	10	46	73.0	79.1	80.0	76.1	10	3.9	0.9
	20	74	72.7	78	79.1	75.1	9	4.0	1.1
	23	79.6	72.7	77.8	79.0	74.8	9	4.2	1.2
	25	85.2	72.6	77.7	78.9	74.6	9	4.3	1.2
	27	90.8	72.4	77.5	78.7	74.5	9	4.2	1.2
	29	96.4	72.2	77.3	78.5	74.3	8	4.2	1.2
	31	102	72.0	77	78.2	74.1	8	4.1	1.2
Luk Yeung Sun Chuen	1	20.8	64.8	73.1	73.7	71.3	4	2.4	0.6
Block A, West	10	46	72.8	76.1	77.8	72.5	8	5.3	1.7
	20	74	72.5	75.5	77.3	71.9	7	5.4	1.8
	23	79.6	72.5	75.3	77.1	71.7	7	5.4	1.8
	25	85.2	72.3	75.2	77.0	71.5	7	5.5	1.8
	27	90.8	72.2	75	76.8	71.4	7	5.4	1.8
	29	96.4	72.0	74.9	76.7	71.2	7	5.5	1.8
	31	102	71.9	74.6	76.5	71.1	6	5.4	1.9
Luk Yeung Sun Chuen	1	20.8	63.0	63.8	66.4	58.4	−4	8.0	2.6
Block F, North	10	46	68.4	68.7	71.6	71.6	2	−0.0	2.9
	20	74	72.9	74.6	76.8	71.1	7	5.7	2.2
	23	79.6	72.8	74.5	76.7	71	7	5.7	2.2
	25	85.2	72.7	74.4	76.6	70.9	7	5.7	2.2
	27	90.8	72.6	74.3	76.5	70.8	7	5.7	2.2
	29	96.4	72.5	74.2	76.4	70.7	6	5.7	2.2
	31	102	72.4	74	76.3	70.6	6	5.7	2.3
Luk Yeung Sun Chuen	1	20.8	66.3	68.7	70.7	64.1	1	6.6	2.0
Block F, West	10	46	71.3	73	75.2	70.6	5	4.6	2.2
	20	74	72.4	73.6	76.0	70.5	6	5.5	2.4
	23	79.6	72.3	73.5	75.9	70.4	6	5.5	2.4
	25	85.2	72.2	73.4	75.9	70.3	6	5.6	2.5
	27	90.8	72.1	73.3	75.8	70.2	6	5.6	2.5
	29	96.4	72.0	73.2	75.7	70	6	5.7	2.5
	31	102	72.0	73	75.5	69.9	6	5.6	2.5
Kwai Ming Wu School	1	21	68.3	75	75.8	71.5	11	4.3	0.6
	4	31.2	73.7	77.1	78.7	73.5	14	5.2	1.6
	7	41.4	74.1	77.4	79.1	73.9	14	5.2	1.7
Muk Min Ha Tsuen, No 1	1	39	74.6	84.7	85.1	78.7	15	6.4	0.4
	3	45	79.8	83.6	85.1	77.7	15	7.4	1.5
Muk Min Ha Tsuen, No 16	1	39	72.9	82.6	83.0	76.5	13	6.5	0.4
	3	45	78.9	82.1	83.8	76	14	7.8	1.7
Tung Lam Home for Aged	1	57	62.5	70.0	70.7	66.5	16	4.2	0.7
	2	60	66.8	72.3	73.4	69.2	18	4.1	1.1
Hoi Pa Village	1	35	71.3	81.9	82.3	76.7	12	5.6	0.4
	3	41	71.9	81.7	82.1	76.6	12	5.5	0.4
Pak Tin Pa Tsuen	1	50	69.4	77.9	78.5	69.9	8	8.6	0.6
	2	56	70.0	77.7	78.4	72.2	8	6.2	0.7
China Dyeing Works Development	1	41.5	75.3	71.3	76.8	59.2	7	17.6	5.5
Block 8	10	66.7	72.9	71.4	75.2	59.9	5	15.3	3.8
	20	91.9	71.4	71.4	74.4	60.1	4	14.3	3.0
	30	117.1	70.2	71.3	73.8	60.4	4	13.4	2.5
	40	142.3	69.3	71	73.3	60.4	3	12.9	2.3
China Dyeing Works Development	1	41.5	77.1	71.8	78.2	60.7	8	17.5	6.4
Block 9	10	66.7	75.2	71.9	76.9	61.3	7	15.6	5.0
	20	91.9	73.8	71.9	76.0	61.4	6	14.6	4.1
	30	117.1	72.7	72.1	75.4	64.3	5	11.1	3.3
	40	142.3	71.8	72.2	75.0	65.4	5	9.6	2.8
Tsuen Kam Centre	1	21.5	58.4	61.5	63.2	53.6	−7	9.6	1.7
Block 1	10	60	69.2	69.1	72.2	60.6	2	11.6	3.1
	20	85.2	69.1	69.1	72.1	60.7	2	11.4	3.0
	30	105.5	70.6	70.8	73.7	64	4	9.7	2.9
Tsuen Kam Centre	1	21.5	52.1	55.6	57.2	52.6	−13	4.6	1.6
Block 2	10	60	69.7	69.2	72.5	64.3	2	8.2	3.3
	20	85.2	69.6	69.3	72.5	64.4	2	8.1	3.2
	30	105.5	69.6	70.3	73.0	64.4	3	8.6	2.7
Pak Tin Pa San Tsuen	1	41.5	67.3	71	72.5	60.4	3	12.1	1.5
Pak Tin Pa	1	58.3	76.2	85.2	85.7	78.9	16	6.8	0.5
Fuk Loi Estate	1	13.5	60.5	80.1	80.1	74.1	10	6.0	0.0
	10	38.7	65.2	77.6	77.8	75.6	8	2.2	0.2
	18	52.7	66.0	76.5	76.9	75.4	7	1.5	0.4

Notes:

PNL: Prevailing Noise Level
RNL : Relevant Noise Level, (L'A+L'B)
CRTN Criteria (1) RNL – HKPSG
(2) RNL – PNL
(3) RNL – L'B

Mitigation Measures: Scheme 1

Location	Floor	Height	Predicted Noise Level, dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'a	L'b	RNL	(dB(A))	1	2	3
Shek Wai Kok	1	31.5	57.0	72.1	72.3	71.6	2	0.7	−3.1
West Facade	5	42.7	61.6	76.4	76.5	74.7	7	1.8	−1.3
	10	56.7	61.5	76.3	76.4	74.3	6	2.1	−1.0
	12	62.3	61.3	76.2	76.3	74.2	6	2.2	−0.9
	14	67.9	61.2	76.1	76.2	74.0	6	2.3	−0.9
	16	73.5	60.8	76.9	77.0	73.8	7	3.2	0.1
	18	79.1	60.8	76.7	76.8	73.6	7	3.2	0.1
	20	84.7	60.3	76.5	76.6	73.5	7	3.1	−0.0
Shek Wai Kok	1	31.5	0.0	71.5	71.5	72.7	1	−1.3	−3.2
North Facade	5	42.7	0.0	71.6	71.6	72.7	2	−1.1	−3.1
	10	56.7	0.0	75.4	75.4	74.1	5	1.3	−1.4
	14	67.9	0.0	76.6	76.6	74.7	7	1.9	−1.0
	16	73.5	0.0	76.3	76.3	74.4	6	1.9	−1.0
	18	79.1	0.0	76.0	76.0	74.1	6	1.9	−1.0
	20	84.7	0.0	75.7	75.7	73.9	6	1.9	−1.0
Fairview Garden	1	24.4	60.7	78.3	78.4	79.2	8	−0.8	−0.2
	10	49.6	62.6	77.5	77.7	76.9	8	0.7	0.2
	18	72.0	62.7	76.7	76.9	75.4	7	1.4	0.3
	20	77.6	62.6	76.5	76.7	75.2	7	1.5	0.3
	22	83.2	62.7	76.3	76.5	74.9	6	1.6	0.3
	24	88.8	62.7	76.1	76.3	74.6	6	1.7	0.2
	26	94.4	62.8	75.9	76.1	74.4	6	1.7	0.2
Luk Yeung Sun Chuen	1	20.8	52.8	67.6	67.7	69.3	−2	−1.6	−4.4
Block A, North	10	46.0	64.7	78.2	78.4	76.1	8	2.3	−0.7
	20	74.0	64.9	77.5	77.7	75.1	8	2.7	−0.3
	23	79.6	65.0	77.5	77.7	74.9	8	2.9	−0.1
	25	85.2	65.1	77.3	77.6	74.7	8	2.9	−0.1
	27	90.8	65.8	77.3	77.6	74.5	8	3.2	0.1
	29	96.4	65.9	77.3	77.6	74.3	8	3.4	0.3
	31	102.0	66.4	77.1	77.4	74.1	7	3.3	0.4
Luk Yeung Sun Chuen	1	20.8	54.5	70.0	70.1	71.2	0	−1.1	−3.0
Block A, West	10	46.0	65.5	75.8	76.2	72.5	6	3.7	0.1
	20	74.0	66.1	75.5	76.0	71.9	6	4.1	0.5
	23	79.6	66.1	75.3	75.8	71.7	6	4.1	0.5
	25	85.2	66.2	75.1	75.7	71.6	6	4.1	0.5
	27	90.8	66.3	75.0	75.6	71.4	6	4.2	0.6
	29	96.4	66.5	74.9	75.5	71.2	5	4.2	0.6
	31	102.0	67.4	74.6	75.3	71.1	5	4.3	0.7
Luk Yeung Sun Chuen	1	20.8	58.3	62.7	64.0	58.4	−6	5.7	0.2
Block F, North	10	46.0	65.5	68.8	70.4	71.6	0	−1.1	1.7
	20	74.0	66.7	74.4	75.1	71.1	5	3.9	0.5
	23	79.6	66.8	74.3	75.0	71.0	5	4.0	0.5
	25	85.2	66.7	74.3	75.0	70.9	5	4.1	0.6
	27	90.8	66.8	74.2	74.9	70.8	5	4.1	0.6
	29	96.4	66.9	74.1	74.8	70.7	5	4.1	0.6
	31	102.0	67.0	73.9	74.7	70.6	5	4.1	0.7
Luk Yeung Sun Chuen	1	20.8	60.2	67.1	67.9	64.1	−2	3.8	−0.8
Block F, West	10	46.0	66.2	73.0	73.8	70.6	4	3.3	0.8
	20	74.0	66.8	73.6	74.4	70.5	4	3.9	0.8
	23	79.6	67.0	73.5	74.4	70.4	4	4.0	0.9
	25	85.2	67.1	73.4	74.3	70.3	4	4.0	0.9
	27	90.8	67.1	73.3	74.2	70.2	4	4.1	0.9
	29	96.4	67.1	73.2	74.2	70.0	4	4.1	1.0
	31	102.0	67.1	73.0	74.0	69.9	4	4.1	1.0
Kwai Ming Wu School	1	21.0	62.6	70.6	71.2	71.5	6	−0.3	−3.8
	4	31.2	64.1	75.5	75.8	73.5	11	2.3	−1.3
	7	41.4	65.7	76.9	77.2	73.9	12	3.3	−0.2
Muk Min Ha Tsuen, No 1	1	39.0	69.2	84.6	84.8	78.7	15	6.1	0.1
	3	45.0	73.2	83.6	84.0	77.7	14	6.3	0.4
Muk Min Ha Tsuen, No 16	1	39.0	70.2	82.5	82.8	76.5	13	6.3	0.2
	3	45.0	75.4	82.1	82.9	76.0	13	6.9	0.8
Tung Lam Home for Aged	1	57.0	60.6	69.9	70.3	66.5	15	3.9	0.3
	2	60.0	65.7	72.1	73.0	69.2	18	3.7	0.7
Hoi Pa Village	1	35.0	55.7	79.0	79.0	76.7	9	2.3	−2.9
	3	41.0	65.8	79.9	80.1	76.6	10	3.5	−1.6
Pak Tin Pa Tsuen	1	50.0	64.3	77.1	77.3	69.9	7	7.4	−0.6
	2	56.0	65.0	77.1	77.4	72.2	7	5.2	−0.3
China Dyeing Works Development	1	41.5	71.7	71.3	74.5	59.2	5	15.3	3.2
Block 8	10	66.7	69.6	71.4	73.6	59.9	4	13.7	2.2
	20	91.9	68.2	71.4	73.1	60.1	3	13.0	1.7
	30	117.1	67.2	71.3	72.7	60.4	3	12.3	1.4
	40	142.3	66.3	71.0	72.3	60.4	2	11.9	1.3
China Dyeing Works Development	1	41.5	76.8	71.8	78.0	60.7	8	17.3	6.2
Block 9	10	66.7	75.0	71.9	76.7	61.3	7	15.4	4.8
	20	91.9	73.6	71.9	75.8	61.4	6	14.4	3.9
	30	117.1	74.5	72.1	76.4	64.3	6	12.1	4.3
	40	142.3	71.6	72.2	74.9	65.4	5	9.5	2.7
Tsuen Kam Centre	1	21.5	58.4	61.5	63.2	53.5	−7	9.8	1.7
Block 1	10	60.0	69.2	69.1	72.2	60.6	2	11.6	3.1
	20	85.2	69.1	69.1	72.1	60.7	2	11.3	3.0
	30	105.5	70.6	70.8	73.7	64.0	4	9.7	2.9
Tsuen Kam Centre	1	21.5	51.3	55.6	57.0	52.6	−13	4.4	1.4
Block 2	10	60.0	68.3	69.3	71.8	64.3	2	7.5	2.6
	20	85.2	68.3	69.3	71.8	64.4	2	7.4	2.5
	30	105.5	68.5	70.4	72.5	64.4	3	8.1	2.2
Pak Tin Pa San Tsuen	1	41.5	58.1	71.0	71.2	60.3	1	10.8	0.2
Pak Tin Pa	1	58.3	75.9	85.2	86.6	78.9	16	6.8	0.4
Fuk Loi Estate	1	13.5	60.5	80.1	80.1	81.0	10	−0.9	0.0
	10	38.7	65.2	77.6	77.8	78.0	8	−0.2	0.2
	18	52.7	66.0	76.5	76.9	76.7	7	0.2	0.4

Notes:

PNL : Prevailing Noise Level
RNL : Relevant Noise Level, (L'a + L'b)
CRTN Criteria (1) RNL − HKPSG
(2) RNL − PNL
(3) RNL − L'B
(where L'B = Unmitigated noise level due to roads outside Route 5 scheme)

Mitigation Measures: Scheme 2

Location	Floor	Height	Predicted Noise Level, dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'a	L'b	RNL	(dB(A))	1	2	3
Shek Wai Kok	1	31.5	65.4	72.1	73.0	71.6	3	1.4	−2.4
West Facade	5	42.7	67.9	76.4	77.0	74.7	7	2.3	−0.8
	10	56.7	69.7	76.3	77.1	74.3	7	2.8	−0.3
	12	62.3	69.8	76.2	77.1	74.2	7	2.9	−0.1
	14	67.9	69.8	76.1	77.0	74.0	7	3.1	−0.1
	16	73.5	69.6	76.9	77.6	73.8	8	3.8	0.7
	18	79.1	69.9	76.7	77.5	73.6	8	3.9	0.8
	20	84.7	69.7	76.5	77.3	73.5	7	3.8	0.7
Shek Wai Kok	1	31.5	51.6	71.5	71.5	72.7	2	−1.2	−3.2
North Facade	5	42.7	55.6	71.8	71.7	72.7	2	−1.0	−3.0
	10	56.7	62.5	75.4	75.6	74.1	6	1.5	−1.2
	14	67.9	68.8	76.6	77.3	74.7	7	2.6	−0.3
	16	73.5	68.8	76.3	77.0	74.4	7	2.6	−0.3
	18	79.1	68.7	76.0	76.7	74.1	7	2.6	−0.3
	20	84.7	67.5	75.7	76.3	73.9	6	2.5	−0.4
Fairview Garden	1	24.4	61.3	76.3	76.4	79.2	8	−0.8	−0.2
	10	49.6	64.5	77.5	77.7	76.9	8	0.8	0.2
	18	72	67.4	76.7	77.2	75.4	7	1.7	0.6
	20	77.6	67.4	76.5	77.0	75.2	7	1.8	0.6
	22	83.2	68.0	76.3	76.9	74.9	7	2.0	0.7
	24	88.8	68.0	76.1	76.7	74.6	7	2.1	0.6
	26	94.4	68.0	75.9	76.6	74.4	7	2.2	0.7
Luk Yeung Sun Chuen	1	20.8	53.8	67.6	67.6	69.3	−2	−1.5	−4.3
Block A, North	10	46	67.3	78.2	78.6	76.1	9	2.4	−0.5
	20	74	68.9	77.5	78.1	75.1	8	3.0	0.1
	23	79.6	69.0	77.5	78.1	74.9	8	3.2	0.3
	25	85.2	69.0	77.3	77.9	74.7	8	3.3	0.2
	27	90.8	69.1	77.3	77.9	74.5	8	3.5	0.4
	29	96.4	69.1	77.3	77.9	74.3	8	3.7	0.6
	31	102	69.3	77.1	77.7	74.1	8	3.6	0.7
Luk Yeung Sun Chuen	1	20.8	55.1	70.0	70.2	71.2	0	−1.1	−2.9
Block A, West	10	46	66.1	75.8	76.2	72.5	6	3.7	0.1
	20	74	66.9	75.5	76.1	71.9	6	4.1	0.6
	23	79.6	66.9	75.3	75.9	71.7	6	4.2	0.6
	25	85.2	67.2	75.1	75.8	71.6	6	4.2	0.6
	27	90.8	67.2	75.0	75.7	71.4	6	4.3	0.7
	29	96.4	67.3	74.9	75.6	71.2	6	4.3	0.7
	31	102	68.0	74.6	75.4	71.1	5	4.4	0.8
Luk Yeung Sun Chuen	1	20.8	59.4	62.7	64.4	58.4	−6	6.0	0.6
Block F, North	10	46	66.4	68.8	70.8	71.6	1	−0.8	2.1
	20	74	68.4	74.4	75.3	71.1	5	4.2	0.7
	23	79.6	68.4	74.3	75.3	71.0	5	4.3	0.8
	25	85.2	68.4	74.3	75.3	70.9	5	4.4	0.9
	27	90.8	68.4	74.2	75.2	70.8	5	4.4	0.9
	29	96.4	68.5	74.1	75.1	70.7	5	4.4	0.9
	31	102	68.6	73.9	75.0	70.6	5	4.4	1.0
Luk Yeung Sun Chuen	1	20.8	61.1	67.1	68.0	64.1	−2	3.9	−0.7
Block F, West	10	46	67.0	73.0	74.0	70.6	4	3.4	1.0
	20	74	67.5	73.6	74.5	70.5	5	4.0	0.9
	23	79.6	67.7	73.5	74.5	70.4	5	4.1	1.0
	25	85.2	67.7	73.4	74.4	70.3	4	4.2	1.0
	27	90.8	67.6	73.3	74.3	70.2	4	4.2	1.0
	29	96.4	67.7	73.2	74.3	70.0	4	4.2	1.1
	31	102	67.7	73.0	74.1	69.9	4	4.2	1.1
Kwai Ming Wu School	1	21	63.1	70.6	71.3	71.5	6	−0.2	−3.7
	4	31.2	65.4	75.5	75.9	73.5	11	2.4	−1.2
	7	41.4	67.2	76.9	77.3	73.9	12	3.4	−0.1
Muk Min Ha Tsuen, No 1	1	39	69.5	84.6	84.8	78.7	15	6.1	0.1
	3	45	73.7	83.6	84.0	77.7	14	6.4	0.4
Muk Min Ha Tsuen, No 16	1	39	70.5	82.5	82.8	76.5	13	6.3	0.2
	3	45	76.0	82.1	83.0	76.0	13	7.0	0.9
Tung Lam Home for Aged	1	57	60.4	69.9	70.3	66.5	15	3.8	0.3
	2	60	63.2	72.1	72.6	69.2	16	3.3	0.3
Hoi Pa Village	1	35	63.5	79.0	79.1	76.7	9	2.4	−2.8
	3	41	68.4	79.9	80.2	76.6	10	3.7	−1.5
Pak Tin Pa Tsuen	1	50	66.2	77.1	77.5	69.9	7	7.5	−0.4
	2	56	67.2	77.1	77.5	72.2	8	5.4	−0.2
China Dyeing Works Development	1	41.5	71.7	71.3	74.5	59.2	5	15.3	3.2
Block 8	10	66.7	69.6	71.4	73.6	59.9	4	13.7	2.2
	20	91.9	68.2	71.4	73.1	60.1	3	13.0	1.7
	30	117.1	67.2	71.3	72.7	60.4	3	12.3	1.4
	40	142.3	66.4	71.0	72.3	60.4	2	11.9	1.3
China Dyeing Works Development	1	41.5	76.8	71.8	78.0	60.7	8	17.3	6.2
Block 9	10	66.7	75.0	71.9	76.7	61.3	7	15.4	4.8
	20	91.9	73.6	71.9	75.8	61.4	6	14.4	3.9
	30	117.1	72.5	72.1	75.3	64.3	5	11.0	3.2
	40	142.3	71.6	72.2	74.9	65.4	5	9.5	2.7
Tsuen Kam Centre	1	21.5	58.4	61.5	63.2	53.5	−7	9.8	1.7
Block 1	10	50	69.2	69.1	72.2	60.6	2	11.6	3.1
	20	85.2	69.1	69.1	72.1	60.7	2	11.3	3.0
	30	105.5	70.6	70.8	73.7	64.0	4	9.7	2.9
Tsuen Kam Centre	1	21.5	51.7	55.6	57.1	52.6	−13	4.5	1.5
Block 2	10	50	68.8	69.3	72.1	64.3	2	7.8	2.9
	20	85.2	68.8	69.3	72.1	64.4	2	7.7	2.8
	30	105.5	68.9	70.4	72.7	64.4	3	8.3	2.4
Pak Tin Pa San Tsuen	1	41.5	58.2	71.0	71.2	60.3	1	10.8	0.2
Pak Tin Pa	1	58.3	76.0	85.2	85.6	78.9	16	6.8	0.4
Fuk Loi Estate	1	13.5	60.5	80.1	80.1	81.0	10	−0.9	0.0
	10	38.7	65.2	77.6	77.8	78.0	8	−0.2	0.2
	18	52.7	66.0	76.5	76.9	76.7	7	0.2	0.4

Notes

PNL Prevailing Noise Level
RNL Relevant Noise level. (L'a + L'b)
CRTN Criteria (1) RNL − HKPSG
(2) RNL − PNL
(3) RNL − L'B
(L'B = Unmitigated noise level due to roads outside Route 5 scheme)

Mitigation Measures: Scheme 3

Location	Floor	Height	Predicted Noise Level dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'a	L'b	RNL	(dB(A))	1	2	3
Shek Wai Kok	1	31.5	65.4	72.1	**73.0**	71.6	3	1.4	−2.4
West Facade	5	42.7	67.9	76.4	**77.0**	74.7	7	2.3	−0.8
	10	56.7	69.7	76.3	**77.1**	74.3	7	2.8	−0.3
	12	62.3	69.8	76.2	**77.1**	74.2	7	2.9	−0.1
	14	67.9	69.9	76.1	**77.0**	74.0	7	3.1	−0.1
	16	73.5	69.8	76.9	**77.6**	73.8	8	3.8	0.7
	18	79.1	70.0	76.7	**77.5**	73.6	8	3.9	0.8
	20	84.7	69.8	76.5	**77.3**	73.5	7	3.9	0.7
Shek Wai Kok	1	31.5	51.6	71.5	**71.5**	72.7	2	−1.2	−3.2
North Facade	5	42.7	55.6	71.6	**71.7**	72.7	2	−1.0	−3.0
	10	56.7	62.5	75.4	**75.6**	74.1	6	1.5	−1.2
	14	67.9	68.8	76.6	**77.3**	74.7	7	2.6	−0.3
	16	73.5	68.8	76.3	**77.0**	74.4	7	2.6	−0.3
	18	79.1	68.7	76.0	**76.7**	74.1	7	2.6	−0.3
	20	84.7	67.5	75.7	**76.3**	73.9	6	2.5	−0.4
Fairview Garden	1	24.4	62.2	78.3	**78.4**	79.2	8	−0.8	−0.2
	10	49.6	65.0	77.5	**77.8**	76.9	8	0.8	0.3
	18	72	67.7	76.7	**77.2**	75.4	7	1.8	0.6
	20	77.6	67.7	76.5	**77.0**	75.2	7	1.9	0.6
	22	83.2	68.3	76.3	**76.9**	74.9	7	2.1	0.7
	24	88.8	68.3	76.1	**76.8**	74.6	7	2.1	0.7
	26	94.4	68.3	75.9	**76.6**	74.4	7	2.2	0.7
Luk Yeung Sun Chuen	1	20.8	54.4	67.6	**67.8**	69.3	−2	−1.5	−4.3
Block A, North	10	46	68.0	78.2	**78.6**	76.1	9	2.5	−0.5
	20	74	69.6	77.5	**78.2**	75.1	8	3.1	0.2
	23	79.6	69.8	77.5	**78.2**	74.9	8	3.3	0.4
	25	85.2	69.8	77.3	**78.0**	74.7	8	3.4	0.3
	27	90.8	69.9	77.3	**78.0**	74.5	8	3.6	0.5
	29	96.4	69.8	77.3	**78.0**	74.3	8	3.8	0.7
	31	102	70.0	77.1	**77.8**	74.1	8	3.8	0.8
Luk Yeung Sun Chuen	1	20.8	55.2	70.0	**70.2**	71.2	0	−1.1	−2.9
Block A, West	10	46	66.6	75.8	**76.3**	72.5	6	3.8	0.2
	20	74	67.8	75.5	**76.2**	71.9	6	4.3	0.7
	23	79.6	67.9	75.3	**76.0**	71.7	6	4.3	0.7
	25	85.2	68.4	75.1	**76.0**	71.6	6	4.4	0.8
	27	90.8	68.3	75.0	**75.8**	71.4	6	4.5	0.8
	29	96.4	68.3	74.9	**75.7**	71.2	6	4.5	0.8
	31	102	68.9	74.6	**75.6**	71.1	6	4.5	1.0
Luk Yeung Sun Chuen	1	20.8	58.3	62.7	**64.0**	58.4	−6	5.7	0.2
Block F, North	10	46	65.6	68.8	**70.5**	71.6	0	−1.1	1.8
	20	74	66.7	74.4	**75.0**	71.1	5	3.9	0.4
	23	79.6	68.4	74.3	**75.3**	71.0	5	4.3	0.8
	25	85.2	68.3	74.3	**75.3**	70.9	5	4.3	0.9
	27	90.8	68.4	74.2	**75.2**	70.8	5	4.4	0.9
	29	96.4	68.4	74.1	**75.1**	70.7	5	4.4	0.9
	31	102	68.6	73.9	**75.0**	70.6	5	4.4	1.0
Luk Yeung Sun Chuen	1	20.8	60.2	67.1	**67.9**	64.1	−2	3.8	−0.8
Block F, West	10	46	66.3	73.0	**73.9**	70.6	4	3.3	0.9
	20	74	67.1	73.6	**74.5**	70.5	4	4.0	0.9
	23	79.6	67.3	73.5	**74.4**	70.4	4	4.1	0.9
	25	85.2	67.4	73.4	**74.4**	70.3	4	4.1	1.0
	27	90.8	67.4	73.3	**74.3**	70.2	4	4.1	1.0
	29	96.4	67.5	73.2	**74.2**	70.0	4	4.2	1.0
	31	102	67.5	73.0	**74.1**	69.9	4	4.2	1.1
Kwai Ming Wu School	1	21	63.3	70.6	**71.3**	71.5	6	−0.2	−3.7
	4	31.2	64.9	75.5	**75.8**	73.5	11	2.4	−1.3
	7	41.4	67.0	76.9	**77.3**	73.9	12	3.4	−0.1
Muk Min Ha Tsuen, No 1	1	39	69.7	84.6	**84.8**	78.7	15	6.1	0.1
	3	45	74.3	83.6	**84.1**	77.7	14	6.4	0.5
Muk Min Ha Tsuen, No 16	1	39	70.3	82.5	**82.8**	76.5	13	6.3	0.2
	3	45	75.4	82.1	**82.9**	76.0	13	6.9	0.8
Tung Lam Home for Aged	1	57	60.8	70.3	**70.8**	66.5	16	4.3	0.8
	2	60	63.7	72.6	**73.1**	69.2	16	3.9	0.8
Hoi Pa Village	1	35	63.6	79.0	**79.1**	76.7	9	2.4	−2.8
	3	41	68.5	79.9	**80.2**	76.6	10	3.7	−1.5
Pak Tin Pa Tsuen	1	50	66.4	77.1	**77.5**	69.9	7	7.5	−0.4
	2	56	67.4	77.1	**77.6**	72.2	8	5.4	−0.1
China Dyeing Works Development	1	41.5	71.7	71.3	**74.5**	59.2	5	15.3	3.2
Block 8	10	66.7	69.6	71.4	**73.6**	59.9	4	13.7	2.2
	20	91.9	68.2	71.4	**73.1**	60.1	3	13.0	1.7
	30	117.1	67.2	71.3	**72.7**	60.4	3	12.3	1.4
	40	142.3	66.3	71.0	**72.3**	60.4	2	11.9	1.3
China Dyeing Works Development	1	41.5	76.8	71.8	**78.0**	60.7	8	17.3	5.2
Block 9	10	66.7	75.0	71.9	**76.7**	61.3	7	15.4	4.8
	20	91.9	73.6	71.9	**75.8**	61.4	6	14.4	3.9
	30	117.1	74.5	72.1	**76.4**	64.3	6	12.1	4.3
	40	142.3	71.6	72.2	**74.9**	65.4	5	9.5	2.7
Tseun Kam Centre	1	21.5	58.4	61.5	**63.2**	53.5	−7	9.8	1.7
Block 1	10	60	69.5	69.1	**72.3**	60.6	2	11.8	3.2
	20	85.2	69.4	69.1	**72.2**	60.7	2	11.5	3.1
	30	105.5	70.7	70.8	**73.8**	64.0	4	9.7	3.0
Tsuen Kam Centre	1	21.5	51.7	55.6	**57.1**	52.6	−13	4.5	1.5
Block 2	10	60	68.8	69.3	**72.1**	64.3	2	7.8	2.9
	20	85.2	68.8	69.3	**72.1**	64.4	2	7.7	2.8
	30	105.5	68.9	70.4	**72.7**	64.4	3	8.3	2.4
Pak Tin Pa San Tsuen	1	41.5	58.2	71.0	**71.2**	60.3	1	10.8	0.2
Pak Tin Pa	1	58.3	75.9	85.2	**85.6**	78.9	16	6.8	0.4
Fuk Loi Estate	1	13.5	61.6	80.1	**80.2**	81.0	10	−0.8	0.1
	10	38.7	66.9	77.6	**78.0**	78.0	8	−0.1	0.4
	18	52.7	68.1	78.5	**77.1**	76.7	7	0.4	0.6

Notes:

PNL: Prevailing Noise Level
RNL : Relevant Noise Level, (L'a+L'b)
CRTN Criteria (1) RNL − HKPSG
(2) RNL − PNL
(3) RNL − L'B
(L'B = Unmitigated noise level due to roads outside Route 5 scheme)

Mitigation Measures: Scheme 4

Location	Floor	Height	Predicted Noise Level dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'a	L'b	RNL		1	2	3
Shek Wai Kok	1	31.5	65.1	72.1	**72.9**	71.6	3	1.3	−2.5
West Facade	5	42.7	67.6	76.3	**76.9**	74.7	7	2.2	−0.9
	10	56.7	69.5	76.2	**77.1**	74.3	7	2.8	−0.3
	12	62.3	69.6	76.2	**77.0**	74.2	7	2.9	−0.2
	14	67.9	69.7	76.1	**77.0**	74.0	7	3.0	−0.1
	16	73.5	69.6	76.6	**77.6**	73.8	8	3.8	0.7
	18	79.1	69.8	76.7	**77.5**	73.6	7	3.9	0.8
	20	84.7	69.7	76.5	**77.3**	73.5	7	3.8	0.7
Shek Wai Kok	1	31.5	51.6	71.5	**71.5**	72.7	2	−1.2	−3.2
North Facade	5	42.7	55.6	71.6	**71.7**	72.7	2	−1.0	−3.0
	10	56.7	62.5	75.4	**75.6**	74.1	6	1.5	−1.2
	14	67.9	68.8	76.6	**77.3**	74.7	7	2.6	−0.3
	16	73.5	68.8	76.3	**77.0**	74.4	7	2.6	−0.3
	18	79.1	68.7	76.0	**76.7**	74.1	7	2.6	−0.3
	20	84.7	67.5	75.7	**76.3**	73.9	6	2.5	−0.4
Fairview Garden	1	24.4	61.7	78.3	**78.4**	79.2	8	−0.9	−0.2
	10	49.6	64.2	77.4	**77.6**	76.9	8	0.7	0.1
	18	72	67.2	76.5	**77.0**	75.4	7	1.6	0.4
	20	77.6	67.3	76.3	**76.8**	75.2	7	1.7	0.4
	22	83.2	67.9	76.1	**76.7**	74.9	7	1.9	0.5
	24	88.8	67.9	75.9	**76.6**	74.6	7	1.9	0.5
	26	94.4	67.8	75.8	**76.4**	74.4	6	2.0	0.5
Luk Yeung Sun Chuen	1	20.8	52.1	67.5	**67.7**	69.3	−2	−1.6	−4.4
Block A, North	10	46	67.8	76.0	**76.4**	76.1	8	2.2	−0.7
	20	74	69.3	77.2	**77.9**	75.1	8	2.8	−0.1
	23	79.6	69.4	77.2	**77.9**	74.9	8	3.0	0.1
	25	85.2	69.4	77.1	**77.7**	74.7	8	3.1	0.0
	27	90.8	69.2	77.1	**77.7**	74.5	8	3.2	0.2
	29	96.4	69.1	77.1	**77.7**	74.3	8	3.4	0.4
	31	102	69.1	76.8	**77.5**	74.1	7	3.4	0.5
Luk Yeung Sun Chuen	1	20.8	53.2	69.9	**70.0**	71.2	−0	−1.3	−3.1
Block A, West	10	46	65.6	75.3	**75.7**	72.5	6	3.2	−0.4
	20	74	66.8	75.0	**75.6**	71.9	6	3.7	0.1
	23	79.6	67.1	74.8	**75.5**	71.7	5	3.8	0.2
	25	85.2	67.3	74.6	**75.4**	71.6	5	3.8	0.2
	27	90.8	67.2	74.5	**75.2**	71.4	5	3.9	0.2
	29	96.4	67.0	74.4	**75.1**	71.2	5	3.9	0.2
	31	102	67.3	74.1	**74.9**	71.1	5	3.8	0.3
Luk Yeung Sun Chuen	1	20.8	57.1	62.5	**63.6**	58.4	−6	5.2	−0.2
Block F, North	10	46	63.4	68.1	**69.3**	71.6	−1	−2.2	0.6
	20	74	67.1	73.7	**74.5**	71.1	5	3.4	−0.1
	23	79.6	67.1	73.6	**74.5**	71.0	4	3.4	−0.0
	25	85.2	67.1	73.6	**74.5**	70.9	4	3.6	0.1
	27	90.8	67.1	73.5	**74.4**	70.8	4	3.6	0.1
	29	96.4	67.2	73.4	**74.3**	70.7	4	3.6	0.1
	31	102	67.5	73.2	**74.2**	70.6	4	3.6	0.2
Luk Yeung Sun Chuen	1	20.8	59.0	66.1	**66.9**	64.1	−3	2.8	−1.8
Block F, West	10	46	64.3	72.2	**72.8**	70.6	3	2.3	−0.2
	20	74	65.5	72.8	**73.5**	70.5	4	3.0	−0.1
	23	79.6	65.8	72.7	**73.5**	70.4	3	3.1	−0.0
	25	85.2	65.8	72.6	**73.4**	70.3	3	3.1	−0.0
	27	90.8	65.7	72.5	**73.3**	70.2	3	3.1	0.0
	29	96.4	65.8	72.4	**73.2**	70.0	3	3.2	0.0
	31	102	65.8	72.1	**73.0**	69.9	3	3.1	0.0
Kwai Ming Wu School	1	21	62.9	70.4	**71.1**	71.5	6	−0.4	−3.9
	4	31.2	64.2	74.8	**75.1**	73.5	10	1.7	−2.0
	7	41.4	65.6	76.4	**76.7**	73.9	12	2.8	−0.7
Muk Min Ha Tsuen, No 1	1	39	65.4	84.9	**85.0**	78.7	15	6.3	0.3
	3	45	72.2	84.0	**84.3**	77.7	14	6.6	0.7
Muk Min Ha Tsuen, No 16	1	39	70.6	82.9	**83.1**	76.5	13	6.6	0.5
	3	45	73.2	82.4	**82.9**	76.0	13	6.9	0.8
Tung Lam Home for Aged	1	57	59.9	70.2	**70.6**	66.5	16	4.1	0.6
	2	60	62.9	72.3	**72.7**	69.2	18	3.5	0.5
Hoi Pa Village	1	35	68.2	79.0	**79.3**	76.7	9	2.7	−2.6
	3	41	69.1	79.9	**80.3**	76.6	10	3.7	−1.4
Pak Tin Pa Tsuen	1	50	67.2	77.1	**77.5**	69.9	8	7.6	−0.4
	2	56	67.8	77.1	**77.6**	72.2	8	5.4	−0.1
China Dyeing Works Development	1	41.5	71.7	71.3	**74.5**	59.2	5	15.3	3.2
Block 8	10	56.7	69.6	71.4	**73.6**	59.9	4	13.7	2.2
	20	91.9	68.2	71.4	**73.1**	60.1	3	13.0	1.7
	30	117.1	67.2	71.3	**72.7**	60.4	3	12.3	1.4
	40	142.3	66.3	71.0	**72.3**	60.4	2	11.9	1.3
China Dyeing Works Development	1	41.5	76.8	71.8	**78.0**	60.7	8	17.3	6.2
Block 9	10	56.7	75.0	71.9	**76.7**	61.3	7	15.4	4.8
	20	91.9	73.5	71.9	**75.8**	61.4	6	14.4	3.9
	30	117.1	72.5	72.1	**75.3**	64.3	5	11.0	3.2
	40	142.3	71.6	72.2	**74.9**	65.4	5	9.5	2.7
Tsuen Kam Centre	1	21.5	58.4	61.5	**63.2**	53.5	−7	9.8	1.7
Block 1	10	60	69.5	69.1	**72.3**	60.6	2	11.8	3.2
	20	85.2	69.4	69.1	**72.2**	60.7	2	11.5	3.1
	30	105.5	70.6	70.4	**73.5**	64.0	4	9.5	2.7
Tsuen Kam Centre	1	21.5	51.3	55.6	**57.0**	52.6	−13	4.4	1.4
Block 2	10	60	68.3	68.4	**71.4**	64.3	1	7.1	2.2
	20	85.2	68.3	68.6	**71.4**	64.4	1	7.0	2.1
	30	105.5	68.5	69.8	**72.2**	64.4	2	7.8	1.9
Pak Tin Pa San Tsuen	1	41.5	57.8	71.0	**71.2**	60.3	1	10.8	0.2
Pak Tin Pa	1	58.3	75.6	85.2	**85.6**	78.9	16	6.7	0.4
Fuk Loi Estate	1	13.5	61.6	80.1	**80.2**	81.0	10	−0.8	0.1
	10	38.7	66.9	77.6	**78.0**	78.0	8	−0.1	0.4
	18	52.7	68.1	76.5	**77.1**	76.7	7	0.4	0.6

Notes:

PNL Prevailing Noise Level
RNL Relevant Noise Level (L'a + L'b)
CRTN Criteria (1) RNL − HKPSG
(2) RNL − PNL
(3) RNL − L'B
(L'B = Unmitigated noise level due to roads outside Route 5 scheme)

No Mitigation

Location	Floor	Height	Predicted Noise Level dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'a	L'b	RNL		1	2	3
Nan Fung Development	1	36	70.5	44.5	**70.5**	69.6	1	1.0	26.0
Tower 4, Block 4	10	61.2	71.5	52.9	**71.6**	69.9	2	1.7	18.7
	20	89.2	73.5	57.0	**73.6**	71.6	4	2.0	16.6
	30	117.2	73.0	56.8	**73.1**	71.2	3	1.9	16.3
	38	139.6	72.5	58.8	**72.7**	70.8	3	1.9	13.9
Nan Fung Development	1	36	71.4	64.9	**72.3**	71.2	2	1.1	7.4
Tower 4, Block 1	10	61.2	74.6	73.1	**76.9**	75.9	7	1.0	3.8
	20	89.2	76.0	73.0	**77.8**	77.1	8	0.7	4.8
	30	117.2	75.5	72.7	**77.3**	76.5	7	0.8	4.6
	38	139.6	75.0	72.5	**76.9**	76.1	7	0.8	4.5
Nan Fung Development	1	45.6	70.2	75.5	**76.6**	76.7	7	−0.1	1.1
Tower 1, Block 1	10	70.8	70.3	75.2	**76.4**	76.5	6	−0.1	1.2
	20	98.8	70.6	74.8	**76.2**	76.3	6	−0.1	1.4
	30	126.8	70.6	74.4	**75.9**	76.0	6	−0.0	1.5
	38	149.2	70.4	74.1	**75.7**	75.7	6	0.0	1.5
Tsuen Tak Garden	1	17.6	79.9	74.6	**81.0**	77.3	11	3.7	6.4
	10	42.8	80.4	72.9	**81.1**	77.8	11	3.4	8.3
	20	70.8	79.1	71.3	**79.8**	76.5	10	3.3	8.5
	23	79.2	78.7	71.0	**79.4**	76.1	9	3.3	8.4
	25	84.8	78.5	70.8	**79.2**	75.9	9	3.3	8.3
	27	90.4	78.3	70.8	**79.0**	75.7	9	3.2	8.2
	29	96	78.0	71.0	**78.8**	75.6	9	3.2	7.8
Kam Fung Garden	1	16.5	82.1	70.7	**82.4**	78.2	12	4.2	11.6
	10	41.7	81.7	70.2	**82.0**	77.5	12	4.5	11.8
	20	69.7	80.1	69.1	**80.4**	75.9	10	4.5	11.3
	30	97.7	78.8	68.6	**79.2**	74.8	9	4.4	10.6
	35	111.7	78.3	69.2	**78.8**	74.5	9	4.3	9.6
Tsuen King Garden	1	22.5	61.4	59.4	**63.5**	60.9	−6	2.7	4.2
	10	47.7	65.0	59.8	**66.2**	63.2	−4	3.0	6.4
	20	75.7	70.1	61.5	**70.7**	65.7	1	4.9	9.2
	22	81.3	70.5	61.5	**71.0**	65.8	1	5.2	9.5
	24	86.8	71.0	61.5	**71.5**	65.9	1	5.6	10.0
	26	92.5	71.6	61.5	**72.0**	66.4	2	5.6	10.5
	28	98.1	71.6	61.8	**72.1**	66.5	2	5.6	10.3
	30	103.7	71.8	61.8	**72.2**	66.6	2	5.6	10.4
China Dyeing Works Development	1	41.5	80.0	57.6	**80.0**	73.9	10	6.1	22.5
Block 1	10	66.7	78.5	61.6	**78.6**	73.0	9	5.6	16.9
	20	91.9	77.1	61.1	**77.2**	71.7	7	5.5	16.1
	30	117.1	76.0	63.2	**76.2**	71.0	6	5.3	13.0
	40	142.3	75.1	63.0	**75.4**	70.2	5	5.2	12.4
China Dyeing Works Development	1	41.5	77.3	58.4	**77.3**	71.0	7	6.3	19.0
Block 2	10	66.7	76.6	61.6	**76.7**	71.3	7	5.4	15.1
	20	91.9	75.6	60.7	**75.7**	70.2	6	5.5	15.1
	30	117.1	74.8	61.0	**74.9**	69.5	5	5.5	13.9
	40	142.3	74.0	62.2	**74.3**	69.0	4	5.3	12.1
China Dyeing Works Development	1	41.5	74.7	59.8	**74.8**	69.2	5	5.6	15.0
Block 4	10	66.7	74.9	62.6	**75.2**	70.8	5	4.3	12.5
	20	91.9	74.7	61.6	**74.9**	70.2	5	4.7	13.2
	30	117.1	74.3	62.5	**74.5**	69.7	5	4.8	12.1
	40	142.3	73.7	62.2	**74.0**	69.2	4	4.8	11.9
China Dyeing Works Development	1	41.5	64.6	54.1	**64.9**	59.3	−5	5.6	10.9
Block 12	10	66.7	67.8	54.0	**68.0**	64.1	−2	3.9	14.0
	20	91.9	68.9	54.3	**69.0**	66.3	−1	2.7	14.7
	30	117.1	68.2	57.4	**68.5**	66.3	−1	2.2	11.2
	40	142.3	67.6	60.2	**68.3**	67.1	−2	1.2	8.1
Joyful Garden	1	31	67.8	55.6	**68.1**	66.9	−2	1.2	12.5
	10	56.2	68.1	67.0	**70.6**	69.3	1	1.2	3.6
	20	81.4	70.8	67.2	**72.3**	70.4	2	2.0	5.2
	22	87	71.3	67.1	**72.7**	70.8	3	1.9	5.6
	24	92.6	71.3	67.1	**72.7**	70.8	3	1.9	5.6
	26	98.2	71.8	67.1	**73.1**	71.2	3	1.9	6.0
	28	103.8	72.2	67.1	**73.3**	71.7	3	1.6	6.3
	30	109.4	72.2	67.2	**73.4**	71.9	3	1.6	6.2
Nan Fung School	1	16.7	66.4	61.7	**67.6**	63.1	−2	4.5	6.0
	7	37.1	75.7	61.6	**75.9**	73.1	6	2.8	14.3

Notes:

PNL : Prevailing Noise Level
RNL : Relevant Noise Level (L'a + L'b)
CRTN Criteria (1) RNL – HKPSG
(2) RNL – PNL
(3) RNL – L'b

Mitigation Measures: Low Noise Surfacing

Location	Floor	Height	Predicted Noise Level dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'a	L'b	RNL		1	2	3
Nan Fung Development	1	36	69.4	44.5	**69.5**	69.6	−1	−0.1	24.9
Tower 4, Block 4	10	61.2	70.6	52.9	**70.6**	69.9	1	0.7	17.7
	20	89.2	72.3	57.0	**72.5**	71.6	2	0.9	15.4
	30	117.2	71.8	56.8	**72.0**	71.2	2	0.8	15.2
	38	139.6	71.4	58.8	**71.6**	70.8	2	0.8	12.8
Nan Fung Development	1	36	70.3	64.9	**71.4**	71.2	1	0.2	6.5
Tower 4, Block 1	10	61.2	73.3	73.1	**76.2**	75.9	6	0.3	3.1
	20	89.2	74.8	73.0	**77.0**	77.1	7	−0.1	4.0
	30	117.2	74.2	72.7	**76.5**	76.5	7	0.0	3.8
	38	139.6	73.7	72.5	**76.1**	76.1	6	0.0	3.7
Nan Fung Development	1	45.6	67.9	75.5	**76.2**	76.7	6	−0.5	0.7
Tower 1, Block 1	10	70.8	68.0	75.2	**75.9**	76.5	6	−0.6	0.8
	20	98.8	68.7	74.8	**75.8**	76.3	6	−0.5	0.9
	30	126.8	68.7	74.4	**75.5**	76.0	5	−0.5	1.0
	38	149.2	68.5	74.1	**75.2**	75.7	5	−0.5	1.0
Tsuen Tak Garden	1	17.6	78.1	74.6	**79.7**	77.3	10	2.4	5.1
	10	42.8	78.5	72.9	**79.6**	77.8	10	1.8	6.7
	20	70.8	77.2	71.3	**78.2**	76.5	8	1.8	6.9
	23	79.2	76.9	71.0	**77.9**	76.1	8	1.8	6.9
	25	84.8	76.7	70.8	**77.7**	75.9	8	1.7	6.8
	27	90.4	76.4	70.8	**77.5**	75.7	7	1.7	6.7
	29	96	76.2	71.0	**77.4**	75.6	7	1.7	6.4
Kam Fung Garden	1	16.5	79.8	70.7	**80.3**	78.2	10	2.1	9.6
	10	41.7	79.5	70.2	**80.0**	77.5	10	2.4	9.8
	20	69.7	77.9	69.1	**78.5**	75.9	8	2.5	9.3
	30	97.7	76.6	68.6	**77.3**	74.8	7	2.5	8.7
	35	111.7	76.1	69.2	**76.9**	74.5	7	2.4	7.7
Tsuen King Garden	1	22.5	59.6	59.4	**62.5**	60.9	−8	1.6	3.1
	10	47.7	63.7	59.8	**65.2**	63.2	−5	2.0	5.3
	20	75.7	68.5	61.5	**69.3**	65.7	−1	3.5	7.8
	22	81.3	68.8	61.5	**69.5**	65.8	−0	3.8	8.1
	24	86.8	69.2	61.5	**69.9**	65.9	−0	4.1	8.4
	26	92.5	69.8	61.5	**70.4**	66.4	0	4.0	8.8
	28	98.1	69.8	61.8	**70.4**	66.5	0	3.9	8.6
	30	103.7	69.9	61.8	**70.5**	66.6	1	4.0	8.7
China Dyeing Works Development	1	41.5	78.0	57.6	**78.0**	73.9	8	4.1	20.5
Block 1	10	66.7	76.7	61.6	**76.8**	73.0	7	3.9	15.2
	20	91.9	75.3	61.1	**75.5**	71.7	5	3.8	14.3
	30	117.1	74.2	63.2	**74.6**	71.0	5	3.6	11.4
	40	142.3	73.4	63.0	**73.8**	70.2	4	3.5	10.7
China Dyeing Works Development	1	41.5	75.5	58.4	**75.6**	71.0	6	4.6	17.3
Block 2	10	66.7	74.8	61.6	**75.0**	71.3	5	3.7	13.4
	20	91.9	73.8	60.7	**74.0**	70.2	4	3.8	13.4
	30	117.1	73.0	61.0	**73.3**	69.5	3	3.8	12.2
	40	142.3	72.2	62.2	**72.7**	69.0	3	3.7	10.4
China Dyeing Works Development	1	41.5	73.0	59.8	**73.2**	69.2	3	4.0	13.4
Block 4	10	66.7	73.1	62.6	**73.5**	70.8	4	2.7	10.9
	20	91.9	72.9	61.6	**73.2**	70.2	3	3.0	11.6
	30	117.1	72.5	62.5	**72.9**	69.7	3	3.1	10.4
	40	142.3	71.9	62.2	**72.4**	69.2	2	3.2	10.2
China Dyeing Works Development	1	41.5	62.2	54.1	**62.8**	59.3	−7	3.5	8.8
Block 12	10	66.7	66.7	54.0	**66.9**	64.1	−3	2.8	13.0
	20	91.9	67.9	54.3	**68.1**	66.3	−2	1.8	13.8
	30	117.1	67.3	57.4	**67.7**	66.3	−2	1.4	10.3
	40	142.3	66.7	60.2	**67.6**	67.1	−2	0.5	7.4
Joyful Garden	1	31	66.7	55.6	**67.0**	66.9	−3	0.2	11.5
	10	56.2	66.9	67.0	**70.0**	69.3	−0	0.6	3.0
	20	81.4	69.5	67.2	**71.5**	70.4	1	1.1	4.3
	22	87	69.9	67.1	**71.7**	70.8	2	1.0	4.6
	24	92.6	70.0	67.1	**71.8**	70.8	2	1.0	4.7
	26	98.2	70.6	67.1	**72.2**	71.2	2	1.0	5.2
	28	103.8	70.9	67.1	**72.4**	71.7	2	0.7	5.4
	30	109.4	70.9	67.2	**72.5**	71.9	2	0.6	5.2
Nan Fung School	1	16.7	64.8	61.7	**66.5**	63.1	−4	3.4	4.8
	7	37.1	73.8	61.6	**74.1**	73.1	4	1.0	12.5

Notes:

PNL : Prevailing Noise Level
RNL : Relevant Noise Level (L'a + L'b)
CRTN Criteria (1) RNL − HKPSG
(2) RNL − PNL
(3) RNL − L'b

Mitigation Measures: Enclosure 7 + Barrier L (3m)

Location	Floor	Height	Predicted Noise Level dB(A)			PNL	CRTN Criteria		
			Route 5	Other	Total				
		(mPD)	L'a	L'b	RNL		1	2	3
Nan Fung Development	1	36	64.5	44.5	**64.5**	69.6	−5	−5.1	20.0
Tower 4, Block 4	10	61.2	68.2	52.9	**68.3**	69.9	−2	−1.6	15.4
	20	89.2	70.6	57.0	**70.8**	71.6	1	−0.8	13.8
	30	117.2	70.7	56.8	**70.9**	71.2	1	−0.3	14.1
	38	139.6	70.5	58.8	**70.7**	70.8	1	−0.0	12.0
Nan Fung Development	1	36	66.9	64.9	**69.0**	71.2	−1	−2.2	4.1
Tower 4, Block 1	10	61.2	72.2	73.1	**75.7**	75.9	6	−0.2	2.6
	20	89.2	73.6	73.0	**76.3**	77.1	6	−0.8	3.3
	30	117.2	73.4	72.7	**76.1**	76.5	6	−0.4	3.4
	38	139.6	73.6	72.5	**76.1**	76.1	6	−0.0	3.6
Nan Fung Development	1	45.6	67.3	75.5	**76.1**	76.7	6	−0.6	0.6
Tower 1, Block 1	10	70.8	67.7	75.2	**75.9**	76.5	6	−0.6	0.7
	20	98.8	68.4	74.8	**75.7**	76.3	6	−0.6	0.9
	30	126.8	68.6	74.4	**75.4**	76.0	5	−0.5	1.0
	38	149.2	68.5	74.1	**75.2**	75.7	5	−0.5	1.0
Tsuen Tak Garden	1	17.6	74.5	74.6	**77.6**	77.3	8	0.3	2.9
	10	42.8	76.4	72.9	**78.0**	77.8	8	0.2	5.1
	20	70.8	75.5	71.3	**76.9**	76.5	7	0.4	5.6
	23	79.2	75.1	71.0	**76.6**	76.1	7	0.4	5.6
	25	84.8	74.9	70.8	**76.4**	75.9	6	0.4	5.5
	27	90.4	74.8	70.8	**76.2**	75.7	6	0.5	5.5
	29	96	74.6	71.0	**76.2**	75.6	6	0.5	5.2
Kam Fung Garden	1	16.5	79.0	70.7	**79.6**	78.2	10	1.4	8.9
	10	41.7	79.2	70.2	**79.7**	77.5	10	2.2	9.5
	20	69.7	77.7	69.1	**78.2**	75.9	8	2.3	9.1
	30	97.7	76.5	68.6	**77.1**	74.8	7	2.3	8.5
	35	111.7	76.0	69.2	**76.8**	74.5	7	2.3	7.6
Tsuen King Garden	1	22.5	56.8	59.4	**61.3**	60.9	−9	0.4	1.9
	10	47.7	61.2	59.8	**63.5**	63.2	−6	0.3	3.7
	20	75.7	66.9	61.5	**68.0**	65.7	−2	2.3	6.5
	22	81.3	67.0	61.5	**68.1**	65.8	−2	2.3	6.6
	24	86.8	67.7	61.5	**68.6**	65.9	−1	2.8	7.2
	26	92.5	68.5	61.5	**69.3**	66.4	−1	2.9	7.8
	28	98.1	68.5	61.8	**69.4**	66.5	−1	2.9	7.6
	30	103.7	68.7	61.8	**69.5**	66.6	−1	2.9	7.7
China Dyeing Works Development	1	41.5	78.0	57.6	**78.0**	73.9	8	4.1	20.4
Block 1	10	66.7	76.7	61.6	**76.8**	73.0	7	3.9	15.2
	20	91.9	75.3	61.1	**75.5**	71.7	5	3.8	14.4
	30	117.1	74.3	63.2	**74.6**	71.0	5	3.6	11.4
	40	142.3	73.4	63.0	**73.8**	70.2	4	3.6	10.7
China Dyeing Works Development	1	41.5	74.4	58.4	**74.5**	71.0	5	3.5	16.2
Block 2	10	66.7	74.7	61.6	**74.9**	71.3	5	3.6	13.3
	20	91.9	73.9	60.7	**74.1**	70.2	4	3.8	13.4
	30	117.1	73.0	61.0	**73.3**	69.5	3	3.8	12.3
	40	142.3	72.3	62.2	**72.7**	69.0	3	3.7	10.5
China Dyeing Works Development	1	41.5	71.4	59.8	**71.7**	69.2	2	2.5	11.9
Block 4	10	66.7	72.0	62.6	**72.5**	70.8	2	1.6	9.8
	20	91.9	72.8	61.6	**73.1**	70.2	3	2.9	11.5
	30	117.1	72.4	62.5	**72.8**	69.7	3	3.1	10.3
	40	142.3	72.0	62.2	**72.4**	69.2	2	3.2	10.2
China Dyeing Works Development	1	41.5	62.2	54.1	**62.8**	59.3	−7	3.5	8.8
Block 12	10	66.7	66.7	54.0	**66.9**	64.1	−3	2.8	13.0
	20	91.9	67.9	54.3	**68.1**	66.3	−2	1.8	13.8
	30	117.1	67.3	57.4	**67.7**	66.3	−2	1.4	10.3
	40	142.3	66.7	60.2	**67.6**	67.1	−2	0.5	7.4
Joyful Garden	1	31	61.9	55.6	**62.8**	66.9	−7	−4.1	7.2
	10	56.2	64.1	67.0	**68.8**	69.3	−1	−0.5	1.8
	20	81.4	68.0	67.2	**70.6**	70.4	1	0.2	3.5
	22	87	68.5	67.1	**70.9**	70.8	1	0.1	3.8
	24	92.6	68.6	67.1	**70.9**	70.8	1	0.1	3.8
	26	98.2	69.8	67.1	**71.6**	71.2	2	0.4	4.6
	28	103.8	70.1	67.1	**71.8**	71.7	2	0.1	4.8
	30	109.4	70.1	67.2	**71.9**	71.9	2	0.1	4.7
Nan Fung School	1	16.7	61.0	61.7	**64.4**	63.1	−1	1.2	2.7
	7	37.1	69.1	61.6	**69.8**	73.1	5	−3.3	8.2

Notes:

PNL : Prevailing Noise Level
RNL : Relevant Noise Level (L'a + L'b)
CRTN Criteria (1) RNL – HKPSG
(2) RNL – PNL
(3) RNL – L'b

2. Bulldozing

$$EmissionRate(kg/hour) = \frac{2.6(s)^{1.2}}{M^{1.3}}$$

where s = material silt content in % = 20
M = material moisture content in % = 17

No	Easting	Northing	Height (mPD)	Area (m^2)	Emission Factor ($g/s/m^2$)	
					1-hr Avg	24-hr Avg
1	30474	26234	20	15284	9.516E-5	3.569E-5
2	28917	26197	15	8163	8.10E-5	3.038E-5

3. Stockpiling

Emission Rate, Active ($g/m^2/day$) = 1.48

Emission Rate, Inactive ($g/m^2/day$) = 3.9

No	Easting	Northing	Height (mPD)	Area (m^2)	Emission Factor ($g/s/m^2$)	
					1-hr Avg	24-hr Avg
1	30261	26243	21	1756	9.081E-5	3.405E-5

4. Drilling

Emission Rate (g/Mg) = 0.4

No	Easting	Northing	Height (mPD)	Area (m^2)	Emission Factor ($g/s/m^2$)	
					1-hr Avg	24-hr Avg
1	30583	26297	26	1956	2.209E-6	8.286E-7
2	30474	26234	20	6948	7.107E-6	2.665E-6
3	29908	26354	25	30370	6.810E-8	2.554E-8
4	29719	26452	30	9974	1.238E-6	4.643E-7
5	29408	26329	11	2800	1.234E-6	4.628E-7
6	28917	26197	15	8163	3.630E-8	1.361E-8
	Starting	Ending	Height (mPD)	Width (m)	Emission Factor (g/s/m)	
					1-hr Avg	24-hr Avg
7	29190, 26290	26330, 26290,	21	10	5.811E-6	2.179E-6

5. Construction

Emission Rate (kg/m^2/month) = 0.269

	Starting	Ending	Height (mPD)	Width (m)	Emission Factor (g/s/m)	
					1-hr Avg	24-hr Avg
1	30748, 26360	30430, 26240	26	40	3.196E-4	1.199E-4
2	30430, 26240	30162, 26252	20	60	3.196E-4	1.199E-4
3	30162, 26252	29780, 26400	25	80	3.196E-4	1.199E-4
4	29780, 26400	29670, 26482	30	40	3.196E-4	1.199E-4
5	29644, 26360	29760, 26376	25	30	3.196E-4	1.199E-4
6	29560, 26228	29454, 26268	10.5	30	3.196E-4	1.199E-4
7	29454, 26268	29020, 26268	10.5	40	3.196E-4	1.199E-4
6	29020, 26268	28844, 26142	15	40	3.196E-4	1.199E-4

6. Emission Rates for Hauling

$$EmissionRate(kg/v-km) = k(1.7)\left(\frac{s}{12}\right)\left(\frac{S}{48}\right)\left(\frac{W}{2}.7\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}\left(\frac{365-p}{365}\right)$$

where	k	=	Particle Size Multiplier	=	0.8 (TSP)
	s	=	Silt Content in %	=	20
	S	=	Mean Vehicle Speed	=	10 km/hr
	W	=	Mean Vehicle Weight	=	30 tonnes (loaded),
				=	10 tonnes (unload)
	w	=	Number of Wheels	=	10
	p	=	Number of day with ≥ 0.254 mm of precipitation	=	136 days

	Starting	Ending	Height (mPD)	Width (m)	Emission Factor (g/s/m)	
					1-hr Avg	24-hr Avg
1	29776, 26404	30254, 26242	23	3.5	0.0151	5.663E-3

APPENDIX D2 - VEHICLE EMISSION RATES

Fleet Average Emission Factors (g/km)

Pollutant	MC	P/C-p	P/C-d	Taxi	PuBus	PrBus	PuLB	PrLB	L-pI	L-dI	L-pII	L-dII	MGV	HGV
PM	0.040	0.041	0.282	0.238	1.375	1.257	0.352	0.342	0.039	0.266	0.039	0.361	1.259	1.260
NO_x	0.548	1.321	0.870	0.779	10.475	9.775	1.782	1.762	0.738	1.540	1.417	1.803	7.937	9.802
CO	18.1	6.504	0.894	1.073	11.593	8.096	1.307	0.992	6.136	0.999	6.136	1.131	8.453	8.458

Key:

MC	=	Motor cycle (petrol)
PC-p	=	Private car (petrol)
PC-d	=	Private car (diesel)
Taxi	=	Taxi (diesel)
PuBus	=	Public bus (diesel)
PrBus	=	Private bus (diesel)
PuLB	=	Public light bus (diesel)
PrLB	=	Private light bus (diesel)
L-pI	=	Light goods vehicle below 2.5 ton GVW (petrol)
L-dI	=	Light goods vehicle below 2.5 ton GVW (diesel)
L-pII	=	Light goods vehicle 2.5T < GVW (petrol)
L-dII	=	Light goods vehicle 2.5T < GVW (diesel)
MGV	=	Medium goods vehicle
HGV	=	Heavy goods vehicle