LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AQO	Air Quality Objective
ANL	Acceptable Noise Level
AR	Airport Railway
BU	Beneficial Use
CKR	Central Kowloon Route
CO	Carbon Monoxide
EPD	Environmental Protection Department
HKPSG	Hong Kong Planning Standards and Guidelines
GSP	Good Site Practice
MIDS	Metroplan Interim Development Statement for West Kowloon
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NSR	Noise Sensitive Receiver
O_3	Ozone
P1	Primary Feeder Road 1
PADS	Port and Airport Development Strategy
PCU	Passenger Car Unit
PCWA	Public Cargo Working Area
PD	Principal Datum
ppm	Parts Per Million
ppb	Parts Per Billion
RSP	Respirable Suspended Particulates
SR	Sensitive Receiver
THA	Temporary Housing Area
TSP	Total Suspended Particulates
WHC	Western Harbour Crossing
WKE	West Kowloon Expressway
WKR	West Kowloon Reclamation
WKRS	West Kowloon Reclamation Study
WKRTS	West Kowloon Reclamation Transport Study
WQO	Water Quality Objective

Introduction

CHAPTER 1

1. INTRODUCTION

1.1 BACKGROUND

1.1.1 The West Kowloon Expressway (WKE) is an Airport Core Project within the Hong Kong Port and Airport Development Strategy (PADS). It will form a major highway link between the proposed new Western Harbour Crossing (WHC) in the south, and Route 3 (leading to the PRC border and the airport at Chek Lap Kok) in the north. The WKE will be built on newly reclaimed land within the West Kowloon Reclamation (WKR), with the Southern Section in a slightly depressed, or at grade vertical alignment and the Northern Section on elevated structure. A primary feeder road (P1) will run beside the WKE in both directions for the full length of its route. Figure 1.1 shows the main elements of the Project.

1.1.2 South to north, the Project includes :

- o an east-west flyover, as an extension of Jordan Road;
- o a major interchange at Yau Ma Tei, linking the Expressway to a proposed new Central Kowloon Route (CKR);
- o an east-west flyover as an extension of Cherry Street;
- o a roundabout at the intersection with Prince Edward Road (P1 only);
- o a three-way intersection with Tonkin Street (P1 only);
- o a major interchange with the proposed Route 16 road to Sha Tin.

1.1.3 In close proximity to the WKE all along its route is the proposed new Airport Railway (AR). This is to be built by the cut and cover method of construction south of Cherry Street. At Cherry Street a ground level Tai Kok Tsui Station is proposed, to lie east of the Expressway. North of Cherry Street it is envisaged that the railway will lie beneath the Expressway for the remainder of its length.

1.1.4 This document forms volume 3 of a three volume set representing the Preliminary Report for the West Kowloon Expressway Project. In addition to the three volumes an Executive summary of Volume 3 will be produced in both English and Chinese. The three volumes are:

- o Volume 1 Engineering Investigation;
- o Volume 2 Drawings;
- o Volume 3 Environmental Assessment.

1.2 OBJECTIVES AND SCOPE

1.2.1 The formal objectives of the Environmental Assessment (EA) are given in the brief issued by Government (this is given as an appendix to Volume 1). In summary, the objectives are to :

- o describe the Project;
- o describe the affected community and environment;
- o minimise pollution and nuisance due to the Project;
- o identify and evaluate impacts upon the community and environment during construction and operation;
- o identify measures to mitigate these impacts;
- o recommend any necessary environmental monitoring and auditing.

1.2.2 Government has also defined the scope of the assessment, which is to include :

- o noise impacts;
- o air quality impacts;
- o water quality impacts;
- o land use impacts;
- o visual impacts.

All impacts are to be assessed at both the construction and operational phases.

1.3 CHRONOLOGY

1.3.1 The work has been undertaken in two stages. The first stage led to the issue, on 4 January 1991, of an Initial Environmental Assessment Working Paper. This Working Paper was discussed at the first meeting of the WKE Environmental Assessment Working Group held on 31 January 1991.

1.3.2 The draft Environmental Assessment Working Paper which constituted a full Environmental Assessment of the Project was circulated on 15 March 1991 and discussed at the second meeting of the WKE Environmental Assessment Working Group on 27 March 1991. Responses to comments received on the draft EAWP were circulated on 19 June 1991.

1.3.3 The Steering Group of the West Kowloon Reclamation met on 18 April 1991 to update Members on progress, and seek guidance on outstanding issues before finalising the Preliminary Report.

1.4 APPROACH

1.4.1 The EA forms part of the preliminary design brief for the WKE. The approach to the work has included both ongoing environmental advice to the project engineers and assessment of the net environmental impacts of the engineering proposals. In other words, the EA is an iterative process. Environmental considerations have already been taken into account in engineering proposals, but the present assessment may indicate that certain residual impacts still require mitigation.

1.4.2 It is important to note two significant constraints upon the work. The first is that from the very start of the Project, in September 1990, both horizontal and vertical alignment had already been defined by WKRTS, at least in broad-brush terms. Obviously this has limited the scope to identify means of preventing and mitigating environmental impacts.

1.4.3 The second constraint has been the lack of information on future land use patterns for the reclamation, within which the Expressway will lie. This has made the identification of sensitive receivers very difficult. To overcome this problem it has been assumed that the general land use pattern will be as shown in the Metroplan Interim Development Statement (MIDS) for West Kowloon Reclamation (October 1990). Having made this assumption, attempts have been made to ensure that the Expressway proposals will not have an unacceptable environmental impact upon adjoining land uses. Where necessary, or where satisfactory mitigation is impossible, guidance has been given on separation distances or changes to the proposed land use pattern.

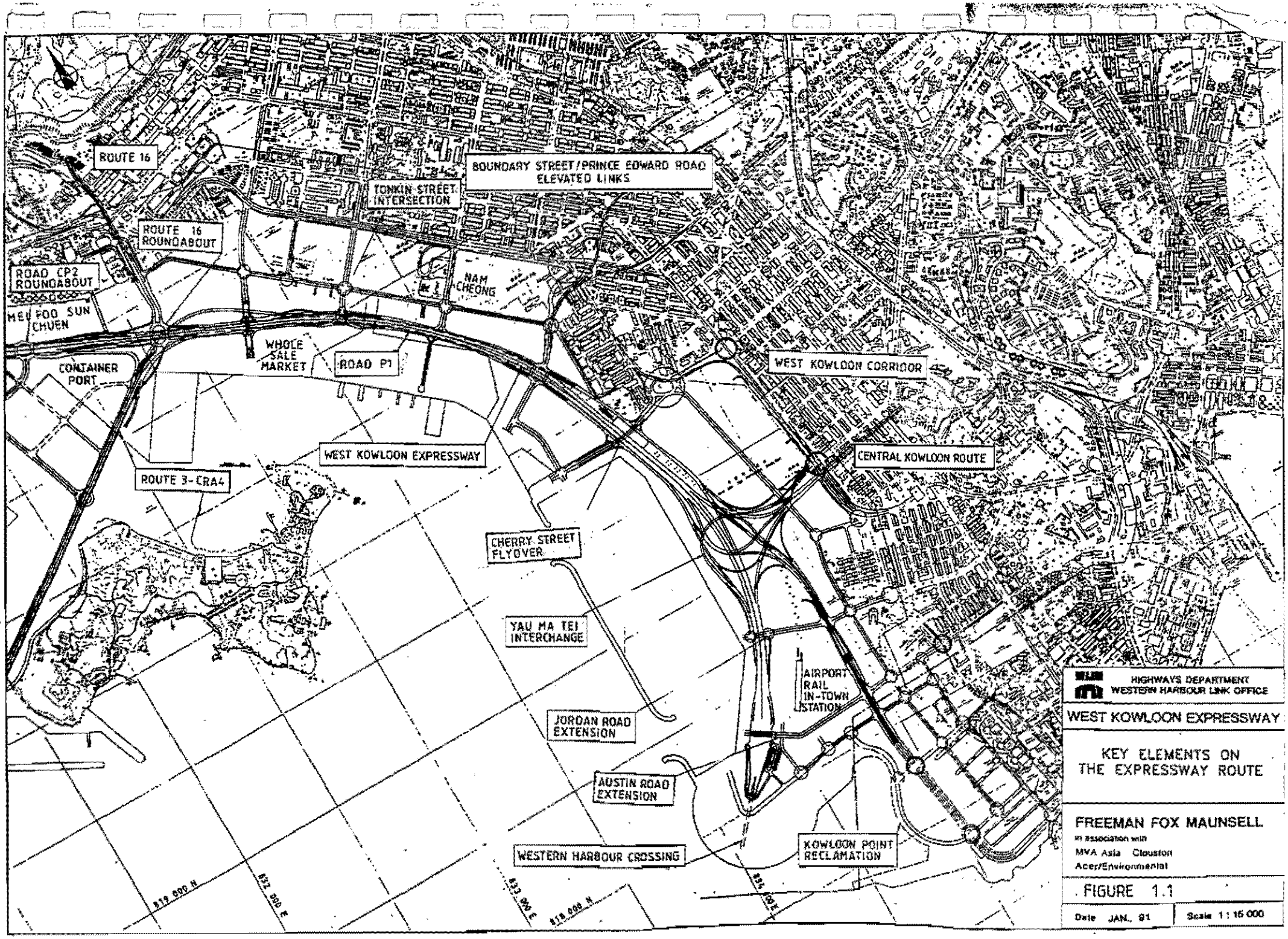
1.5 STRUCTURE OF THE REPORT

1.5.1 This Report is structured as follows. Chapter 2 describes the project characteristics, including horizontal and vertical alignments, construction activities and programme, and the projected traffic flows upon the Expressway in future.

1.5.2 Chapter 3 describes the existing and proposed land use context for the Project.

1.5.3 Chapters 4 through 8 present details of predicted noise, air quality, water quality, land use and visual impacts, including general recommendations for impact mitigation.

1.5.4 Chapter 9 contains a summary and discussion of environmental impacts, a cost estimate of the major noise mitigation proposals, environmental monitoring and auditing and identifies a requirement for further studies that should be undertaken as detailed design proceeds. Environmental monitoring for each impact category is discussed in the respective Chapters.


ROUTE 16
BOUNDARY STREET/PRINCE EDWARD ROAD ELEVATED LINKS
TONKIN STREET INTERSECTION
ROUTE 16 ROUNDABOUT
ROAD CP2 ROUNDABOUT
NAM CHEONG
MEI FOO SUN CHUEN
WHOLE SALE MARKET
ROAD P1
CONTAINER PORT
WEST KOWLOON CORRIDOR
WEST KOWLOON EXPRESSWAY
CENTRAL KOWLOON ROUTE
ROUTE 3-CR4
CHERRY STREET FLYOVER
YAU MA TEI INTERCHANGE
AIRPORT RAIL IN-TOWN STATION
JORDAN ROAD EXTENSION
AUSTIN ROAD EXTENSION
WESTERN HARBOUR CROSSING
KOWLOON POINT RECLAMATION
819 000 N
832 000 E
833 000 E
818 000 N
834 000 E
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
KEY ELEMENTS ON THE EXPRESSWAY ROUTE
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental
FIGURE 1.1
Date JAN., 91
Scale 1:15 000

Project Characteristics

CHAPTER 2

2. PROJECT CHARACTERISTICS

2.1 GENERAL

2.1.1 The WKE will be constructed on land reclaimed from Victoria Harbour to the west of Kowloon, as part of the WKR project. It is assumed that all reclamation work on the route will be completed in advance of WKE construction, which is planned to commence in June 1993 and be completed by the end of 1996.

2.1.2 The Expressway is designed to have three lanes plus hard shoulder in each direction. In some sections there will be additional lanes to allow merging, diverging and weaving of traffic. The adjacent primary feeder road P1 will consist of three lanes in each direction, generally with a 5.5m wide strip accomodating footpaths and planting.

2.2 ALIGNMENT

2.2.1 The route has been divided into a Northern Section and a Southern Section, with the break point at Cherry Street. It is proposed that the two sections will be constructed under separate contracts. The split is also convenient in environmental terms since the Southern Section is at grade or slightly depressed, and includes the Yau Ma Tei Interchange, while the Northern Section for the most part will be on elevated structure.

2.2.2 Details of the Expressway's horizontal and vertical alignment are summarized in Table 2.1, working from south to north. The southern project limit lies north of the WHC toll plaza and Austin Road extension; the northern limit between the Route 16 roundabout and the Container Port roundabout on Route 3.

Southern Section

2.2.3 As the road exits from the toll plaza, it will be five lanes wide in the northern direction and six in the southbound direction and will be at grade in the reclamation generally. It will be crossed on flyover by the Jordan Road extension. The complex Yau Ma Tei Interchange to the north will give access to and from the P1 distributor. This will run northwards parallel to the Expressway; southwards it will separate from the Expressway to follow a more easterly route to Kowloon Point. The Interchange will also link, in due course, to the CKR, to be built post 1996. The Expressway will be slightly depressed in the intersection to reduce the height of the interchange elevated structures.

Northern Section

2.2.4 At Cherry Street the WKE will be at grade. The AR will be at ground level to the east, between the Expressway and P1, creating a particularly wide transport corridor at this point, over which an east-west flyover will be built as an extension to Cherry Street. Further north, the Expressway will rise to a maximum height of 21.6m PD and the AR will be built at grade beneath the Expressway. Between the Expressway and the AR, at around 11m PD, will be a number of roundabouts (Prince Edward Road, Route 16) and intersections (Tonkin Street and Road D4). These will connect road P1 (which is generally at grade) with east-west road routes.

Table 2.1 West Kowloon Expressway Alignment Details

Route Section	Horizontal Alignment (distance to existing waterfront)	Vertical Alignment	Approximate Corridor Width
WHC to Yau Ma Tei Interchange	Expressway 400m to Man Cheong, P1 100m to Man Cheong	Both Expressway and P1 at grade (c. 5.5m PD)	45m (Expressway) 30m (P1)
Yau Ma Tei Interchange	500m from centre of interchange to Yau Ma Tei	Expressway partially depressed (2.5m PD). P1 and slip roads generally at grade (c. 5.5m PD) Flyovers elevated (up to 17m PD)	450m across interchange
Yau Ma Tei Interchange	500m to Mong Kok	Expressway at-grade. P1 at-grade. Flyover height to be determined.	200m in south decreasing to 100m at Cherry Street
Cherry Street to Prince Edward Road	Directly adjacent to Tai Kok Tsui in south, 160m away in north	Expressway at grade (5.5m PD) in south, rising to elevated (19.5m PD). at Prince Edward P1 at grade. Roundabout at 11m PD	110m in south decreasing to 80m in north
Prince Edward Road to Tonkin Street	150-200m to Sham Shui Po	Expressway elevated (16.2-19.5m PD). P1 at grade. Intersection at 11m PD	45 - 80m
Tonkin Street to Route 3	350m to Cheung Sha Wan 150m to Mei Foo Sun Chuen	Expressway elevated (19.5-21.5m PD) P1 at grade. Roundabout at 11m PD	60 - 100m

2.3 CONSTRUCTION PHASE CHARACTERISTICS

Construction Sites

2.3.1 In Volume 1 of this Report, Engineering Investigation, it is recommended that the flyovers and depressed structures within the Southern Section of the WKE be constructed in-situ; concrete would be placed against formwork on site in the conventional manner. In the Northern Section, it is recommended that the long length of elevated viaduct will be constructed by the precast segmental method. In this method, the viaduct is precast as a series of short (typically 2.5m) lengths in a precast yard, and assembled on site using purpose designed equipment. Foundation and columns are still constructed by in-situ methods. The main reason for choosing the precast segmental method is its relative speed. This is a critical factor given the tight construction schedule.

2.3.2 The choice of construction method in turn dictates the works areas required. For the Southern Section an area of 0.5 ha should be adequate. It will be used mainly for staff offices, workshop, batching plant, and storage of plant and materials. A location within the Yau Ma Tei interchange is proposed.

2.3.3 For the Northern Section, because of the need for a precasting yard, a much larger area of 3 to 4 ha is needed, preferably located near a sliproad to facilitate transport of viaduct segments. The site will include major storage areas, as well as the casting areas themselves, and facilities for disposal of wash water and waste concrete. The proposed location is in reclamation area LC1, west of the Expressway at Lai Chi Kok.

2.3.4 The route itself will form a linear works site, with activities taking place on all sections at some stage of the programme. There will be major concentrations of activity at intersections where embankments, sliproads and flyovers are to be constructed.

2.3.5 The location of construction sites and accesses is shown on Figure 2.1.

Construction Access

2.3.6 Under current proposals, a temporary bridge from Man Cheong Street would be the main access to the Southern Section. It would serve the reclamation works, the WHC, and an interim access to the relocated Public Cargo Working Area (PCWA) as well as the WKE and AR. However, in recognition of the traffic problems that this would cause in Man Cheong Street, an additional access will be provided southwards from Tai Kok Tsui onto reclamation area d7. From Tai Kok Tsui there will also be access westwards along the line of the Cherry Street extension to serve the reprovisioned Tai Kok Tsui ferry pier.

2.3.7 In the Northern Section, construction accesses have also been planned to combine works access with temporary access to reprovisioned land uses on the new waterfront. Thus the access at Tonkin Street will link to the Wholesale Market; and Po Lun Street extension will lead to the shipyards.

2.3.8 It is likely that an access road running adjacent to the Expressway alignment will be constructed to allow movement of manpower and materials to the various activity areas. This access will probably be on the alignment of one of the P1 feeder roads.

Construction Traffic

2.3.9 Construction traffic will be of two kinds : access traffic, and internal traffic between the main works area for each section and the works sites in use at any given time.

2.3.10 For the Southern Section, access traffic volumes associated with the WKE works are expected to be as shown in Table 2.2.

Table 2.2 Access Traffic Volumes - Southern Section

Location	Man Cheong Street and reclamation area d7
Vehicle Numbers	200 each direction per day per access
Working Period	July 1993 to September 1996
Working Hours	0800 - 1700 (possibly later but would then require a Noise permit from EPD)
Average Vehicle Movements	44 per hour per access

2.3.11 For the Northern Section, estimated access traffic volumes will be as shown in Table 2.3.

Table 2.3 Access Traffic Volumes - Northern Section

Location	Po Lun Street Extension
Vehicle Numbers	600 each direction per day
Working Period	July 1993 to May 1996
Working Hours	0900 to 1700
Average Vehicle Movements	150 per hour

2.3.12 Internal traffic will be generated by :

- o delivery of materials from works area to works site;
- o delivery of materials between works sites;
- o transportation of labour and personnel;

Details are as shown in Table 2.4.

Table 2.4 Estimated Internal Traffic Movements

Location	Along the WKE alignment
Vehicle Numbers	1700 per day
Working Period	July 1993 to September 1996
Working Hours	0800 - 1800
Average Vehicle Movements	170 per hour

Construction Programme

2.3.13 Work on both sections of the route will proceed in parallel, to meet programming requirements. Key dates are :

- o June 1993, when land becomes available for construction;
- o September 1993, when road construction commences (starting in the south with the slightly depressed section, and in the north with the Route 3 interface);
- o June 1994, when construction of Cherry Street flyover starts;
- o July 1995, when roads south of Yau Ma Tei Interchange begin to be built;
- o July 1996, when all work should be complete except for finishing work in the Southern Section.

Construction Activities

Excavation

2.3.14 There will be general superficial excavation for road formation and column foundations along the full length of the route. Excavation will be of material placed during the formation of the reclamation. South of Cherry Street, where the alignment is slightly depressed, excavation will be more extensive.

Piling

2.3.15 Bored piles for foundations have been recommended all along the route, in preference to driven piles. The method has been selected on cost and engineering grounds as well as for its lower environmental impact, since machine excavation for bored piles is a relatively quiet operation compared to pile driving. However driven piles may be used for the Cherry Street flyover.

Embankments

2.3.16 Earthworks to provide access to bridge overpasses in the Yau Ma Tei Interchange and at the three intersections north of Cherry Street will involve landscape works which require moving, compacting and grading of material. At Yau Ma Tei, ground modelling will require reworking of large quantities of material.

Road Construction - At Grade

2.3.17 Following limited excavation for the formation, at-grade construction involves forming a stable base. The base is made up of a series of layers of graded material which are placed and spread by scraper, and rolled by heavy plant, with potential for considerable dust generation. A final, flexible, black top surface is placed by specialist plant and rolled by heavy construction equipment.

Road Construction - Slightly Depressed

2.3.18 The Expressway in this section takes the form of a trough structure. Construction will be similar to at-grade but will require work in open excavation with reinforced concrete retaining walls built in-situ.

Road Construction - Elevated

2.3.19 This will involve the in-situ casting of bridge piers, then the, of precast viaduct segments, working from one end of the deck to the other.

2.4 OPERATIONAL PHASE CHARACTERISTICS

2.4.1 In environmental terms, the main operational characteristics of the Expressway that are of interest are traffic volumes and flows, which will result in noise and air quality impacts. Full information on traffic flows is given in Volume 1 of this Report but indicative figures are included in Table 2.5 for information.

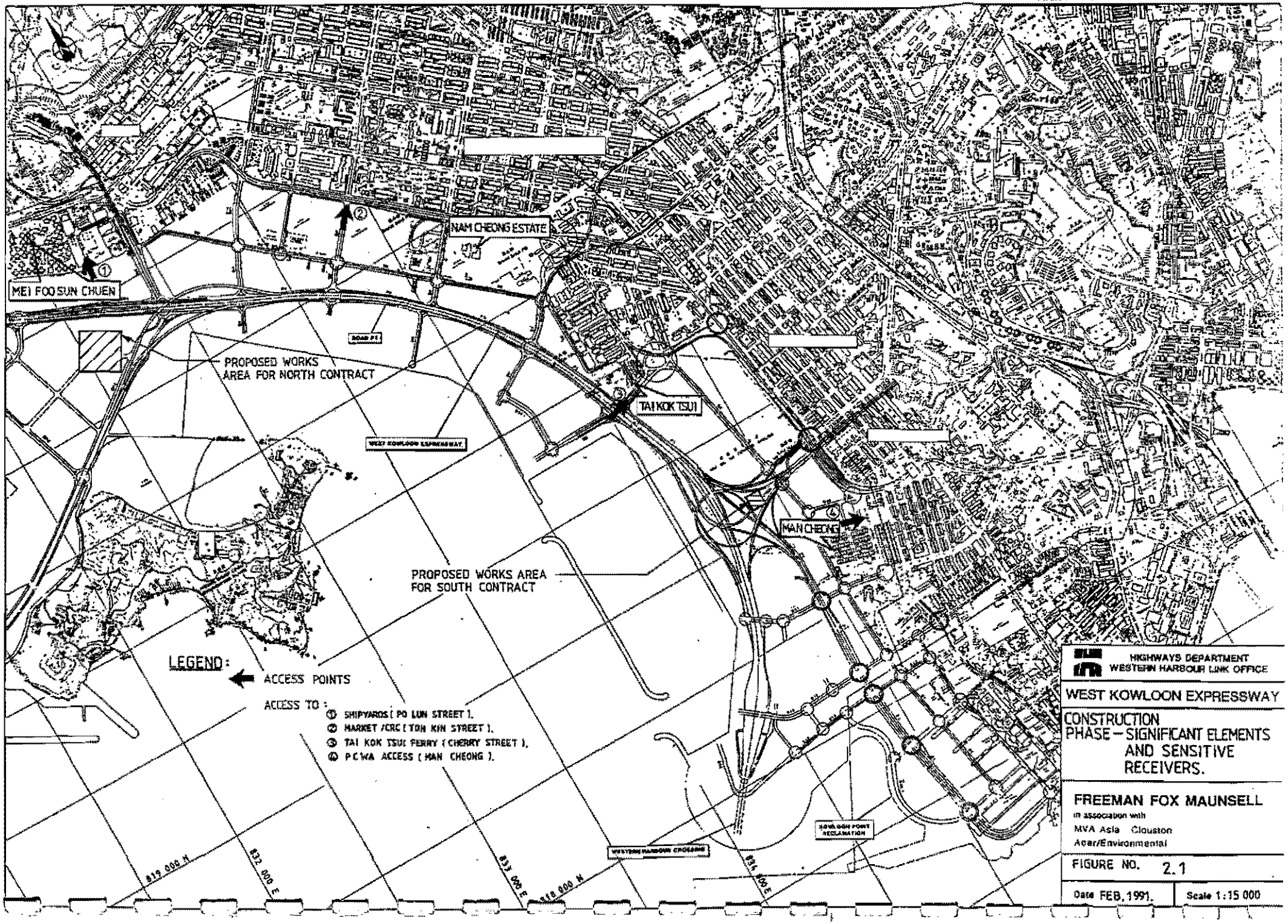
2.4.2 The design speed on the Expressway will be 85 km/h and it will be designed for constant through flows, with minimum braking and acceleration, and no stopping except under extreme conditions.

2.4.3 The design speed on P1 will be 70 km/h, but with grade separated junctions, there is likely to be more braking and acceleration than for the Expressway. However, as this road becomes more popular, approaching design capacity in 2011, it is anticipated that the travelling speed will fall to 65km/h.

Table 2.5 Indicative Traffic Flows - am Peak

Location/ Direction	1996 (PCUs/hour)	2011 (PCUs/hour)
Expressway Southern Section		
Northbound	2050	4650
Southbound	2850	6250
P1 Southern Section		
Northbound	1050	2750
Southbound	1400	1900
Expressway Northern Section		
Northbound	2050	4650
Southbound	2850	6250
P1 Northern Section		
Northbound	150	2400
Southbound	700	3300

Key: PCU - Passenger Car Unit


NAM CHEONG ESTATE
MEI FOO SUN CHUEN
PROPOSED WORKS AREA FOR NORTH CONTRACT
TAI KOK TSUI
MAN CHEONG
PROPOSED WORKS AREA FOR SOUTH CONTRACT
LEGEND :
ACCESS POINTS
ACCESS TO :
① SHIPYARDS (PO LUN STREET).
② MARKET /CRC (TON KIN STREET).
③ TAI KOK TSUI FERRY (CHERRY STREET).
④ P.C.W.A. ACCESS (MAN CHEONG).
819 000 N
832 000 E
833 000 E
818 000 N
834 000 E
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONSTRUCTION PHASE – SIGNIFICANT ELEMENTS AND SENSITIVE RECEIVERS.
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental
FIGURE NO. 2.1
Date FEB, 1991.
Scale 1:15 000

Land Use Context

CHAPTER 3

3. LAND USE CONTEXT

3.1 GENERAL

3.1.1 An understanding of the land use context for the Project is essential to permit the identification of sensitive receivers in the environment. Ideally land use during both the construction and operational phases should be known, so that all impact predictions can be made against the background of other developments likely to take place along the route. Key dates for the assessment are:

- o 1995, which represents the peak year of construction activity;
- o 2011, scheduled to be year 15 of operations.

3.1.2 Land use for each of these two dates is described briefly here, as background to the assessment; further details are given in Chapter 7. Information on land use in 1995 has been taken from outline development and zoning plans. Likely land use in 2011 is less clear, as definitive land use proposals for the reclamation are still in preparation as part of the WKRS. Hence it has been assumed that land use will be as shown in MIDS.

3.2 CONSTRUCTION PHASE LAND USE (1995)

3.2.1 In 1995 land use in the Kowloon hinterland will largely be as existing. The majority of the reclamation will have been completed and construction on both the WKE and the AR should be underway. Within the reclamation, few land uses will be in place; the exception being reprovisioned waterfront uses.

Southern Section

3.2.2 South to north, the main land uses east of the Southern Section of the WKE will be commercial areas along the existing waterfront at Tsim Sha Tsui; housing at Man Cheong Street, and mixed commercial and residential areas at Yau Ma Tei. To the west of the WKE will be the reprovisioned PCWA.

Northern Section

3.2.3 To the east of the WKE three major residential areas will remain: Tai Kok Tsui, Nam Cheong Estate and Mei Foo Sun Chuen. To the west, reprovisioned land uses include the wholesale market and shipyards at Cheung Sha Wan.

3.3 OPERATIONAL PHASE LAND USE (2011)

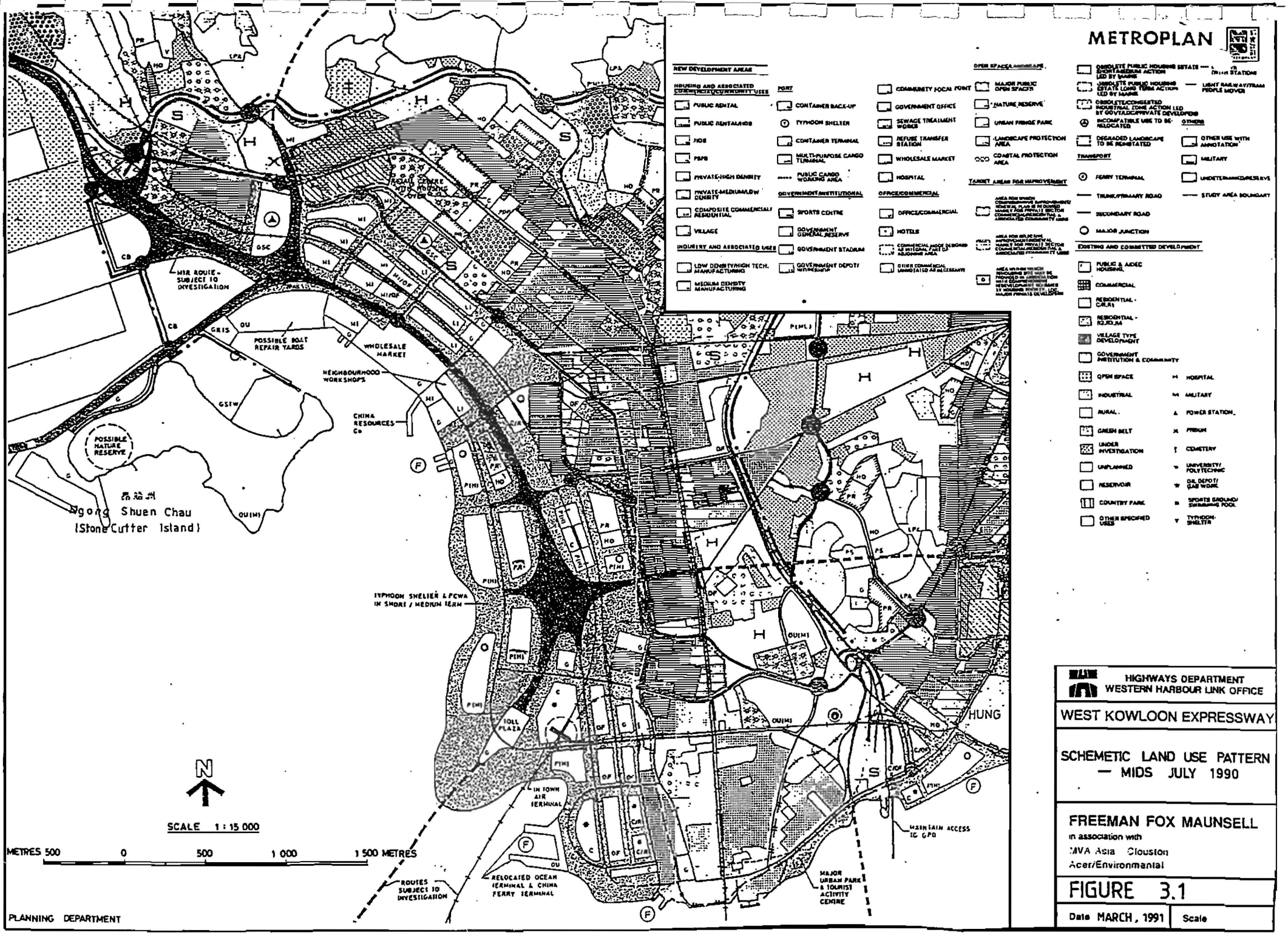
3.3.1 By 2011 all the future land uses envisaged in MIDS should be in place, as shown in Figure 3.1. The majority of the development described is programmed to be completed by 2001. Development within the reprovisioned typhoon shelter is likely to occur post-2006. The general pattern is one of commercial and housing development in the south, and port and industrial development in the north.

Southern Section

3.3.2 Broadly, south of Cherry Street, the area east of the WKE will comprise commercial and residential development, including high density private housing just north of the Yau Ma Tei Interchange. To the west, it is envisaged that the reprovisioned typhoon shelter and PCWA is also zoned to be used for high density private housing in Stage 2 of the reclamation.

Northern Section

3.3.3 North of Cherry Street the land uses to the east will comprise (south to north): high density commercial/residential; low density high-tech manufacturing, medium density manufacturing; and a sports centre. To the west will be housing; reprovisioned ferry terminals; manufacturing including neighbourhood workshops; the replacement Wholesale Market; a refuse transfer station; government depot; and shipyards.


METROPLAN
NEW DEVELOPMENT AREAS
HOUSING AND ASSOCIATED COMMERCIAL/CULTURAL/COMMUNITY USES
PUBLIC RENTAL
PUBLIC RENTAL/HOS
HOS
PSPS
PRIVATE-HIGH DENSITY
PRIVATE-MEDIUM/LOW DENSITY
COMPOSITE COMMERCIAL/RESIDENTIAL
VILLAGE
INDUSTRY AND ASSOCIATED USES
LOW DENSITY/HIGH TECH. MANUFACTURING
MEDIUM DENSITY MANUFACTURING
PORT
CONTAINER BACK-UP
TYPHOON SHELTER
CONTAINER TERMINAL
MULTI-PURPOSE CARGO TERMINAL
PUBLIC CARGO WORKING AREA
GOVERNMENT/INSTITUTIONAL
SPORTS CENTRE
GOVERNMENT/SEMI-RESERVE
GOVERNMENT STADIUM
GOVERNMENT DEPOT/WAREHOUSE
COMMUNITY/LOCAL POINT
GOVERNMENT OFFICE
SEWAGE TREATMENT WORKS
REFUSE TRANSFER STATION
WHOLESALE MARKET
HOSPITAL
OFFICE/COMMERCIAL
OFFICE/COMMERCIAL
HOTELS
OTHER COMMERCIAL
OPEN SPACE/AMENITY
MAJOR PUBLIC OPEN SPACES
NATURE RESERVE
URBAN FRINGE PARK
LANDSCAPE PROTECTION AREA
COASTAL PROTECTION AREA
TARGET AREAS FOR IMPROVEMENT
OBSOLETE PUBLIC HOUSING ESTATE — SHORT/MEDIUM ACTION LED BY HAHK
OBSOLETE PUBLIC HOUSING ESTATE LONG TERM ACTION LED BY HAHK
OBSOLETE/CONGESTED INDUSTRIAL ZONE ACTION LED BY GOVT/ALD/PRIVATE DEVELOPERS
INCOMPATIBLE USE TO BE RELOCATED
OTHERS
DEGRADED LANDSCAPE TO BE REHABITATED
OTHER USE WITH ANNOTATION
TRANSPORT
MILITARY
FERRY TERMINAL
TRUNK/PRIMARY ROAD
SECONDARY ROAD
MAJOR JUNCTION
LIGHT RAILWAY/TRAM/PEOPLE MOVER
STUDY AREA BOUNDARY
EXISTING AND COMMITTED DEVELOPMENT
PUBLIC & AIDED HOUSING
COMMERCIAL
RESIDENTIAL - C/R,R1
RESIDENTIAL - R2,R3,R4
VILLAGE TYPE DEVELOPMENT
GOVERNMENT INSTITUTION & COMMUNITY
OPEN SPACE
INDUSTRIAL
RURAL
GREEN BELT
UNDER INVESTIGATION
UNPLANNED
RESERVOIR
COUNTRY PARK
OTHER SPECIFIED USES
HOSPITAL
MILITARY
POWER STATION
PRISON
CEMETERY
UNIVERSITY/POLYTECHNIC
OIL DEPOT/GAS WORK
SPORTS GROUND/SWIMMING POOL
TYPHOON SHELTER
MIR ROUTE - SUBJECT TO INVESTIGATION
POSSIBLE BOAT REPAIR YARDS
WHOLESALE MARKET
NEIGHBOURHOOD WORKSHOPS
CHINA RESOURCES Co
POSSIBLE NATURE RESERVE
Ngong Shuen Chau (Stone Cutter Island)
TYPHOON SHELTER & PCWA IN SHORT / MEDIUM TERM
TOLL PLAZA
IN TOWN AIR TERMINAL
ROUTES SUBJECT TO INVESTIGATION
RELOCATED OCEAN TERMINAL & CHINA FERRY TERMINAL
MAINTAIN ACCESS TO GPO
MAJOR URBAN PARK & TOURIST ACTIVITY CENTRE
HUNG
N
SCALE 1 : 15 000
METRES 500 0 500 1 000 1 500 METRES
PLANNING DEPARTMENT
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
SCHEMETIC LAND USE PATTERN — MIDS JULY 1990
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental
FIGURE 3.1
Date MARCH, 1991
Scale

Noise Impacts

CHAPTER 4

4. NOISE IMPACTS

4.1 BACKGROUND

Construction Phase

4.1.1 The likely noise impact during the construction of the WKE has been briefly assessed in the Initial Assessment Working Paper 8 - Environmental. A more detailed assessment is presented in this Chapter.

Operational Phase

4.1.2 The WKRTS concluded that the operation of WKE will have a major noise impact on the reclamation area and the West Kowloon hinterland along the entire length of the route. In order to conform with the noise guidelines in the HKPSG for the proposed and existing noise sensitive development, noise mitigation options have been suggested and evaluated for different sections of the road. These options include :

Toll Plaza (Western Harbour Crossing) - Yau Ma Tei Interchange

- A combination of setback and barrier for the proposed residential development to the west of the alignment.

Yau Ma Tei Interchange

- Commercial-residential development close to the road corridor. Podium development of four storeys or more containing commercial uses to partially screen residential facades from traffic noise;
- Depressing P1 together with landscaping to raise the height of the ground between P1 and the outer slip roads (it is understood that this may no longer be an option).

Yau Ma Tei Interchange - Cherry Street

- Provision of a buffer zone of 130m in conjunction with depression of the Expressway. Further noise reduction could be achieved by landscaping at the side of P1;
- Commerical development at 10m from the edge of podia to screen the lower floors partially from road traffic noise. Noise levels on lower floors could be further reduced by decking over or the use of louvres over short sections of the Expressway. Noise reduction for upper floors may be more economically achieved by fitting fixed glazing and providing central air conditioning. However, this is unlikely to be acceptable for residential development.

Cherry Street - Prince Edward Road/Boundary Street

- Mixed commercial/residential developments at Tai Kok Tsui.

Prince Edward Road/Boundary Street - Yen Chow Street

- Provision of a setback of 150m in conjunction with a quiet road surface. Additional treatments to the roads and the intervening ground can reduce the noise further such as rasing the landform close to the Expressway to screen noise from the ground level P1 as well as to provide some noise absorption capacity close to the Expressway.

Mei Foo Sun Chuen

- Provision of a 150m strip of open space to the front of the estate.

4.1.3 In particular, the Yau Ma Tei Interchange - Cherry Street section was further investigated in the WKRS because of its importance as the main residential area for the whole of the WKR. In Working Paper 2 "West Kowloon Expressway, Vertical Alignment Options", five vertical alignment options were assessed in terms of costs and environmental benefits though it should be noted that the Airport Railway was not taken into account and effects from the Yau Ma Tei Interchange were also excluded from the analysis. The WKR study concluded that :

- o Fully enclosing the Expressway and P1 either at grade or depressed would significantly reduce the noise impact and provide an area of land for recreational purposes within the proposed residential developments;

- o Enclosing the depressed Expressway and P1 with louvres would require a setback of 30m for residential development. Without noise louvres the setback distance is likely to be at least 80m;

- o A setback distance of about 100m would be required for residential development if a 4m high noise screen is provided for an at-grade Expressway and P1;

- o A setback distance of 100m would be required for residential development if the Expressway is elevated while the P1 is at grade, both uncovered.

4.1.4 However, in view of cost and construction programming implications it was decided that this section should only be slightly depressed. A preliminary design for a slightly depressed vertical alignment for the Expressway in this section has been developed as the basis for the Environmental Assessment Working Paper.

4.1.5 Given the horizontal and vertical alignments of the WKE and the associated slip roads, this Chapter presents the constraints imposed by road traffic noise and the opportunities for accommodating noise sensitive uses on the WKR.

Baseline Survey and Existing Environment

4.1.6 As a part of the West Kowloon Reclamation Study, a baseline noise survey was carried out by the WKR Consultants. A total of fourteen sites along the existing waterfront of West Kowloon were selected for noise monitoring. The locations and the measurement results have been documented in the report entitled "Construction Environmental Impact Assessment Report" presented by the consultant.

4.1.7 In a broad sense, the existing noise environment along the waterfront of West Kowloon is characterized by road traffic and marine traffic. This is modified locally by specific activities. Towards the southern end, barges and cargo handling activities in the Yau Ma Tei typhoon shelter are significant noise sources. Shouting, loudspeaker and lorry movement noises are characteristics of the noise environment near the Wholesale Fruit and Vegetable Market in Yau Ma Tei. At Nam Cheong Estate, cargo handling and air traffic noises are important noise sources. Near the Wholesale Fish Market in Sham Shui Po, apart from air traffic noise, shouting, loud hailer and lorry movement noises become important again. Towards the northern end, aircraft noise is a major noise source.

4.2 CONSTRUCTION PHASE

Assessment Methodology and Impact Assessment Criteria

4.2.1 Volume 1 of this Report describes the proposed method of construction and the construction programme. Schedule No. 11.1 and 11.3 of the report outline the proposed construction programmes for the northern and southern sections of the WKE respectively. Major noise generating activities, together with the working hours, duration of work, types and numbers of items of powered mechanical equipment likely to be used are summarized in Appendix B of this Volume.

4.2.2 From the outline programme, it is clear that several activities are likely to be carried out in parallel at any one time with possible noise implications. However, there is a limit to which parallel operations can be performed within short distances of each other because of the nature of the works and space limitation. This is because all works would be confined mainly to the transport corridor, apart from the activities in the Works Areas. Also, it is clear that some of the works will have to be carried out in sequence, e.g. piling, pile cap and pier construction. Hence, with a few exceptions the calculated maximum noise levels arising from single activity, i.e. the noise levels perceived by receivers when a single activity is operating at its closest distance from individual receivers, should be able to define the worst case scenario at the identified receivers.

4.2.3 In most cases, parallel operation of more than one activity may not lead to a significant cumulative noise effect. For example, if one activity occurs simultaneously with another activity at large separation, the noise level perceived at any identified receiver is expected to be no higher than the calculated maximum noise level arising from either activity.

Parallel operations could produce a significant cumulative noise effect when two equally noisy activities are operating within close proximity of each other. However, the cumulative effect of the two is that the noise level at the nearest receiver would be no higher than 3 dB(A) of the calculated maximum noise level arising from either activity. As discussed above, this is considered to be a less likely scenario because of space limitation and programming constraint. At this preliminary engineering investigation stage it is impossible to determine the exact periods during which more than one activity is likely to occur simultaneously.

4.2.4 In this assessment the impact from construction noise has been assessed by calculating the maximum noise level in terms of Leq arising from individual activity at the facade of identified noise sensitive receivers on the waterfront of West Kowloon. The method of calculation follows a similar procedure to those in the Technical Memorandum of the Noise Control Ordinance except with the noise sources located at the closest possible positions to the receivers, where applicable.

4.2.5 Haul routes have been defined tentatively for the construction traffic. The noise generated by haul route traffic has been calculated based on the procedure of the BS 5228:Part 1:1984 "Noise Control on Construction and Open Sites".

4.2.6 Potential noise impacts from construction activities have been assessed by comparing the overall noise levels at the facade of the identified receivers with a set of noise assessment criteria. There is currently no applicable standard in the Noise Control Ordinance for the day time operations. However, based on the noise survey results referenced above, it appears that the commonly adopted noise standard of 75 dB(A) Leq(5-min) for urban areas should be appropriate for the day time activities.

4.2.7 The Noise Control Ordinance provides for the control of percussive piling and the use of powered mechanical equipment in the period 1900-0700 hours and on all general holidays including Sundays, through a permit system. The applicable noise standards are the Acceptable Noise Level (ANL) stipulated in the Technical Memorandum on Noise from Percussive Piling and the Technical Memorandum on Noise from Construction Work Other Than Percussive Piling. In the subsequent discussion, these ANL have been adopted as the basis for noise assessment.

Impact Assessment and Evaluation

Noise Sensitive Receivers

4.2.8 The "Construction Environmental Impact Assessment Report" for the WKRS identified 11 typical "noise neighbourhoods" likely to be affected by the proposed reclamation along the waterfront of West Kowloon. It is likely that these noise neighbourhoods will again be subject to construction noise when the WKE is being built. Figure 4.1 shows the locations of these noise neighbourhoods and Table 4.1 summarizes the associated noise sensitive receivers.

4.2.9 The location of the nearest existing schools to the proposed alignment is indicated in Table 4.1. Whether any of these would be exposed to unacceptable noise levels will depend on the adoption of the recommended mitigation measures. However it will be more appropriate and relevant to consider this further in the detailed design stage when decisions are made regarding specific mitigation measures to be adopted (including the timing of their installation) and land use planning (which may provide noise shielding) will be much further advanced.

Table 4.1 Noise Sensitive Receivers Along Waterfront of West Kowloon

Noise Sensitive Receivers	Sensitive Uses
Mei Foo Sun Chuen, (MFSC) Lai Chi Kok	- Residential buildings - Waterfront walkway - Community Centre - Delia Memorial School
Waterfront Annexe of Haking Wong Technical School, (HWTI) Lai Chi Kok	- Technical school
Fat Tseung Street THA, Sham Shui Po (FTS)	- Temporary housing area
Nam Cheong Estate, Sham Shui Po (NCE)	- Residential buildings - Public open space
Wong Tai Street, Tai Kok Tsui (WTS)	- Residential buildings
Hoi King Street, Tai Kok Tsui (HKS)	- Residential buildings
Cherry Street, Tai Kok Tsui (CS)	- Residential buildings - Sharon Luthern School - Ming Kei College
Ferry Street, Yau Ma Tei (FS)	- Residential buildings - Yau Ma Tei Catholic Primary School
Man Cheong Street, Yau Ma Tei (MCS)	- Residential buildings
King George V Memoria Park, Jordan (KGV)	- Park
Canton Road (CR) Tsim Sha Tsui	- Government medical and dental clinics - Residential buildings - Kowloon Park, Schools, Hotels

Note: The abbreviations for Noise Sensitive Receivers which are used in this Table are also used in the various Tables in this Chapter and in Chapter 5.

Northern Section

4.2.10 The northern section will comprise mainly the following key structural elements :

- o Elevated Expressway and associated slip road viaducts;
- o Elevated roundabouts at Route 16 and Prince Edard Road/Boundary Street intersections;
- o Elevated intersection at Tonkin Street;
- o Elevated viaduct of Road D4 overpassing the Airport Railway and Road P1.

4.2.11 Major noise generating activities in the construction of this part of the alignment are identified and discussed in the following sections:

Piling

4.2.12 Piling at foundation locations will proceed from north to south for the elevated Expressway and the associated slip road viaducts. It is assumed that machine bored piles 1.8m in diameter will be used. It is further assumed that four pile boring rigs will be operating at the neighbouring foundation points simultaneously. The noisiest equipment is likely to be the four boring rigs, each emitting a sound power level of 115 dB(A).

Pile Cap Construction

4.2.13 Pile cap construction will proceed as soon as piling work is complete at each foundation point. It will involve excavation for the caps, fixing reinforcement, concreting and backfilling. The noisiest equipment is likely to be vibrating pokers, each emitting a sound power level of about 113 dB(A).

Pier Construction

4.2.14 Pier construction will immediately follow pile cap construction. The work will involve steel fixing, formwork erection and concreting. The noisiest equipment is likely to be vibrating pokers, each emitting a sound power level of about 113 dB(A).

Superstructure

4.2.15 Superstructure will be erected from north to south along the elevated Expressway and associated slip road viaducts by joining precast bridge segments using a electrically or hydraulically operated launching girder. Precast bridge units will be cast in the works area and transport to site by special trucks in combination with a trolley and rail system. The work within the area is expected to be carried out 24 hours a day. The noisiest equipment is likely to be the special truck but this will be operated only in the day time.

Roadworks

4.2.16 Roadworks will involve earthworks, drainage work and road surfacing from north to south along the transport corridor. The noisiest equipment is likely to be the trucks.

Works in the Works Area

4.2.17 Activities in the works area will include :

- o batching plant operation;
- o precasting of concrete units;
- o movement of materials.

4.2.18 The location of the works area has been given in Figures 8.1 and 8.3 of Volume 2 of this Report. The work is expected to be carried out 24 hours a day. The noisiest equipment is likely to be vibrating pokers.

4.2.19 Based on the sound power levels of the equipment to be employed, the maximum noise levels at the facade of the identified NSRs for day works have been predicted and are summarized in Table 4.2. Detailed noise calculations are presented in Appendix C.

4.2.20 Maximum noise levels for the night time works have been predicted and are given in Table 4.3. It is expected that 24 hour working will be required only for deck construction and in the works area. Noise emissions from deck construction will affect all NSRs along the waterfront while noise emissions from the works area should affect mainly Mei Foo Sun Chuen.

Table 4.2 Maximum Predicted Noise Levels for Day Works (Northern Section)

NSR	Plg	PCap	Pier	Deck	EWk	Drge	Surf	WArea
MSFC	72	73	71	67	71	68	71	66
HWTI	67	68	66	59	66	63	66	61
FTS	72	73	71	67	71	68	71	56
NCE	72	73	71	67	71	68	71	-
WTS	78*	79*	77*	73	83*	83*	83*	
HKS	70	71	70	66	75	75	75	

* noise exceeding criterion.

Plg = Piling
PCap = Pile Cap Construction
Pier = Pier Construction
Deck = Deck Construction
EWK = Earthwork
Drge = Drainage Work
Surf = Road Surfacing
WArea = Work in the Works Area

Table 4.3 Maximum Predicted Noise Levels for Night Works (Northern Section)

NSR	Plg	PCap	Pier	Deck	EWk	Drge	Surf	WArea
MSFC	-	-	-	48	-	-	-	66
HWTI	-	-	-	41	-	-	-	61
FTS	-	-	-	49	-	-	-	56*
NCE	-	-	-	49	-	-	-	-
WTS	-	-	-	55*	-	-	-	
HKS	-	-	-	47	-	-	-	-

4.2.21 According to the Noise Control Ordinance, the appropriate ANL for MSFC, NCE, WTS, and HKS should be 65 dB(A) in 1900-2300 hours and 50 dB(A) in 2300-0700 hours because of the presence of ambient noise sources. On the other hand, FTS is less affected by ambient noise and the appropriate ANL for this NSR should be 60 dB(A) in 1900-2300 hours and 45 dB(A) in 2300-0700 hours.

4.2.22 Based on these criteria, it is likely that deck construction using a electrically or hydraulically operated launching girder and activities in the Works Area near MFSC should be permitted in 1900-2300 hours. However, noise reduction by about 5 dB(A) for deck construction near WTS and FTS and by 15 dB(A) at the Works Area would be required if the works are to proceed into the night.

4.2.23 Apart from the various site activities, construction traffic could impact on the noise levels at the identified NSRs. The impact on MFSC is expected to be greater than at other NSRs since Po Lun Street is chosen tentatively as the main haul route and D5 as an alternative route for the delivery of materials to the Works Area. In addition, site traffic will be generated by the delivery of materials from the works area to work sites and the movement of plant and labour between work sites. For the purpose of this assessment, it has been assumed that 120 vehicles per hour travel both ways on Po Lun Street and 30 vehicles per hour travel both ways on D5. There will also be 150 trips per hour comprising 50% heavy vehicles moving north to south along the work sites. No haulage traffic is envisaged outside the normal working hours.

4.2.24 The noise levels generated by these vehicle movements have been predicted using the British Standard procedure and the results in terms of Leq(1-hr.) are given in Table 4.4. In general, the noise levels are predicted to be quite low because of the volume of traffic and the separation distance. MSFC is expected to be exposed to facade levels of 56-66 dB(A) because of the close proximity to the haul route. At MFSC, construction traffic could increase the noise levels produced by other site activities by 1-3 dB(A), while the combined effect of this and other site activities is expected to be no more than 2 dB(A) increase in noise levels at other NSR locations.

Table 4.4 Predicted Noise Levels Due to Construction Traffic (Northern Section)

NSR	Leq(1-hr.) dB(A)
MSFC	56-66
HWTI	57
FTS	62
NCE	60-61
WTS	60-65
HKS	60
CS	45
FS	43-50
MCS	42-46
KGV	40
CR	39

Southern Section

4.2.25 The southern section comprises the following key structural elements :

- o the slightly depressed section of the Expressway south of Cherry Street;
- o slip roads viaducts in the Yau Ma Tei Interchange;
- o the Cherry Street Flyover;
- o the Jordan Road Flyover.

4.2.26 Major noise generating activities including estimated numbers of vehicles and plant are identified and discussed in the following sections:

Piling

4.2.27 Piling will be required for the Cherry Street Flyover, Yau Ma Tei Interchange, Jordan Road Flyover and Austin Road Flyover. If the Cherry Street flyover foundation were to integrate with box culverts underneath, it is possible that steel H section piles may be required at Cherry Street Flyover, and these would be driven by diesel hammers. Diesel hammer driving steel pile emits 132 dB(A) sound power and is likely to be the noisiest operation. Piling for other sections will be assumed to be machine bored piles.

Pile Cap and Pier Construction

4.2.28 These operations are similar to those for the Northern Section.

Deck Construction

4.2.29 Deck erection will be cast in-situ in this section and the works will proceed along the elevated roads. The noisiest equipment is again vibratory pokers.

Earthworks

4.2.30 The main earthwork consists of excavation for the slightly depressed Expressway and filling of landscaping mounds in the Yau Ma Tei Interchange. The noisiest items in this operation are likely to be the four excavators, each emitting 112 dB(A) sound power and eight trucks, each emitting 117 dB(A).

Drainage and Road Surfacing

4.2.31 Drainage and road surfacing will be carried out along the roads with some drainage works in the open areas or the verges. The noisiest equipment for drainage works and road surfacing is the two trucks, each emitting a sound power level of 117 dB(A).

Works in the Works Area

4.2.32 A concrete batching plant is expected to be operating in the Works Area shown in Figure 8.3 of Volume 1 of this Report. Also some precasting work for precast concrete barriers will be carried out there. But the level of activity is expected to be much lower than the one in the Northern Section.

4.2.33 A similar noise prediction as above for the maximum noise levels at the facade of the identified NSR for day time works in the southern section is presented in Table 4.5. No night time work is expected for this section.

Table 4.5 Maximum Predicted Noise Levels for Day Works (Southern Section)

NSR	Plg	PCap	Pier	Deck	EWk	Drge	Surf	WArea
NCE	68+	60	59	-	-	-	-	-
WTS	79+	71	69	59	-	-	-	-
HKS	90+	81*	80*	61	80*	73	73	59
CS	76+	68	67	60	71	64	64	58
FS	72+	74	72	77*	75	75	75	64
MCS	66+	68	67	66	71	73	73	65
KGV	59	63	62	61	72	65	64	-
CR	60	63	62	61	71	64	63	-

* noise exceeding criterion.
\+ due to percussive piling.

4.2.34 The table shows that it is likely that the maximum noise levels could exceed the noise criterion of 75 dB(A) at HKS because of the close proximity of the site to the receivers.

4.2.35 Under the Noise Control Ordinance, a construction noise permit will be required for percussive piling. As the predicted noise level for piling exceeds the Acceptable Noise Level of 85 dB(A) at HKS by less than 10 dB(A), it is likely that the permitted time for piling may be restricted to three hours in a day for the piling work near these receivers.

4.2.36 Construction traffic for the southern section is expected to impact on the noise levels at some nearby receivers. For example, MCS is expected to be adversely affected as Man Cheong Street has been identified as one of the haul routes. Other haul routes include the ones through area D7 and D6 (see Figure 3.2 of Volume 2 of this Report). As given in Appendix B, it has been assumed that there would be 45 veh./hr. both ways on Man Cheong Street extension and through area D7. Also, there would be 170 trips per hour on a haul road running between the work sites along the transport corridor in the southern section. Table 4.6 shows the predicted noise levels, in terms of Leq(1-hr.) at the facade of the identified NSR in the southern section. Apart from the effect at MCS where haul traffic could contribute significantly to the overall noise level, the combined effect of this and other site activities is expected to be no more than 1-2 dB(A) increase in the noise levels.

Table 4.6 Predicted Noise Levels Due to Construction Traffic (Southern Section)

NSR	Leq(1-hr.) dB(A)
MSFC	36-38
HWTI	41
FTS	44
NCE	49
WTS	30
HKS	59
CS	53-56
FS	51-53
MCS	59-72
KGV	48
CR	46

Mitigation Measures

4.2.37 Options for mitigating construction noise include:

(a) scheduling of activities to avoid parallel operations of several sets of equipment, all at their closest distances to a receiver

(b) use of silenced equipment

(c) reducing the numbers of operating items of powered mechanical equipment

(d) siting of equipment as far as practical from noise sensitive receivers

(e) use of temporary noise barriers or earth bund to screen specific receivers

(f) scheduling of noisy operations for periods with high background noise

(g) ban certain activities

(h) proper maintenance and operation of plant

4.2.38 While it is not feasible to dictate the methods of construction to be employed by 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.

4.2.39 Complying with the day time noise criterion could be achieved easily with options (a), (d), (f) and (h). However, more drastic noise control options such as (b) and (e) may be required to achieve the evening noise criteria. The night time noise criteria would be difficult to achieve without even more drastic control options, such as (c) and (g). In theory, operating half the number of equipment items reduces the noise by about 3 dB(A). In any event, contractors undertaking the works should be encouraged to use silenced equipment as far as possible in order to minimize the overall construction impact on the adjacent NSRs.

Compliance Monitoring

4.2.40 Noise monitoring should be carried out to check for compliance with the noise control standards (excluding percussive piling) stipulated in the contract during the unrestricted hours. Measurements should be made at the facade of the worst-affected dwellings and the noise parameters to be measured should include Leq(5-mins.). The contract should also specify clearly the measurement procedure, when and who is to take the measurement and what action to take in case of any violation of the applicable noise standard.

4.3 OPERATIONAL PHASE

Assessment Methodology and Impact Assessment Criteria

4.3.1 Operational noise will include only road traffic noise within the project limits. Road traffic noise levels have been calculated in terms of the L10(1-hr.) in dB(A), using the U.K. Department of the Transport procedures "Calculation of Road Traffic Noise", 1988.

4.3.2 In order to assess the constraints from traffic noise on the land use development of the WKR, free-field contours of L10(1-hr.) at 35m P.D. have been prepared over the entire length of the route from CP2 roundabout in the north to Toll Plaza (West Harbour Crossing) in the south. As the reclamation level is about +5.5m P.D., the contours should represent the noise levels at about 10 storeys high above ground. By free-field levels, it is meant that no facade effect has been incorporated in the calculation.

4.3.3 Also, free-field noise contours on four typical cross sections of the roads have been drawn to illustrate the constraints from traffic noise on high rise development in these sections. In the calculation, it has been assumed that the Expressway and P1 are both surfaced with pervious macadams. The use of this road surfacing can reduce the noise level by 2.5 dB(A) at vehicle speeds less than 75 km/hr. and 3.5 dB(A) at higher vehicle speeds.

4.3.4 Projected A.M. peak hour traffic volumes in 2001 and 2011 have been used in the noise calculations. Relevant traffic figures in PCU/h. have been presented in Figures 2.6-2.9 of Volume 2 of this Report. Based on these figures and the assumed percentage of heavy vehicles, traffic volumes in veh/h. have been derived. It should be noted that P.M. peak hour traffic flows in 2011 which were based on a series of initial traffic assignments were used in the noise predictions presented in the Environmental Assessment Working Paper. Since the submission of the Working Paper, the traffic figures have been revised to take into account changes in the road network and to include also A.M. peak hour traffic flows which are likely to result in more severe noise impacts on the WKR. Details of the changes are given in Chapter 2 of Volume 1 of this Report.

4.3.5 Also, the percentage heavy vehicles have since been revised from a constant 13% on all roads to the figures in Table 4.7. As a sensitivity test, the noise impact of a traffic flow containing a constant 30% heavy goods vehicles has also been tested. In the context of the noise calculation procedure, "heavy vehicles" are defined as those vehicles with unladen weight in excess of 1.5 tonnes and on average are equivalent to two PCUs.

Table 4.7 Projected Percentage Heavy Vehicles in 2001 and 2011

Location	Expressway		P1	
	2001	2011	2001	2011
Mei Foo Sun Chuen	25-37	31-42	56-72	51-65
Nam Cheong Estate	26-37	27-32	32-45	20-32
Tai Kok Tsui (Wong Tai Street)	26-37	27-32	25-38	18-24
Tai Kok Tsui (Hoi King Street)	26-37	27-32	25-38	18-24
Yau Ma Tei	26-37	27-32	25-38	18-24

4.3.6 The design vehicle speeds will be 85 km/h. on the Expressway and 70 km/h. on P1 for free-flowing traffic conditions. However, actual vehicle speeds are anticipated to be lower by 2001 and 2011 because of increased flows on the roads. Table 4.8 gives the anticipated actual vehicle speeds on the Expressway, P1 and the associated slip roads.

Table 4.8 Anticipated Vehicle Speeds in 2001 and 2011

Road	Vehicle Speed, km/h.	
	2001	2011
Expressway	80	70
Slip Roads	45	45
Road P1	65	50
Yau Ma Tei Interchange	50	45

4.3.7 Potential impacts from road traffic noise have been assessed by comparing the predicted levels with the relevant HKPSG criteria. The recommended maximum road traffic noise level in the HKPSG is 70 dB(A) L10(1-hr.) at the facade of new dwellings and 65 dB(A) L10(1-hr.) at the facade of new schools.

In accordance with the U.K. procedure, the predicted noise level at a facade is 2.5 dB(A) higher than the corresponding level without a facade, i.e. under free-field conditions. Hence all new noise sensitive development, including dwellings and schools should be sited beyond the 67.5 dB(A) contour line or say 68 dB(A) line in the contour plots. In other words, areas within the 68 dB(A) contour would be incompatible with noise sensitive development. New schools should be sited beyond the 62 dB(A) contour line.

Impact Assessment and Evaluation

4.3.8 Figure 4.2 shows the contours of L10(1-hr.) in 2011 due to road traffic on Expressway, P1 and the associated slip roads and viaducts. Impacts on the WKR have been assessed by measuring the displacement of the 68 dB(A) contour from the nearside edge of P1. The further the contour is from the road, the greater will be the likely impacts. The effect of road geometry on the noise levels is apparent in the shape of the contours. On the west side of the WKE, the 68 dB(A) contour line tends to be further away from the road than on the east side in the Tai Kok Tsui and Nam Cheong sections because of the curvature of the roads. Table 4.9 summarizes the displacements of the 68 dB(A) line along different sections of the WKE.

Table 4.9 Displacements of the 68 dB(A) Contour Line from the Nearside Edge of P1

Road Section	Displacement of of 68 dB(A) Line (m)
Yau Ma Tei Interchange/ Cherry Street	250-450
Cherry Street/ Prince Edward Road Roundabout	375-450
Prince Edward Road Roundabout/ Tonkin Street Intersection	375-500
Tonkin Street Intersection/ Route 16 Roundabout	375-450
Route 16 Roundabout/ CP2 Roundabout	325-350

4.3.9 At the southern and northern ends of the Expressway, the roads have been extended beyond the project limits in order to minimize the "edge effect" on the contour shape. Also, the screening effect of buildings at Tai Kok Tsui on the prime development site south of Cherry Street has been incorporated in the calculations.

4.3.10 Without noise mitigation, the land within the above distances from the nearside edge of P1 would be incompatible with noise sensitive development, according to the HKPSG criteria.

4.3.11 Unmitigated noise levels for both assumptions of the percentage of heavy vehicles and design years have been predicted at the facade of existing top-floor dwellings along the alignment and for worst-case facades (i.e. with full view of the WKE) at 50m PD and 30m inward from the boundary of the proposed Yau Ma Tei development site south of Cherry Street. These receivers are considered to be the least protected by road depression or noise barriers. Figure 4.3 shows the locations of the prediction points. Results are shown in Table 4.10 below.

Table 4.10 Predicted Facade Noise Levels without Noise Mitigation

Location	Noise Level L10(1-hr.) dB(A)	
	2001	2011
Mei Foo Sun Chuen*	73.0 - 73.1	73.2 - 73.3
	72.3 - 72.5	72.4 - 72.5
Nam Cheong Estate	72.9 - 73.1	73.7 - 74.0
	72.6 - 72.8	73.6 - 73.8
Tai Kok Tsui (Wong Tai Street)	71.6 - 73.5	72.3 - 74.2
	71.3 - 73.2	72.2 - 74.1
Tai Kok Tsui (Hoi King Street)	70.2 - 70.9	70.8 - 71.5
	69.9 - 70.7	70.8 - 71.6
Yau Ma Tei	75.2 - 77.6	76.9 - 78.7
	75.2 - 77.6	76.9 - 78.7

Notes: * The first row are the noise levels for projected percentage of heavy vehicles and the second row are the noise levels for a constant 30% heavy goods vehicles.

4.3.12 As can be seen from the above Table, the predicted noise levels are not very sensitive to the assumptions regarding the percentage heavy vehicles for given PCU figures. The unmitigated facade noise levels at Mei Foo Sun Chuen exceed the HKPSG guideline by between 2.3 and 3.1 dB(A) in 2001, and by between 2.4 and 3.3 dB(A) in 2011, depending on the assumptions regarding the percentage of heavy vehicles.

4.3.13 At Nam Cheong Estate, the unmitigated facade noise levels exceed the HKPSG guideline by between 2.6 and 3.1 dB(A) in 2001, and by between 3.6 and 4.0 dB(A) in 2011, depending on the assumption regarding the percentage of heavy vehicles.

4.3.14 As the facades of the noise sensitive buildings along Wong Tai Street at Tai Kok Tsui are inclined to the Expressway and Road P1, the unmitigated facade noise levels exceed the HKPSG guideline only by between 1.3 and 3.5 dB(A) in 2001 and by between 2.2 and 4.2 dB(A) in 2011, even though the dwellings are physically closer to the roads than those at other locations.

4.3.15 Dwellings on Hoi King Street at Tai Kok Tsui are partially screened by buildings on Wong Tai Street, with the results that the unmitigated facade noise levels only marginally exceed the HKPSG guideline.

4.3.16 On the development site south of Cherry Street, the worst-case facade noise levels would exceed the HKPSG guideline by between 5.2 and 7.6 dB(A) in 2001, and by between 6.9 and 8.7 dB(A) in 2011, depending on the assumptions regarding the percentage of heavy vehicles. As before, partial screening by buildings at Tai Kok Tsui has been incorporated in the calculations.

4.3.17 In order to elaborate further on the constraints which road traffic noise will place on the land use development on the WKR, contours of L10(1-hr.) on cross sections of the WKE through the above locations (see Figure 4.4) have been produced and are detailed in the following paragraphs.

Section D-D (Yau Ma Tei Section)

4.3.18 This section lies between the Yau Ma Tei Interchange and Cherry Street and comprises the main proposed noise sensitive development on WKR. The contours are shown in Figures 4.5 and 4.6 for this section. Without noise mitigation measures, no noise sensitive development is recommended within 340m from the nearside edge of P1 on the east side and beyond 400m on the west side of the WKE. The main difference in the noise exposure on the east side and west side is due to the presence of screening by buildings at Tai Kok Tsui on the east side and the curvature of the roads.

Section C-C (Tai Kok Tsui Section)

4.3.19 This section lies between Cherry Street and Prince Edward Road Roundabout and comprises the existing residential development on Wong Tai Street in Tai Kok Tsui which are located at 30m - 220m from the nearside edge of P1 (S/B). Noise contours for this section are shown in Figures 4.7 and 4.8. For future redevelopment of Tai Kok Tsui, no noise sensitive development is recommended within 340m from the nearside edge of P1 on the east side without noise mitigation.

Section B-B (Nam Cheong Section)

4.3.20 This is the section through the existing Nam Cheong Estate which is located at about 175 m from the nearside edge of P1 (S/B) and the contours for this section are shown in Figures 4.9 and 4.10. As the 68 contour line is displaced at 370m from the nearside edge of P1 on the east side, it is clear that the future noise levels at the existing Nam Cheong Estate are unlikely to meet the HKPSG standard. Noise sensitive development on the west side would need to be beyond 400m of the road edge without noise mitigation.

Section A-A (Mei Foo Section)

4.3.21 This is the section through the existing Mei Foo Sun Chuen which is located at 175m from the nearside edge of P1 (S/B) and the contours for this section are shown in Figures 4.11 and 4.12. As shown in the contours, the future noise levels at Mei Foo Sun Chuen are unlikely to meet the HKPSG since the 68 dB(A) contour line is displaced at 330m from the nearside edge of the Road P1. No sensitive development is recommended between here and the Expressway.

Mitigation Options

4.3.22 Noise mitigation measures could be in the form of :

- o mitigation at source;
- o mitigation in noise propagation path;
- o mitigation at receivers.

4.3.23 Mitigation at source includes traffic management which controls the volume of traffic and the percentage of heavy vehicles on roads; road modifications which minimize the need for braking, acceleration and gear changing; the use of low noise road surfacing which reduces tyre noise; the use of quiet vehicles. In the preliminary design of the roads, gradients and curvature of the Expressway and Road P1 have been minimized, as have intersections and junctions. Also, the Expressway and the Road P1 have been assumed to have low noise surfaces. As it is beyond the scope of this assessment to consider traffic management and the use of low noise vehicles, it can be concluded that all practical measures for mitigation at source have been taken.

4.3.24 Mitigation in path includes the use of elevated or depressed sections, the use of buffer zone and the construction of noise barriers, louvres or enclosure to intercept the noise propagation path. Although the Expressway is elevated along most of its length and the section between Cherry Street and Yau Ma Tei Interchange is slightly depressed, high rise receivers are unlikely to be adequately protected. The provision of a 150m buffer zone at Mei Foo Sun Chuen and Nam Cheong Estate is also insufficient to reduce the noise levels to acceptable levels.

4.3.25 The last resort is to mitigate at receivers and this includes building height restriction (although this may not maximize the land use development potential) building design and orientation, and sound insulation.

4.3.26 Practical options for mitigating road traffic noise in the path have been identified for different sections of the WKE. These include :

Option 1 : Noise Barrier

4.3.27 This option explores the noise benefit with panel-type noise barriers erected at the roadside. One major advantage with this option is that it is more flexible to implement, i.e. barriers can be installed at a later date without affecting the progress of the roadwork. Also, barriers are relatively easy to install and there are many different types of barrier materials available. In general, barriers are commonly classified under the reflective type such as concrete or plexiglas and absorptive type such as the hollow box type panel. The height of the barriers can vary. In U.K. the height of most roadside barriers is limited to 3m whereas in Canada, the U.S.A. and some European countries, higher barriers are permitted. In Hong Kong, most of the existing noise barriers are no higher than 3m. Higher barriers tend to be visually intrusive and can have structural implications as well as requiring stability considerations.

4.3.28 Roadside barriers may be effective for screening traffic on the nearside carriageway but would be ineffective for screening traffic on the farside carriageway because of the separation. Preliminary calculations presented in Working Paper No. 8 have shown that noise barriers at the medium strip should be effective. In this study barriers at both roadside and medium strip have been considered.

Option 2 : Enclosure with Louvre Covering

4.3.29 This option explores the noise benefit with louvre covering. Basically, it is an enclosure with louvre covering on top. A range of louvre designs are available and these include vertical reflective blades, vertical absorptive blades, cornet shaped blades, sloping reflective blades and sloping absorptive blades. The width of each blade is usually about 2m and is separated by about 1m apart. The acoustic performance of the louvres design depends upon the acoustic properties of the blade surfaces and the shape of the blades. One advantage of using louvres is that they offer greater effective screening for buildings located close to the roads than conventional barriers.

Option 3 : Full Enclosure

4.3.30 This option explores the possibility of enclosing completely a short segment of Expressway/P1 south of Cherry Street. The main advantage of complete enclosure from the noise point of view is that enclosures offer very substantial screening over conventional barriers and therefore may accommodate high-rise noise sensitive development close to the roads. However, the disadvantage is the much higher construction cost involved and the need for artificial lighting and perhaps ventilation. Also, the noise levels inside the enclosure are likely to be higher than for an open road depending upon the degree of noise treatment applied to the internal surfaces.

<u>Evaluation of Mitigation Measures</u>

4.3.31 The effectiveness of these options in protecting the existing and planned noise sensitive development on the east side of the alignment from future traffic noise has been evaluated and is discussed in the following sections. At the time of this Report, there is still no committed noise sensitive development on the west side of the alignment.

Section between Toll Plaza and Yau Ma Tei Interchange

4.3.32 The nearest noise sensitive receivers to the alignment in this section are the existing residential buildings in Man Cheong Street. The unmitigated noise levels at these receivers exceed HKPSG guideline by about 2 dB(A) in 2011. Preliminary investigations show that no effective mitigation can be provided because of the Yau Ma Tei Interchange. As the land adjacent to the WKE appears to be zoned for non-sensitive use, future traffic noise should not constrain identified development.

Section between Cherry Street and Yau Ma Tei Interchange

4.3.33 A preliminary investigation of eight optional mitigation measures for the segment of WKE and P1 between chainage 4810 and 4580 has been carried out and these are discussed below:

(1) Expressway and P1 (S/B) fully enclosed, and P1 (N/B) open.

4.3.34 By fully enclosing the Expressway and the P1 (S/B), while keeping P1 (N/B) open, very substantial noise reduction close to the roads can be expected when compared with the case without any noise mitigation measures. Beyond 100m away the noise reduction drops to about 1-2 dB(A) because of the increasingly important noise contribution from other uncovered segments. It should be noted that by assuming an enclosure structure 6m above the road surface of the WKE, the traffic on P1 (N/B) in this segment should have been screened.

(2) Expressway, P1(S/B) and P1(N/B) fully enclosed.

4.3.35 The effect with also enclosing the P1 (N/B) in this segment is predicted to be very similar to the above case except for the noise levels very close to the roads where a further noise reduction by about 1 dB(A) can be expected.

(3) Expressway fully enclosed, P1 (S/B) covered with louvres and P1 (N/B) open.

4.3.36 The louvre option for P1 (S/B) produces similar noise reduction as the enclosure option. This is mainly because the louvres have been assumed, based on proprietary data supplied by a manufacturer in Germany, to reduce the noise by some 20 - 35 dB(A).

(4) Expressway fully enclosed, P1 (S/B) provided with 3m Roadside Barriers.

4.3.37 With this optional measure, the noise reduction within 200m from the road edge is only about 2 dB(A) at upper levels. On the other hand, noise reduction by as much as 5 dB(A) can be achieved at lower heights.

(5) Expressway and P1 (S/B) covered with louvres and P1(N/B) open.

4.3.38 A 2-3 dB(A) noise reduction can be expected if the expressway and the P1 (S/B) are both covered with louvres. Except within about 50m of the roads where the noise reduction is expected to be slightly lower, the effect is similar to the case with the roads enclosed.

(6) Expressway covered with louvres and P1 (S/B) provided with 3m high roadside barriers.

4.3.39 Within about 200m of the roads, the noise reduction is about 2 dB(A) at upper levels, while as much as 5 dB(A) reduction can be achieved at lower heights.

(7) Expressway provided with 3m high roadside and medium strip barriers, P1 (S/B) provided with 3m high barriers and P1 (N/B) with 1.5m barriers.

4.3.40 At lower heights close to the roads, noise reduction by as much as 5 dB(A) is predicted. However, 0-1 dB(A) reduction is achieved at upper levels.

(8) Expressway, P1 (S/B) fully enclosed, P1(N/B) open together with overhead development atop the proposed Tai Kok Tsui Station. (Figure 4.23)

4.3.41 This optional measure explores the noise benefit with overhead commercial or similar non-noise sensitive development atop the proposed Tai Kok Tsui Station which if in place would serve as a noise barrier block for the uncovered segments north of the covered segments. As can be expected, very significant noise reduction is predicted close to the roads.

Section between Cherry Street and Prince Edward Road Roundabout

4.3.42 Barrier options of 2m and 3m high for the elevated Expressway have been considered to protect the existing residential development in Tai Kok Tsui or any future commercial - residential development along this section of the roads from unacceptably high traffic noise levels.

4.3.43 With 2m high noise barriers, the noise reduction obtained is predicted to be 1 dB(A) at upper levels and 2-3 dB(A) at lower levels. No significant improvement in noise reduction has been predicted by increasing the barrier height to 3m because the main contribution to the noise levels would be from the unscreened P1 at grade if barriers are installed only for the WKE.

Section Between Prince Edward Road Roundabout and Yen Chow Street

4.3.44 Similar barrier options have been considered to protect the existing Nam Cheong Estate in this section from unacceptably high noise levels in 2011 by two 250m long noise barriers for the elevated Expressway and a 200m long noise barrier for the at-grade P1 (S/B).

4.3.45 Compared with the case without noise mitigation, it can be shown that there would be 1 dB(A) reduction at Nam Cheong Estate with 2m high barriers and 2 dB(A) reduction with 3m high barriers.

Mei Foo Sun Chuen Section

4.3.46 Barrier options of 2m and 3m high have been considered to protect the existing Mei Foo Sun Chuen. However, if the areas adjacent to the WKE is zoned for non-noise sensitive uses, the future traffic noise should not constrain the identified development.

Recommended Mitigation Options

4.3.47 Based on the above evaluation of optional mitigation measures, it can be concluded that :

- o conventional noise barriers of 2 to 3 m high adjacent to the Expressway and P1 are ineffective in mitigating noise on high rise development in the Tai Kok Tsui and Yau Ma Tei sections;
- o noise barriers of 3m high should be able to protect the existing dwellings at Nam Cheong and Mei Foo if suitably located;
- o noise louvres may be designed to provide similar noise reduction as total enclosures. However, light flickering and rain dripping could become a nuisance to drivers. Furthermore, the top of the cover would not be suitable for any use;
- o the prime development site south of Cherry Street cannot be adequately protected with a 230m enclosure of the Expressway and P1 southbound. Additional noise barriers in the form of a semi-continuous noise tolerant development around the south-western corner of the site would be required. On the other hand, the P1 northbound needs no additional screening since the enclosure for the Expressway will screen the site from the noise generated by the road;
- o A high rise commercial or similar development above the proposed Tai Kok Tsui Station will be very effective in screening noise from the Expressway and the P1 northbound north of the covered section in Yau Ma Tei.

Yau Ma Tei

4.3.48 Figure 4.13 shows the recommended noise mitigation option at Yau Ma Tei. It comprises a 230m length of total enclosure of the Expressway and the P1 (S/B), a high-rise commercial or similar non-noise sensitive development over the proposed Tai Kok Tsui Station and a sem-continuous non-noise sensitive development around the south-western corner of the site to screen the noise from the Yau Ma Tei Interchange. Free-field noise levels on section D-D (East) with the mitigation option except the non-noise sensitive development are shown in Figure 4.14. The 68 dB(A) contour is shown to have shifted from 340m to 210m with the mitigation option. The added screening of noise from the Yau Ma Tei Interchange by the non-noise sensitive development around the corner of the site should reduce the noise levels at the site boundary to acceptable levels.

Tai Kok Tsui and Nam Cheong

4.3.49 Noise barriers of 3m high on the elevated Expressway and the at-grade P1 together with a short section of noise cover for the southbound Expressway would reduce the noise levels at H1 and H2 in Hoi King Street to 70.0 and 70.6 dB(A) respectively, at T1 and T2 on Wong Tai Street to 67.4 and 70.2 dB(A) respectively and at N1 and N2 of Nam Cheong Estate to 69.3 and 70.3 dB(A) respectively. In order to adequately protect these receivers, it becomes necessary to extend the noise barriers required for Tai Kok Tsui to meet those required for Nam Cheong Estate. Figure 4.15 shows the layout of the recommended mitigation option.

4.3.50 Free-field noise contours on section B-B (East) and C-C (East) with the mitigation measures are shown in Figures 4.16 and 4.17.

Mei Foo Sun Chuen

4.3.51 Figure 4.18 shows the layout of the recommended mitigation option at Mei Foo Sun Chuen. It comprises 3m high noise barriers extending through the CP2 roundabout along the nearside edge of the elevated Expressway and the median strip to about 200m beyond the Route 16 roundabout. With these barriers, the noise levels at M1 and M2 would be reduced to 70.4 and 70.6 dB(A) respectively. Free-field noise contours on section A-A (east) with the mitigation measures are shown in Figure 4.19.

4.3.52 The overall effect of the recommended mitigation options for the above three sections (except the non-noise sensitive development on the development site in Yau Ma Tei) on the future noise levels is shown in Figure 4.20. With the mitigation options all existing residential development at Mei Foo, Nam Cheong and Tai Kok Tsui are located beyond the 68 dB(A) contour line.

Post-Project Audit

4.3.53 There has been some debate on whether noise monitoring will be required during the operational lifetime of the WKE and also which Government Department should be responsible for any monitoring. The consultants consider that operational monitoring is required for a number of reasons, these include:-

- o as a means of checking the accuracy of the modelling predictions and to allow any discrepancies to be recognised and improved in future;
- o to check the effectiveness of the mitigation measures;
- o to assess if any deviations from the assumptions made in the modelling (such as traffic flow predictions and timing of development) are significant;
- o as part of a post project audit process which is a requirement of most environmental assessment briefs.

The allocation of responsibility for carrying out this monitoring/audit process is a Government decision.

4.4 SUMMARY OF KEY ISSUES

Construction Phase

4.4.1 Construction activities have been predicted to cause minimal noise impacts on the identified noise sensitive receivers along the waterfront of West Kowloon in the daytime during the construction. In general, it can be expected that the maximum construction noise levels are no higher than the 75 dB(A) noise standard commonly adopted for urban areas except at Wong Tai Street.

4.4.2 However, significant noise impacts could occur at all receivers in the Northern Section if construction works proceed through the evening and the night. Maximum construction noise levels are likely to exceed 10-15 dB(A) of the ANL in the nightime over a substantial period of the construction.

4.4.3 Major noise sources are the noisy items of equipment on sites. Construction traffic is unlikely to impact significantly on the noise levels at the receivers.

4.4.4 Options for mitigating construction noise have been suggested. The most effective single noise control measure is to include noise control limits and the requirements for noise monitoring in the tender and contract documents.

4.4.5 Contractors should be required to submit detailed noise mitigation proposals for complying with the noise control limits. This should assist the contractors in planning carefully their work schedules to reduce noise.

4.4.6 The recommended day time noise limits should be achievable at all sensitive receiver locations with minimal efforts. However, noise control measures would be required for the contractors to comply with the ANL at night.

Operational Phase

4.4.7 Future road traffic noise could impose severe constraints on noise sensitive development on WKR. Even with quiet type road surface, road traffic noise is likely to render some 250-500m of the reclaimed land on either side of the WKE incompatible with noise sensitive development.

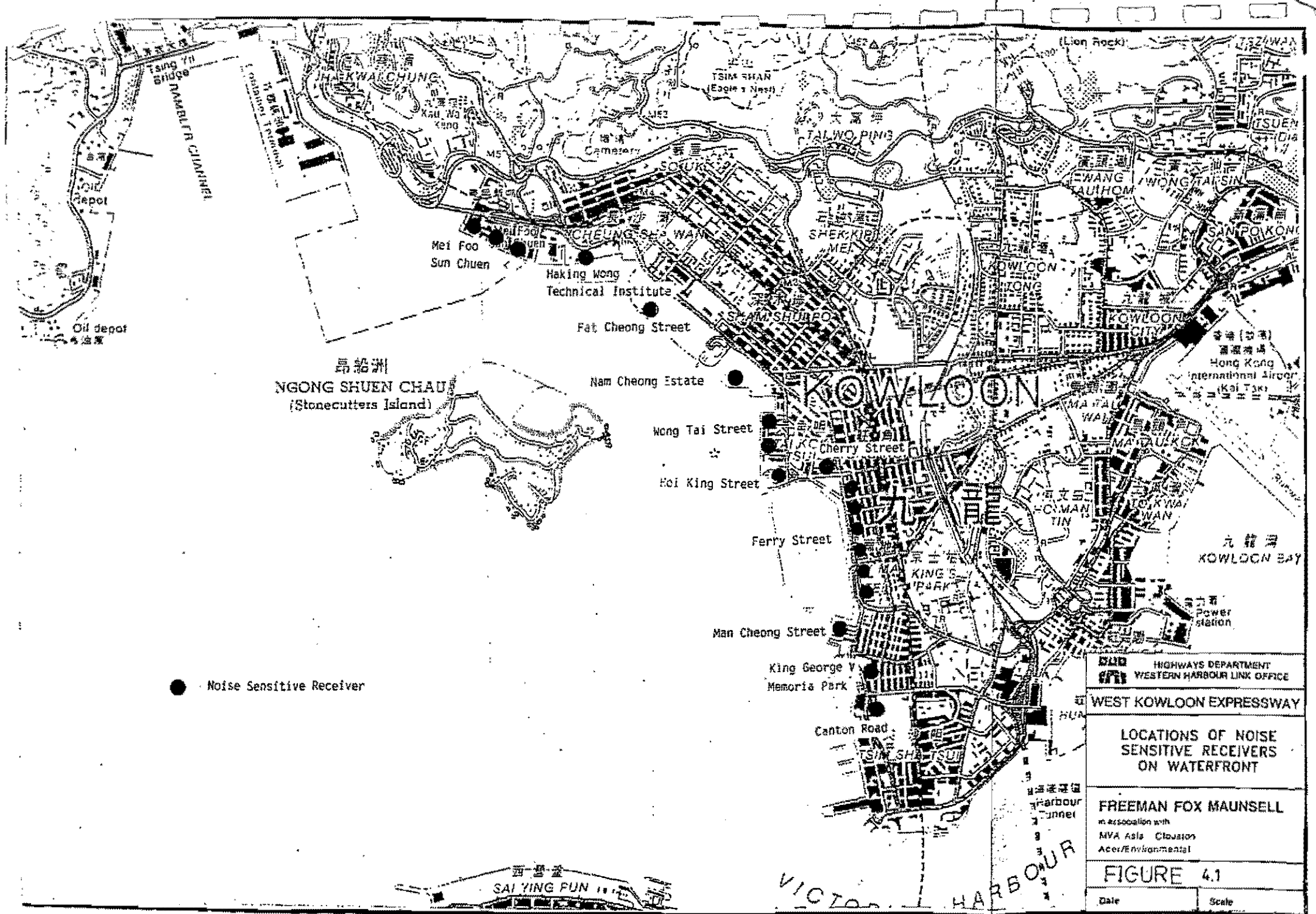
4.4.8 Existing noise sensitive receivers on the waterfront are likely to be affected to a different extent. Unmitigated noise levels at the facades of dwellings on Wong Tai Street in Tai Kok Tsui are predicted to exceed the HKPSG guideline of 70 dB(A) L10(1-hr.) by between 1.3 and 3.5 dB(A) in 2001, and by between 2.2 and 4.2 dB(A) in 2011, depending on the assumptions regarding the percentage of heavy vehicles. Similarly, dwellings on Hoi King Street can expect to have exceedance of the guideline by between 0 and 0.9 dB(A) in 2001, and by between 0.8 and 1.6 d(A) in 2011. Dwellings at Nam Cheong Estate can expect to have exceedance by between 2.6 and 3.1 d(A) in 2011, and by between 3.6 and 4.0 dB(A) in 2011.

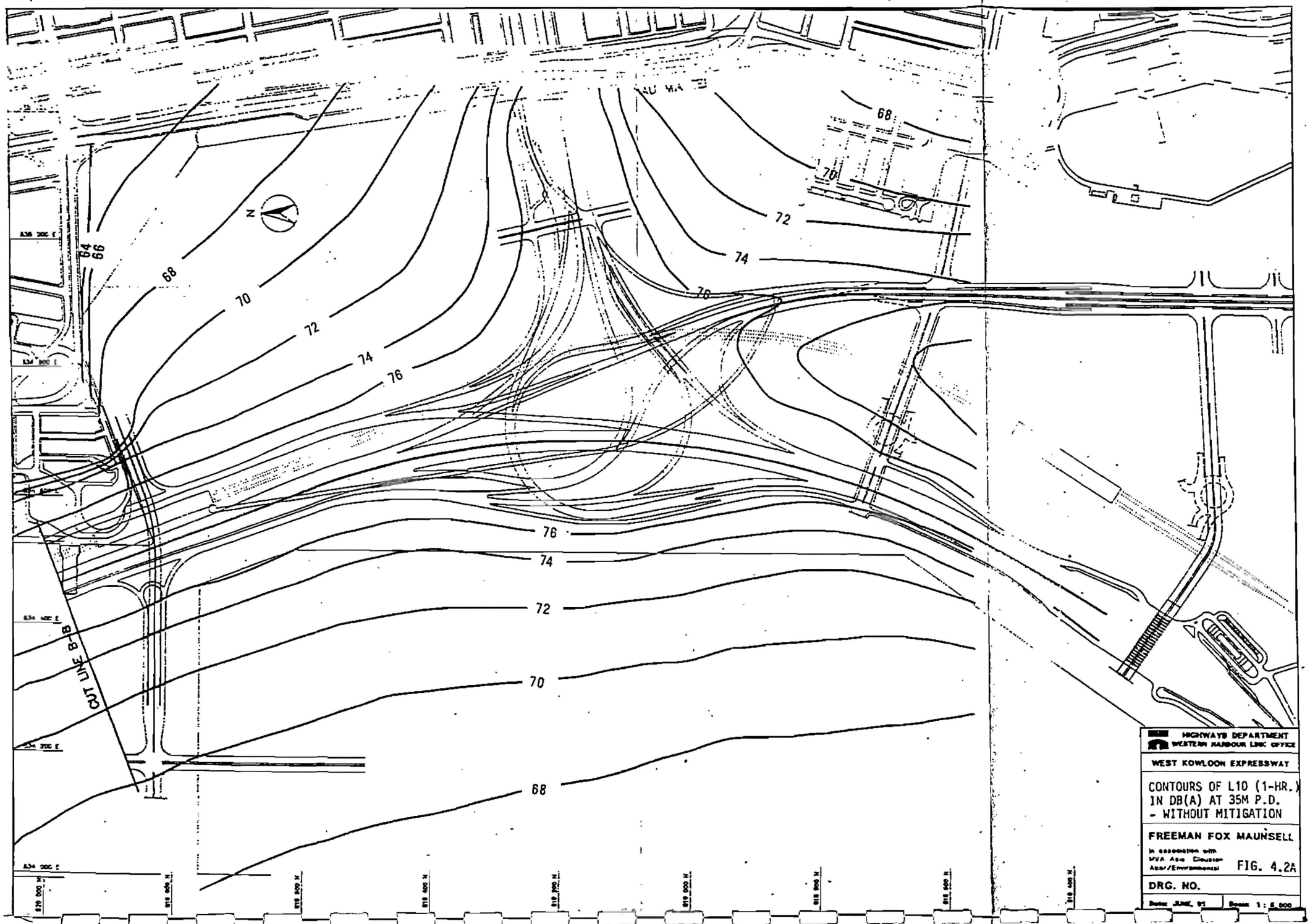
Dwellings at Mei Foo Sun Chuen can expect to have exceedance by between 2.3 and 3.1 dB(A) in 2001, and by between 2.4 and 3.3 dB(A) in 2011.

4.4.9 Options for mitigating the noise in path and hence reducing land use incompatibility on the east side of the alignment have been identified and evaluated. For the section between Yau Ma Tei Interchange and Cherry Street which is the main area for sensitive use development, it is recommended that a 230m section of the WKE and the P1 southbound should be fully enclosed together with overhead commercial or similar non-noise sensitive development atop the proposed Tai Kok Tsui Station. To further reduce incompatibility, it is recommended that the south-western corner of the development site on the east side of the WKE should be zoned for non-noise sensitive development. The P1 northbound need no enclosure if no noise sensitive development is proposed for the west side of the WKE. On noise grounds, similar noise benefit could be obtained with louvres covering the WKE and P1 (S/B) instead of enclosing the roads. However, light flickering, rain dripping and other maintenance problems make this option less desirable.

4.4.10 For the section between Cherry Street and Tonkin Street Extension, it is recommended that 3m high noise barriers on the elevated Expressway and the at-grade P1 together with a short noise cover of the WKE southbound should be provided. On the Mei Foo section, it is recommended that 3m high noise barriers should be erected on the elevated Expressway.

4.4.11 Mitigation of noise at receivers has not been evaluated in this assessment, but this could be considered at a later date if, on visual or cost-benefit grounds, sound insulation is more preferable than the provision of a noise cover for the elevated Expressway in Tai Kok Tsui.


Tsing Yi Bridge
RAMBLER CHANNEL
Oil depot
Oil depot
JIN KWA CHUNG
Kau Wa Keng
TSIM SHAN (Eagle's Nest)
(Lion Rock)
TSZ WAN
TAI WO PING
Cemetery
SOUK KU
TSUEN
WANG TAU HOM
WONG TAI SIN
SAN POI KONG
Mei Foo Sun Chuen
CHEUNG SHA WAN
SHEK KIP MEI
Haking Wong Technical Institute
KOWLOON TONG
Fat Cheong Street
KOWLOON CITY
Hong Kong International Airport (Kai Tak)
昂船洲
NGONG SHUEN CHAU
(Stonecutters Island)
Nam Cheong Estate
KOWLOON
MA TAU WAI
Wong Tai Street
Cherry Street
MA TAU KOK
Hoi King Street
九龍
HUNG HOM
TO KWA WAN
Ferry Street
九龍灣
KOWLOON BAY
KING'S PARK
Power station
Man Cheong Street
King George V Memorial Park
Noise Sensitive Receiver
Canton Road
TSIM SHA TSUI
harbour Tunnel
西營盤
SAI YING PUN
VICTORIA HARBOUR
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
LOCATIONS OF NOISE SENSITIVE RECEIVERS ON WATERFRONT
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clayton
Acer Environmental
FIGURE 4.1
Date
Scale



HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

WEST KOWLOON EXPRESSWAY

CONTOURS OF L10 (1-HR.) IN DB(A) AT 35M P.D. - WITHOUT MITIGATION

FREEMAN FOX MAUNSELL

In association with
MVA Asia Consultants
Acer/Environmental

FIG. 4.2A

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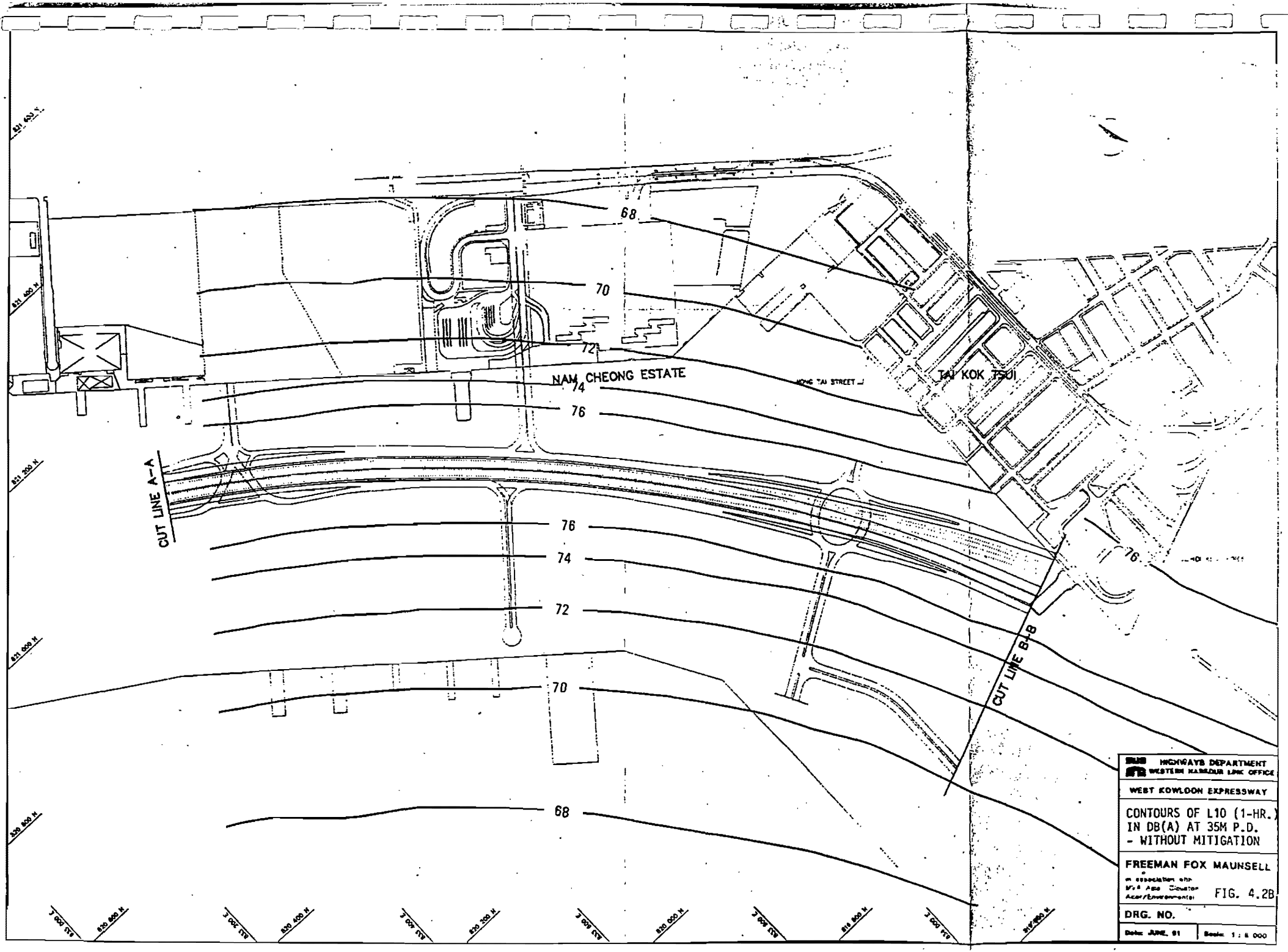

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

WEST KOWLOON EXPRESSWAY

CONTOURS OF L10 (1-HR.) IN DB(A) AT 35M P.D. - WITHOUT MITIGATION

FREEMAN FOX MAUNSELL

in association with
Mott Agra Director
Acer/Environmental

FIG. 4.2B

DRG. NO.

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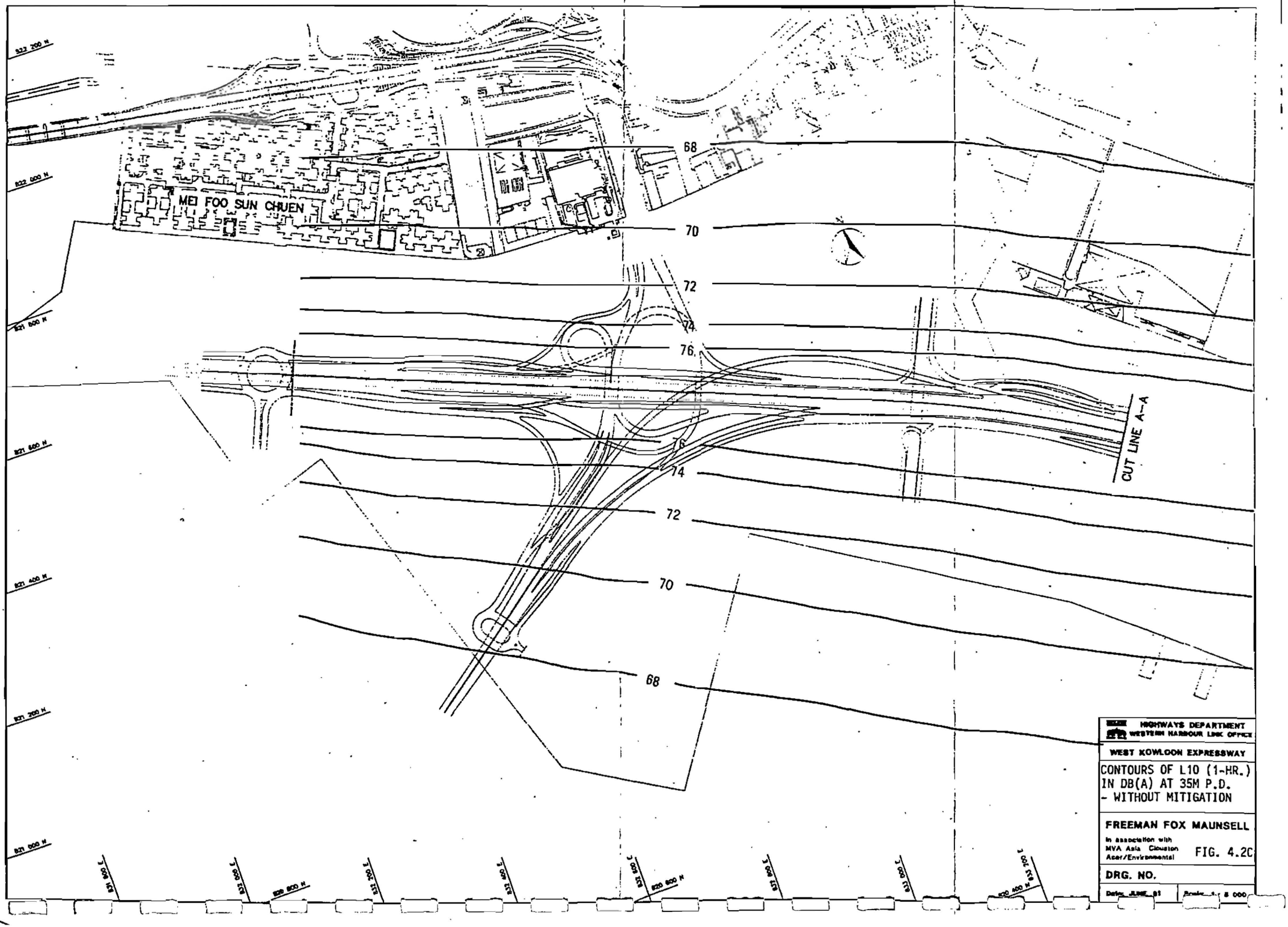
MEI FOO SUN CHUEN
68
70
72
74
76
76
74
72
70
68
CUT LINE A-A
832 200 N
832 600 N
831 800 N
831 600 N
831 400 N
831 200 N
831 000 N
836 800 N
820 400 N
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF L10 (1-HR.) IN DB(A) AT 35M P.D. - WITHOUT MITIGATION
FREEMAN FOX MAUNSELL
In association with MVA Asia Clouston Acer/Environmental
FIG. 4.2C
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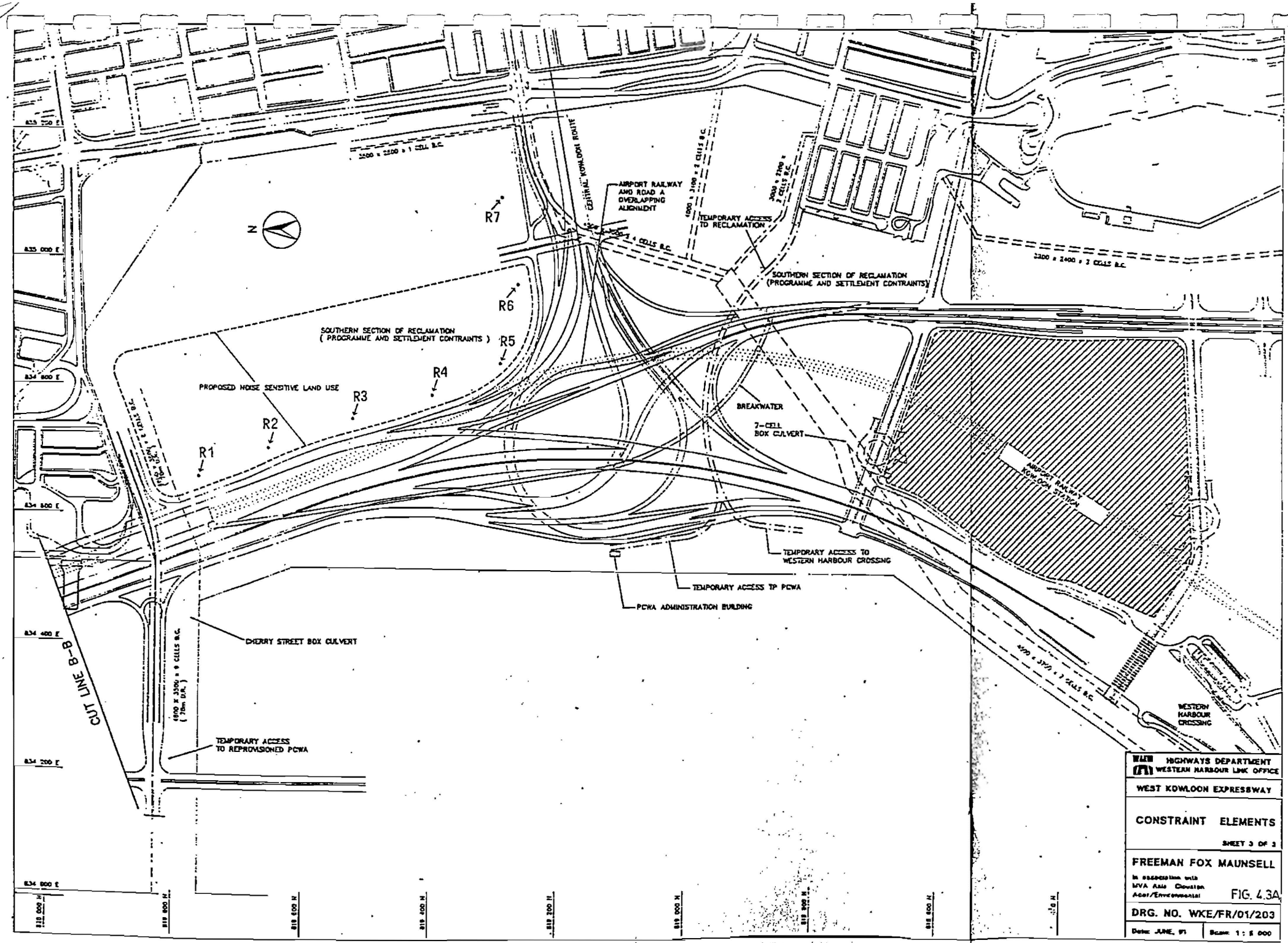
N
R1
R2
R3
R4
R5
R6
R7
PROPOSED NOISE SENSITIVE LAND USE
SOUTHERN SECTION OF RECLAMATION
(PROGRAMME AND SETTLEMENT CONTRAINTS)
SOUTHERN SECTION OF RECLAMATION
(PROGRAMME AND SETTLEMENT CONTRAINTS)
AIRPORT RAILWAY AND ROAD A OVERLAPPING ALIGNMENT
CENTRAL - KOWLOON ROUTE
TEMPORARY ACCESS TO RECLAMATION
BREAKWATER
7-CELL BOX CULVERT
AIRPORT RAILWAY KOWLOON STATION
TEMPORARY ACCESS TO WESTERN HARBOUR CROSSING
TEMPORARY ACCESS TP PCWA
PCWA ADMINISTRATION BUILDING
CHERRY STREET BOX CULVERT
CUT LINE B-B
TEMPORARY ACCESS TO REPROVISIONED PCWA
WESTERN HARBOUR CROSSING
834 400 E
834 600 E
834 800 E
835 000 E
834 200 E
834 000 E
810 000 N
810 200 N
810 400 N
810 600 N
810 800 N
810 000 N
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONSTRAINT ELEMENTS
SHEET 3 OF 3
FREEMAN FOX MAUNSELL
In association with
MVA Asia Consultan
Acer/Environmental
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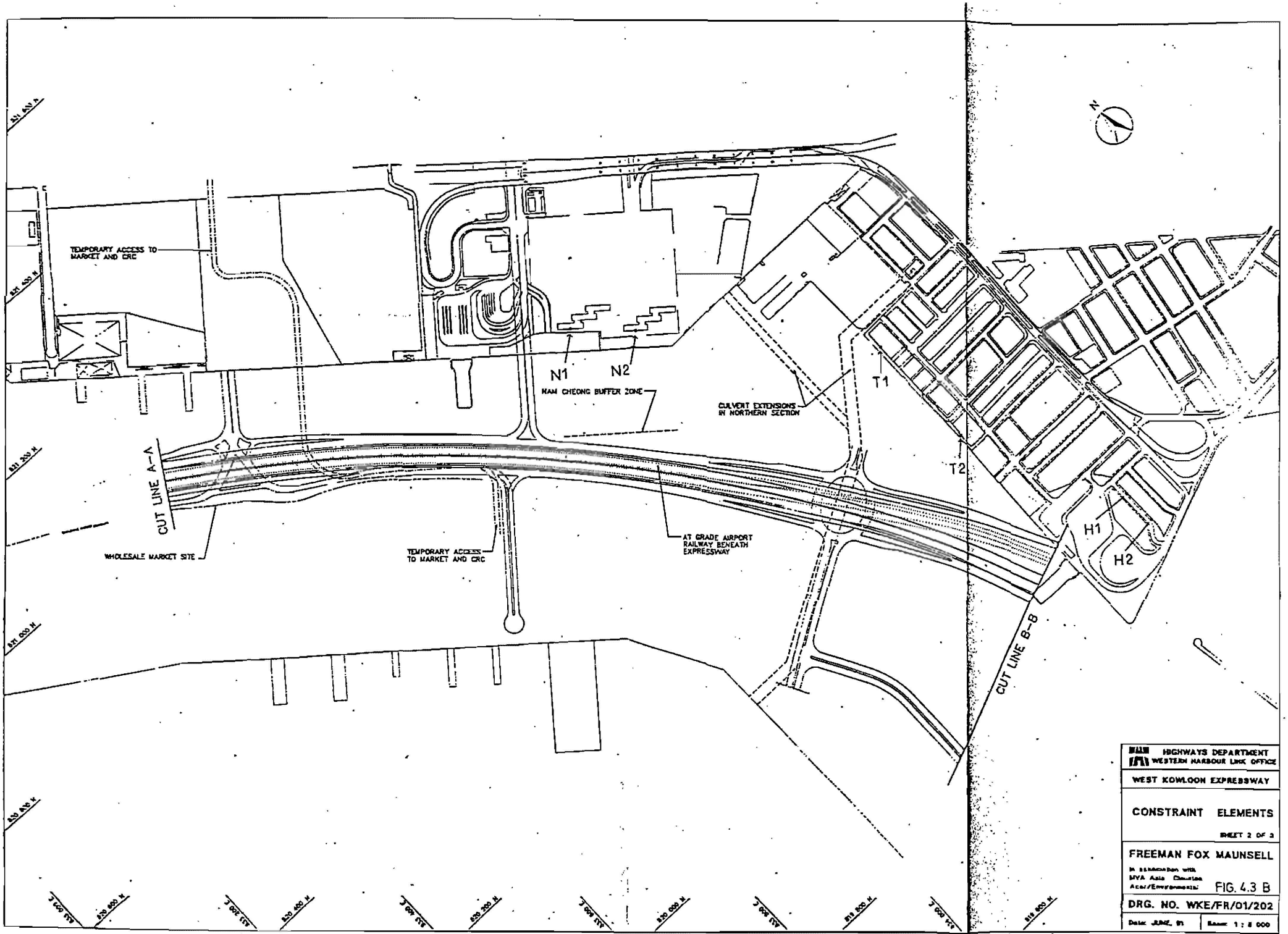
TEMPORARY ACCESS TO MARKET AND CRC
N1
N2
NAM CHEONG BUFFER ZONE
CULVERT EXTENSIONS IN NORTHERN SECTION
T1
T2
H1
H2
CUT LINE A-A
CUT LINE B-B
WHOLESALE MARKET SITE
TEMPORARY ACCESS TO MARKET AND CRC
AT GRADE AIRPORT RAILWAY BENEATH EXPRESSWAY
N
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONSTRAINT ELEMENTS
SHEET 2 OF 3
FREEMAN FOX MAUNSELL
FIG. 4.3 B
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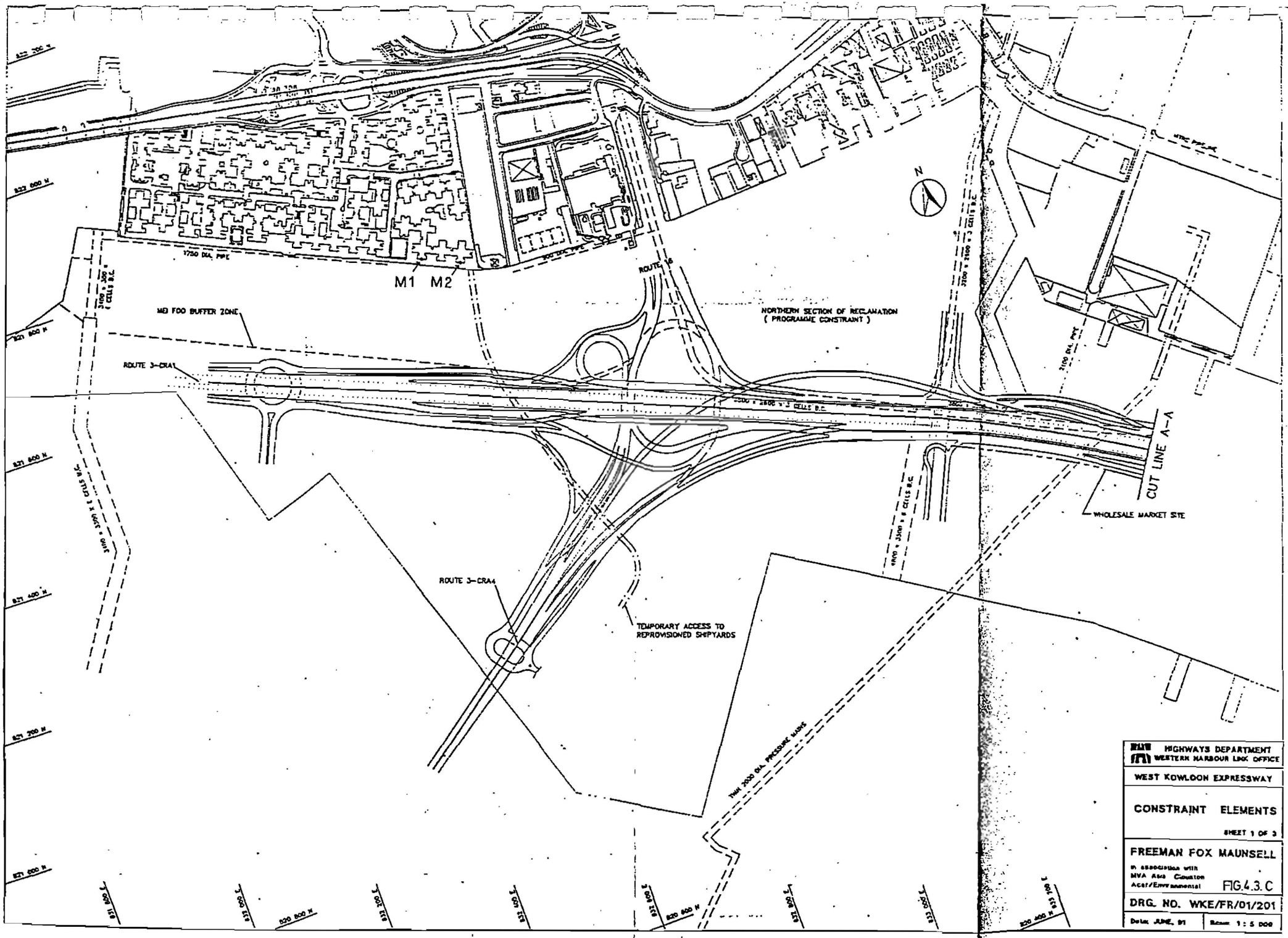
M1
M2
MEI FOO BUFFER ZONE
ROUTE 3-CRA4
ROUTE 16
NORTHERN SECTION OF RECLAMATION
(PROGRAMME CONSTRAINT)
CUT LINE A-A
WHOLESALE MARKET SITE
TEMPORARY ACCESS TO
REPROVISIONED SHIPYARDS
1750 DIA. PIPE
2100 DIA. PIPE
THAN 2000 DIA. PRESSURE MAINS
N
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONSTRAINT ELEMENTS
SHEET 1 OF 3
FREEMAN FOX MAUNSELL
in association with
MVA Asia Consultan
Acer/Environmental
FIG.4.3.C
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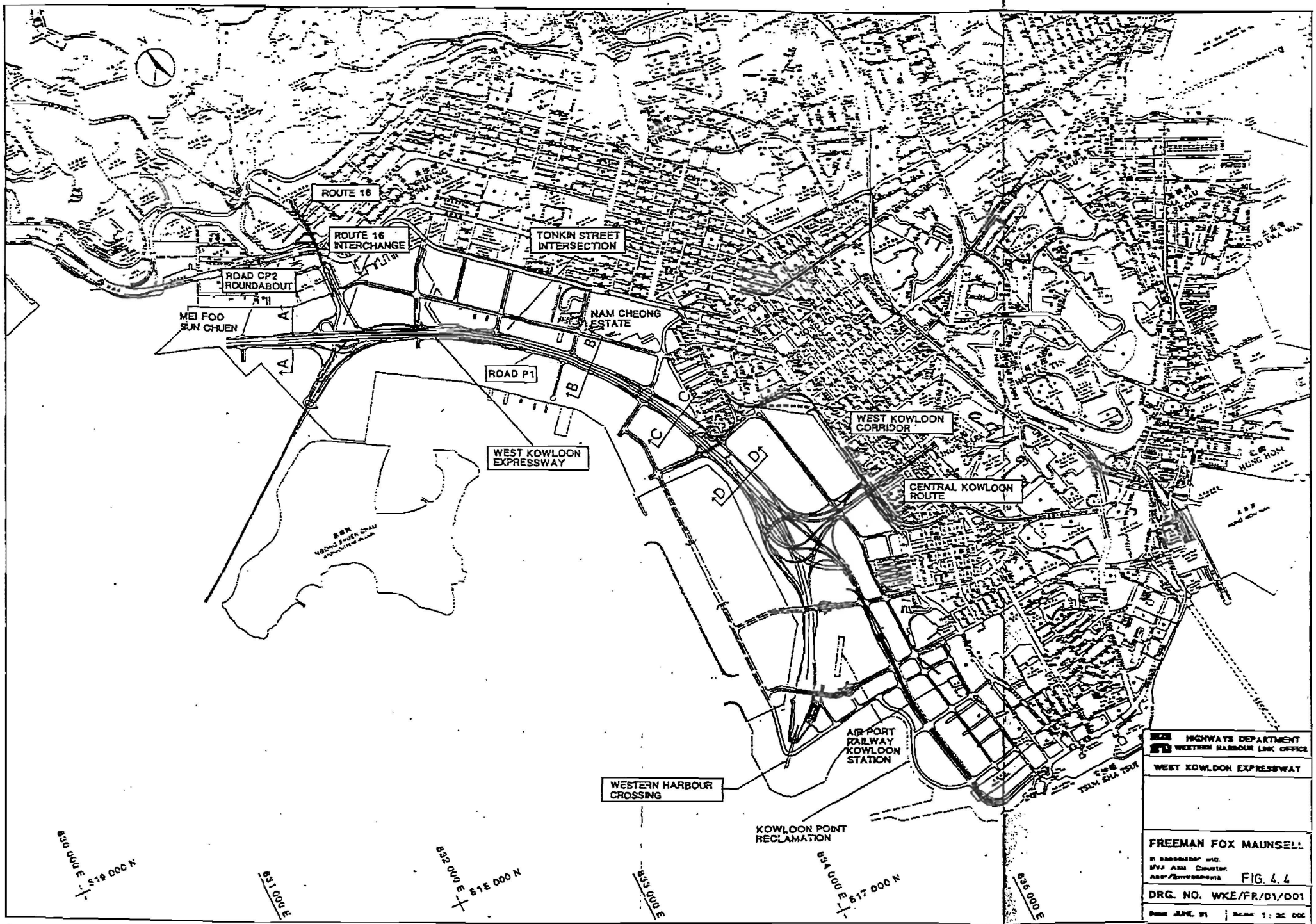

ROUTE 16
ROUTE 16 INTERCHANGE
TONKIN STREET INTERSECTION
ROAD CP2 ROUNDABOUT
MEI FOO SUN CHUEN
NAM CHEONG ESTATE
ROAD P1
WEST KOWLOON EXPRESSWAY
WEST KOWLOON CORRIDOR
CENTRAL KOWLOON ROUTE
AIR-PORT RAILWAY KOWLOON STATION
WESTERN HARBOUR CROSSING
KOWLOON POINT RECLAMATION
TO KAI TAK
HUNG HOM
TSIM SHA TSUI
830 000 E
819 000 N
831 000 E
832 000 E
818 000 N
833 000 E
834 000 E
817 000 N
835 000 E
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
FREEMAN FOX MAUNSELL
FIG. 4.4
DRG. NO. WKE/FR/C1/001
JUNE 91
1 : 2C DGC

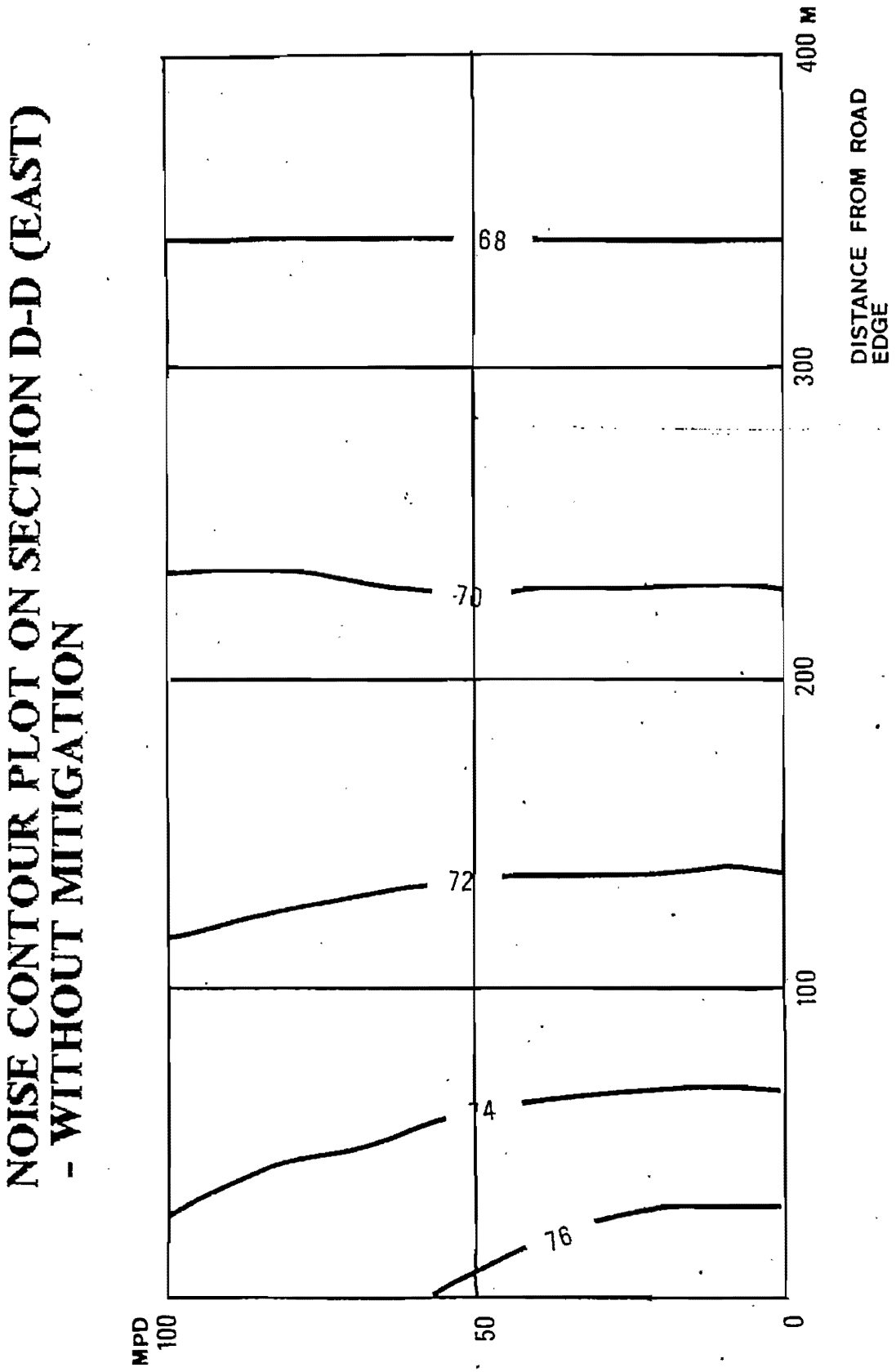

NOISE CONTOUR PLOT ON SECTION D-D (EAST)
- WITHOUT MITIGATION
68
70
72
74
76
400 M
300
200
100
0
DISTANCE FROM ROAD EDGE
MPD
100
50

Fig. 4.5

NOISE CONTOUR PLOT ON SECTION D-D (WEST) - WITHOUT MITIGATION

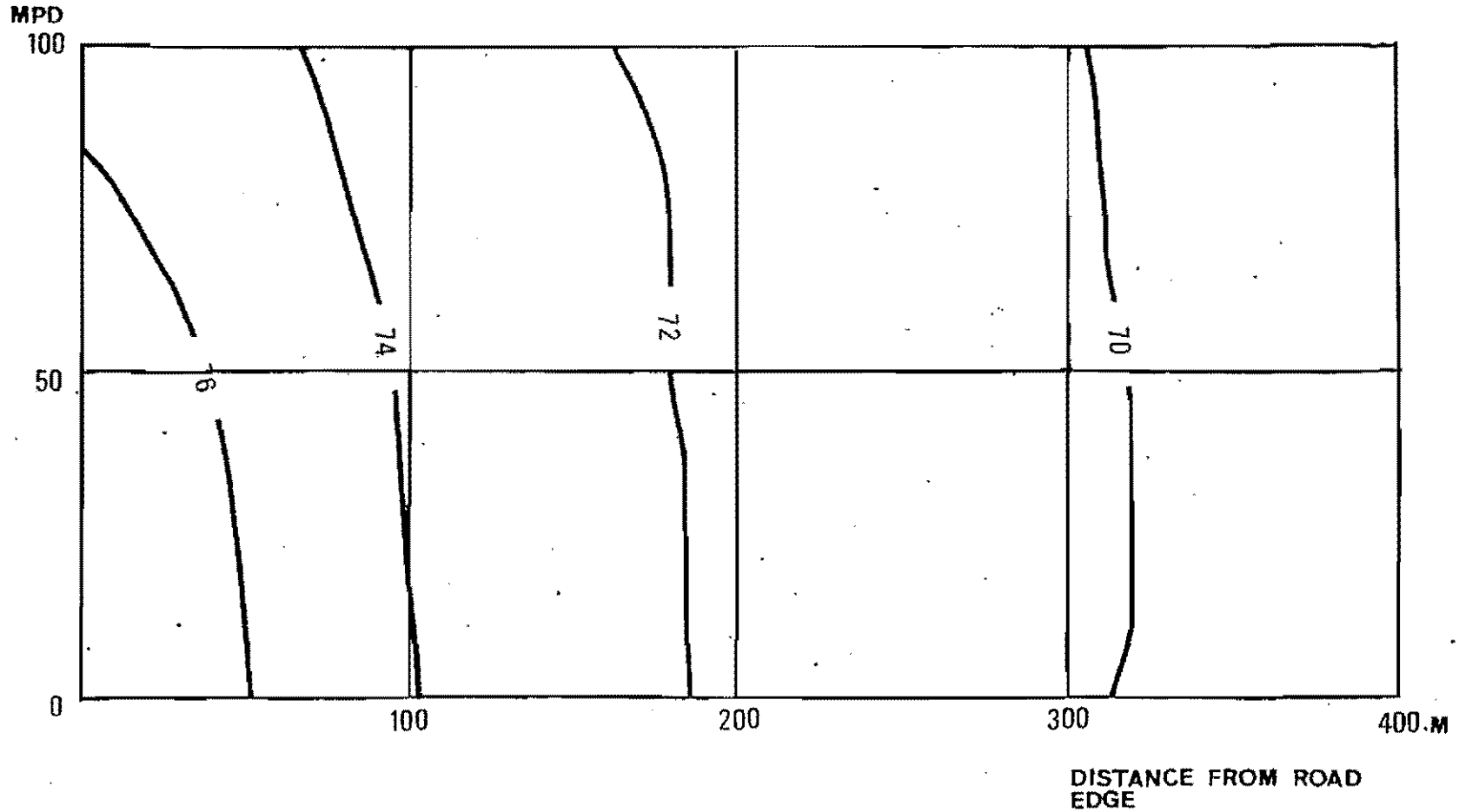


Fig. 4.6

NOISE CONTOUR PLOT ON SECTION C-C (EAST) - WITHOUT MITIGATION

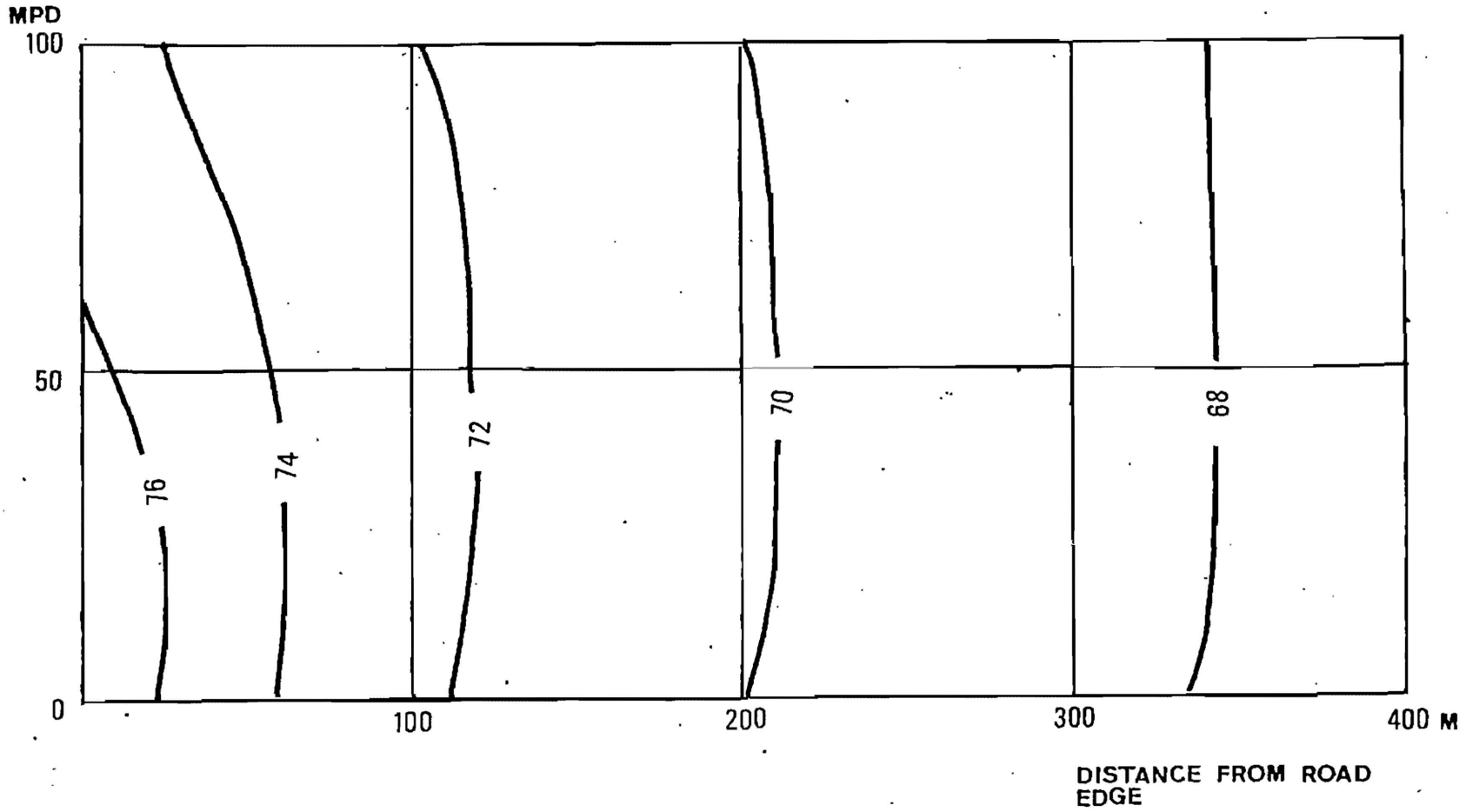


Fig. 4.7

NOISE CONTOUR PLOT ON SECTION C-C (WEST) - WITHOUT MITIGATION

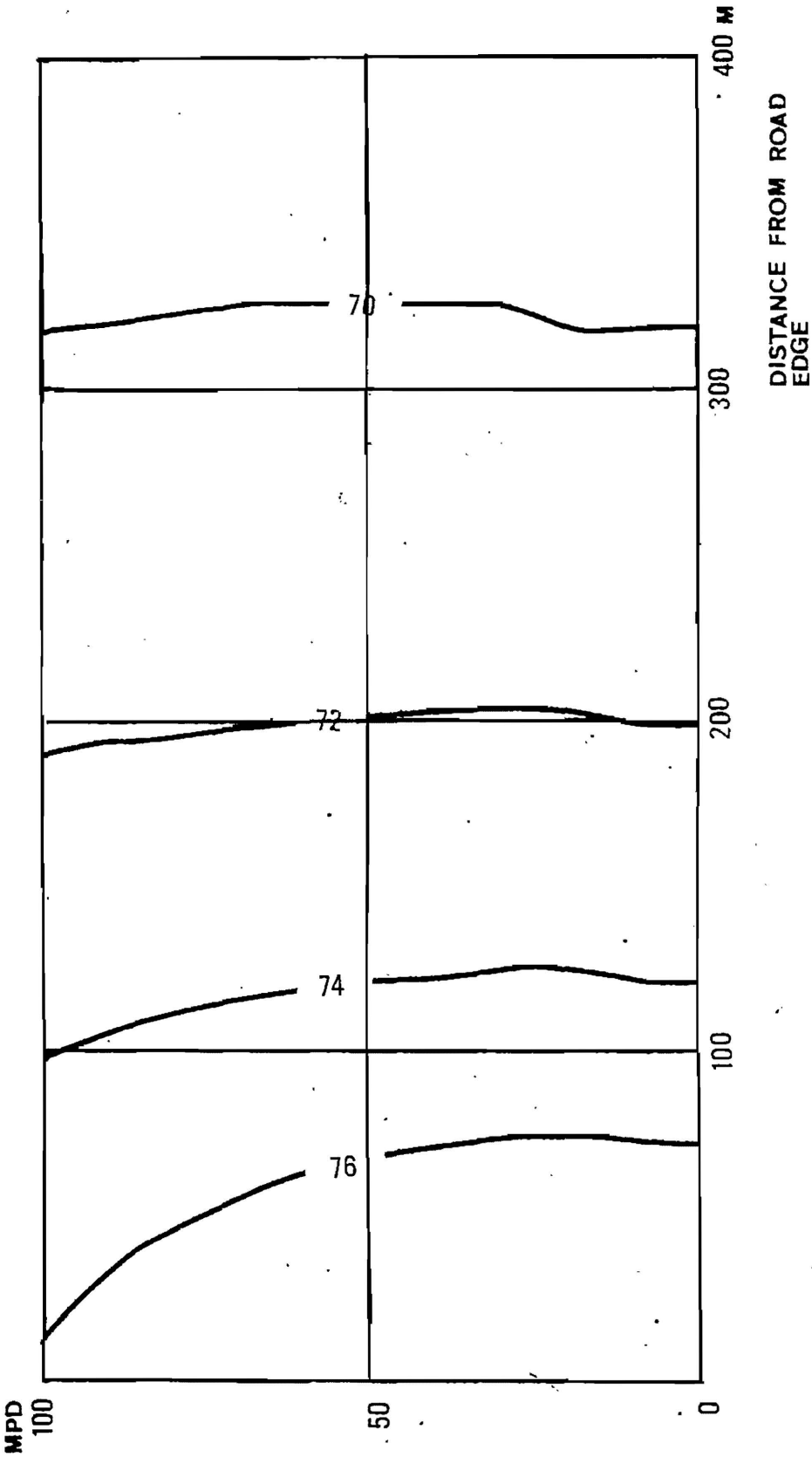


Fig. 4.8

NOISE CONTOUR PLOT ON SECTION B-B (EAST) - WITHOUT MITIGATION

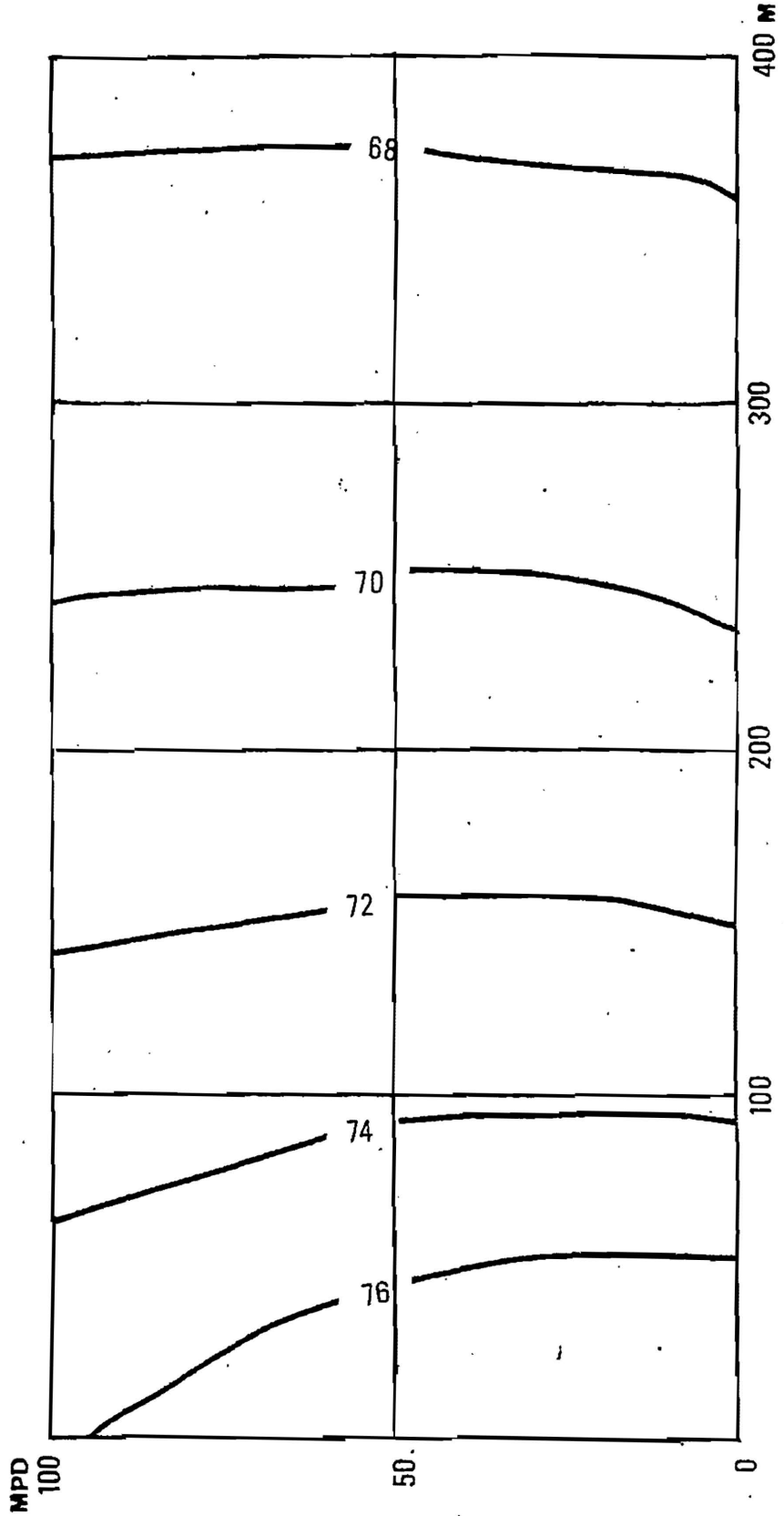


Fig. 4.9

NOISE CONTOUR PLOT ON SECTION B-B (WEST) - WITHOUT MITIGATION

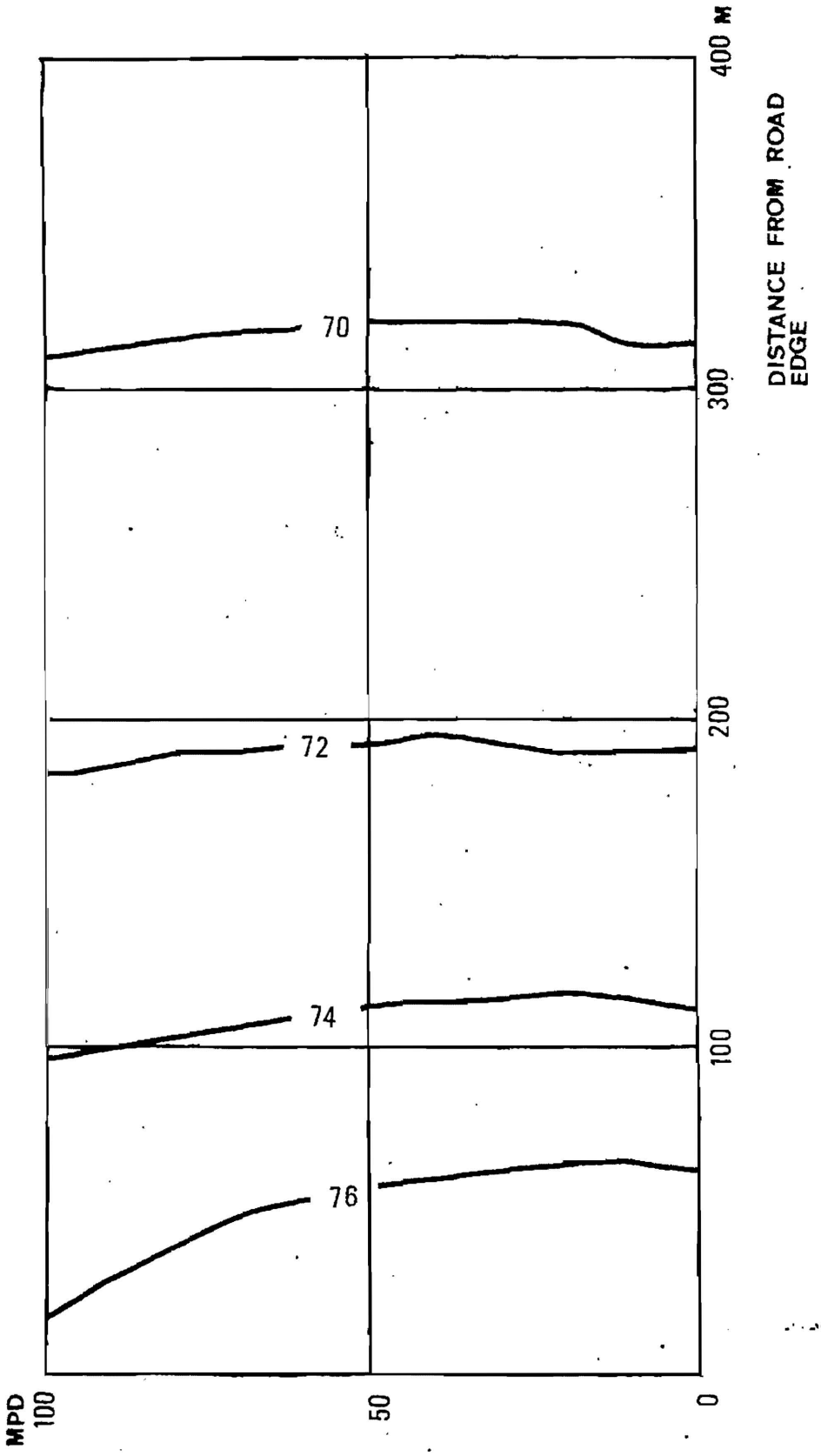


Fig. 4.10

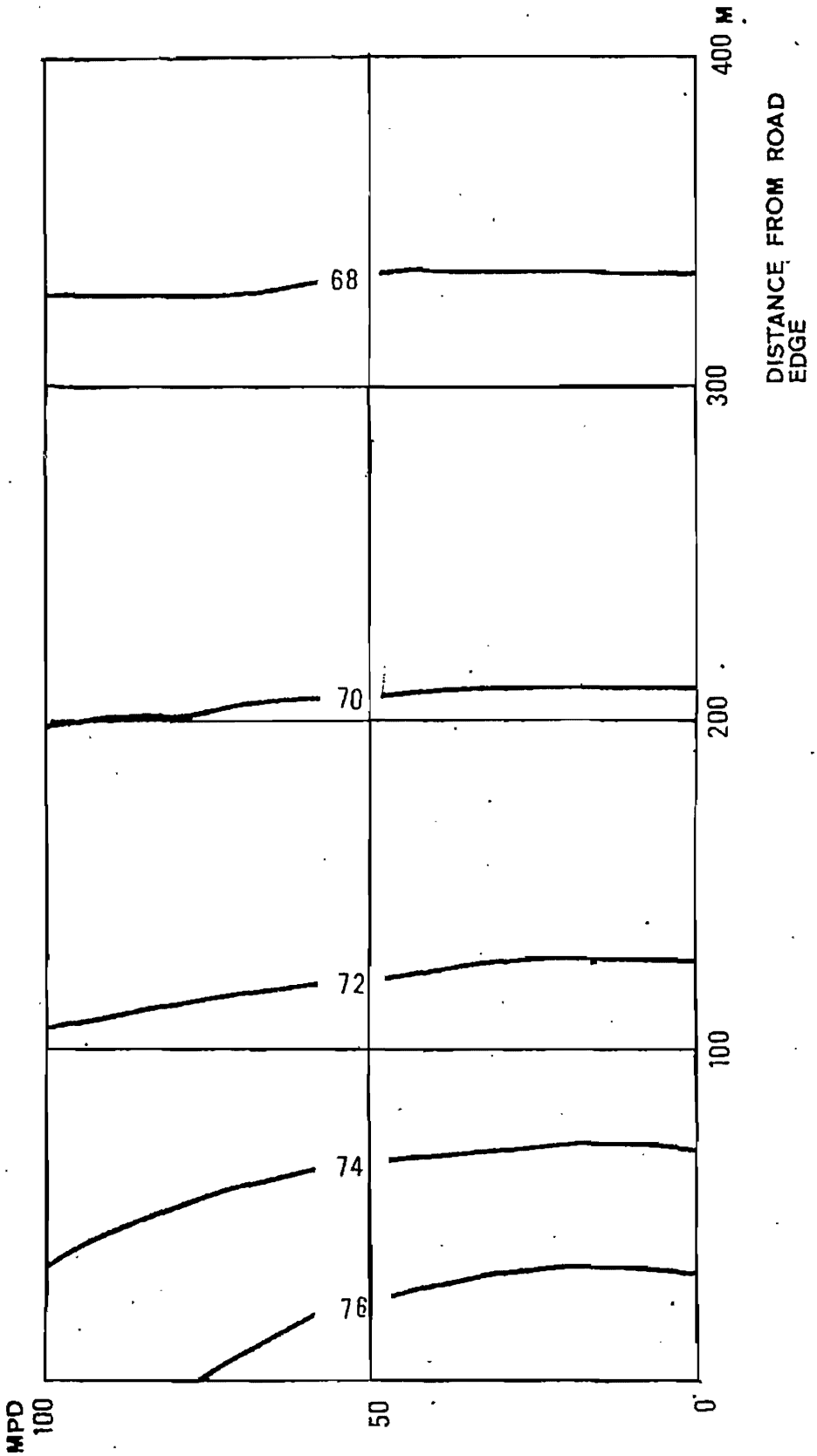

NOISE CONTOUR PLOT ON SECTION A-A (EAST)
- WITHOUT MITIGATION
68
70
72
74
76
MPD
100
50
0
100
200
300
400 M
DISTANCE FROM ROAD EDGE

Fig. 4.11

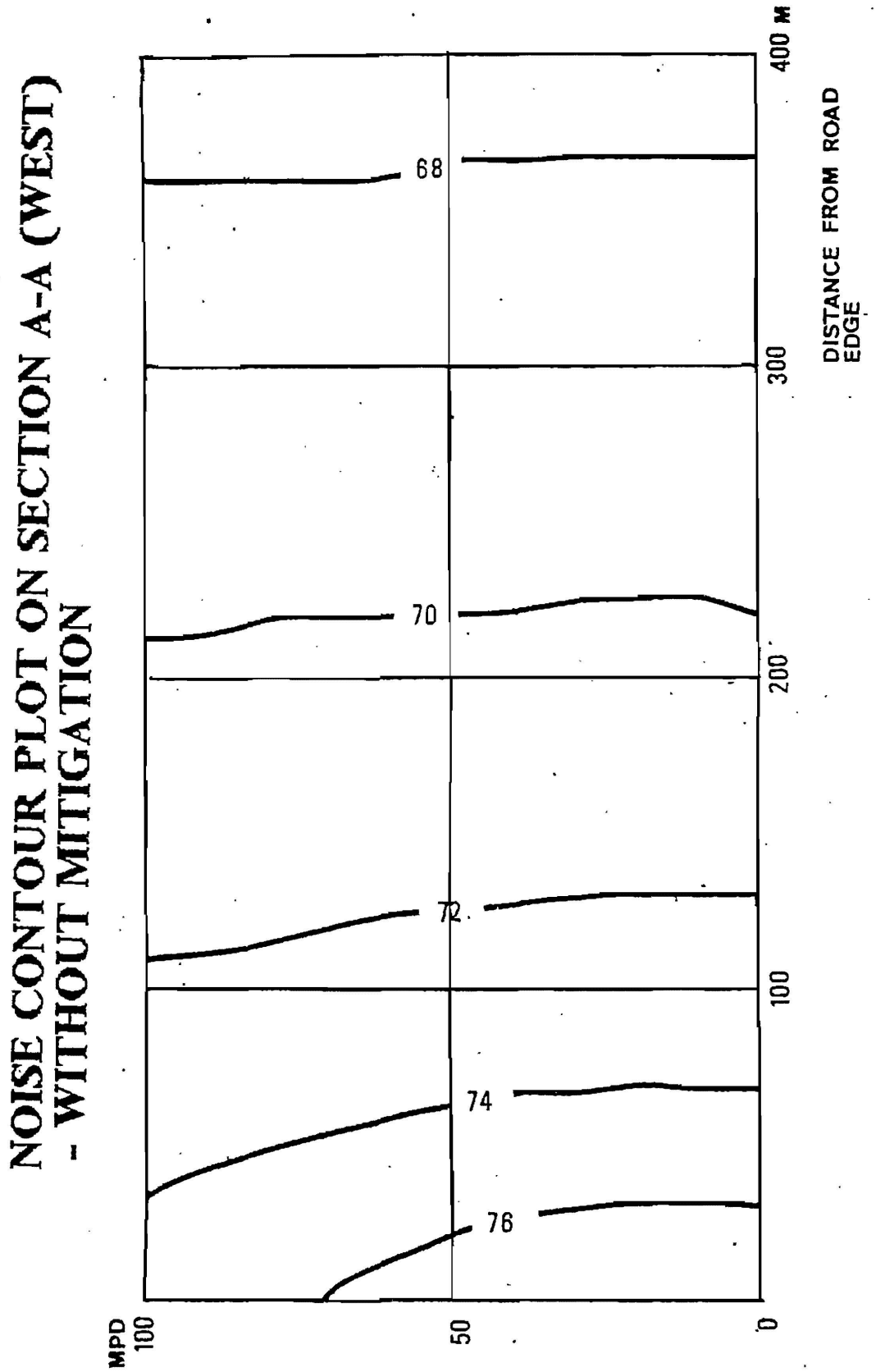
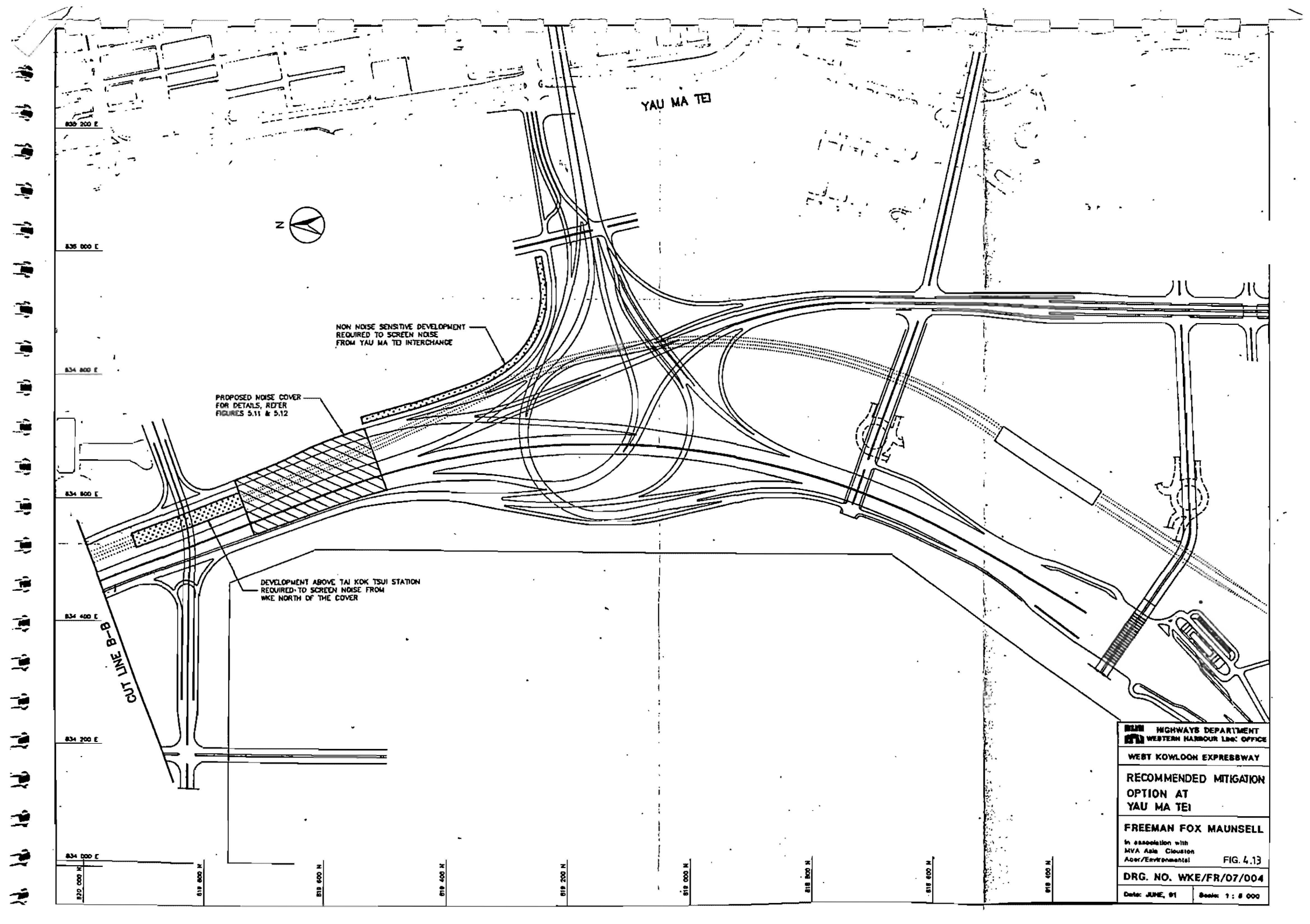

NOISE CONTOUR PLOT ON SECTION A-A (WEST)
- WITHOUT MITIGATION
68
70
72
74
76
400 M
300
200
100
0
DISTANCE FROM ROAD EDGE
MPD
100
50
0

Fig. 4.12


YAU MA TEI
N
835 000 E
834 800 E
834 600 E
834 400 E
834 200 E
834 000 E
NON NOISE SENSITIVE DEVELOPMENT REQUIRED TO SCREEN NOISE FROM YAU MA TEI INTERCHANGE
PROPOSED NOISE COVER FOR DETAILS, REFER FIGURES 5.11 & 5.12
DEVELOPMENT ABOVE TAI KOK TSUI STATION REQUIRED TO SCREEN NOISE FROM WKE NORTH OF THE COVER
CUT LINE B-B
820 000 N
819 800 N
819 600 N
819 400 N
819 200 N
819 000 N
818 800 N
818 600 N
818 400 N
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
RECOMMENDED MITIGATION OPTION AT YAU MA TEI
FREEMAN FOX MAUNSELL
In association with
MVA Asia Clouston
Acer/Environmental
FIG. 4.13
DRG. NO. WKE/FR/07/004
Date: JUNE, 91
Scale: 1 : 8 000

NOISE CONTOUR PLOT ON SECTION D-D (EAST) - WITH MITIGATION

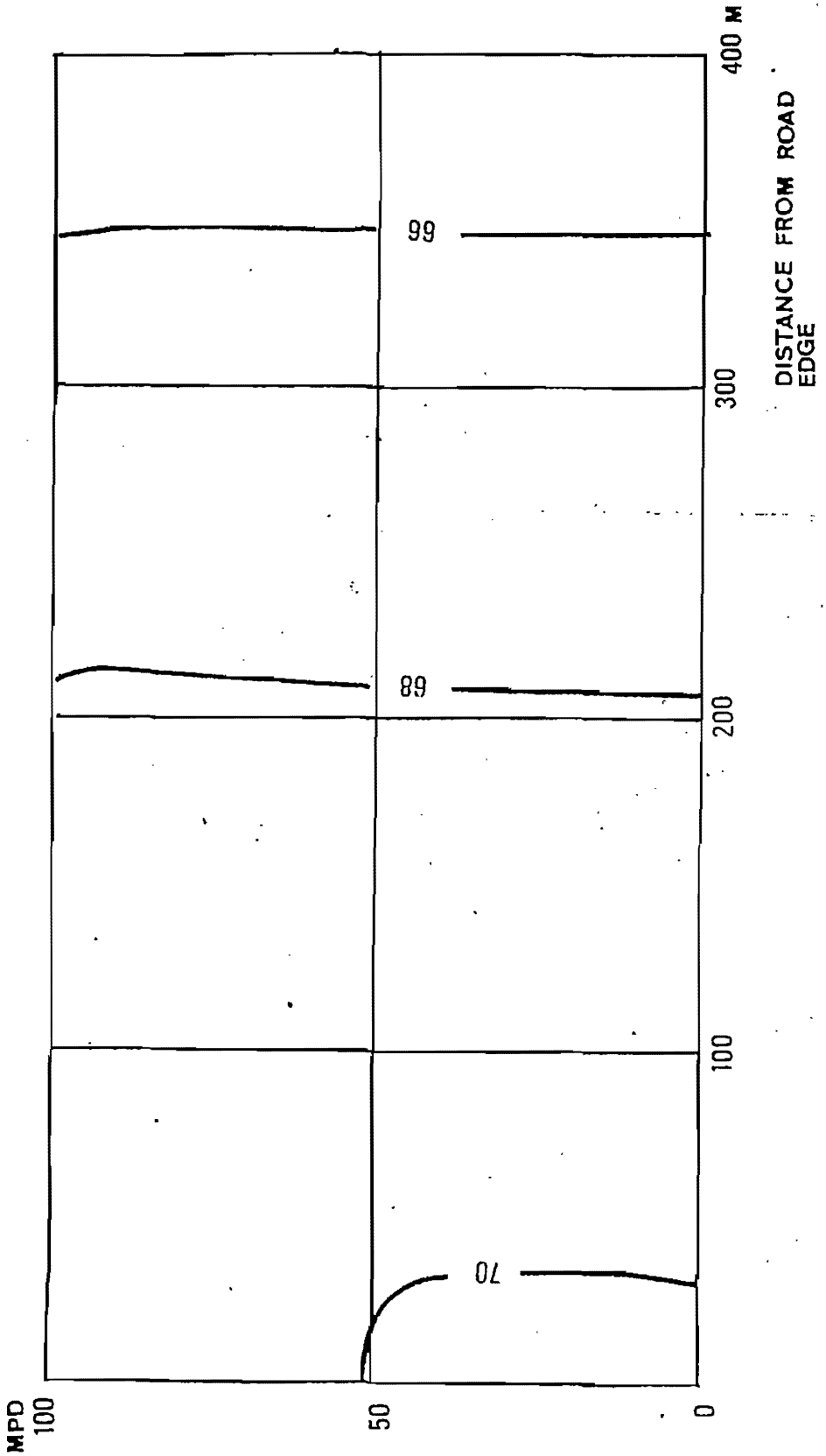
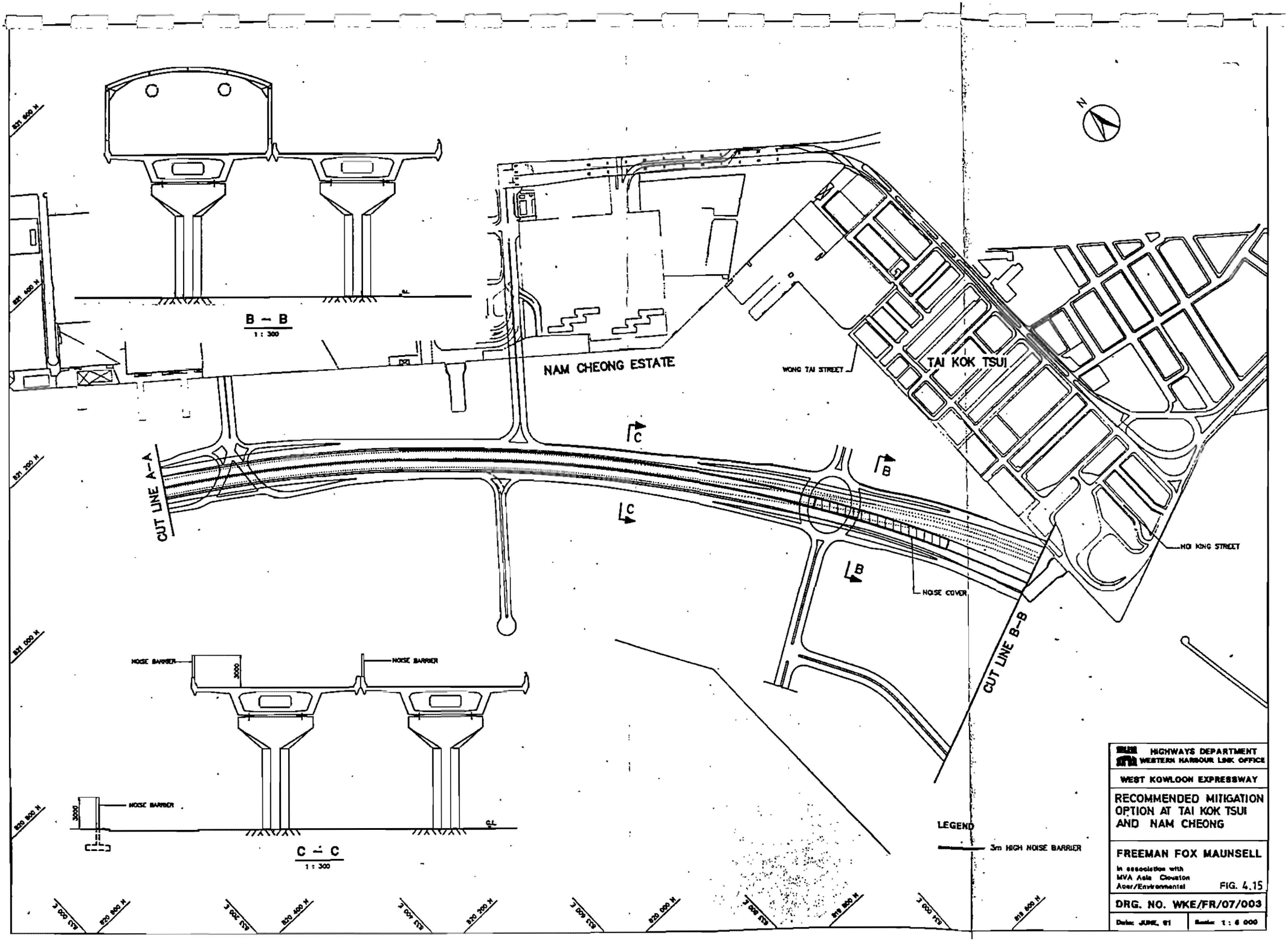


Fig. 4.1


B – B
1 : 300
NAM CHEONG ESTATE
WONG TAI STREET
TAI KOK TSUI
CUT LINE A–A
C
B
NOISE COVER
NOI KING STREET
CUT LINE B–B
NOISE BARRIER
3000
NOISE BARRIER
NOISE BARRIER
3000
C – C
1 : 300
LEGEND
3m HIGH NOISE BARRIER
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
RECOMMENDED MITIGATION OPTION AT TAI KOK TSUI AND NAM CHEONG
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental
FIG. 4.15
DRG. NO. WKE/FR/07/003
Date: JUNE, 97
Scale: 1 : 6 000

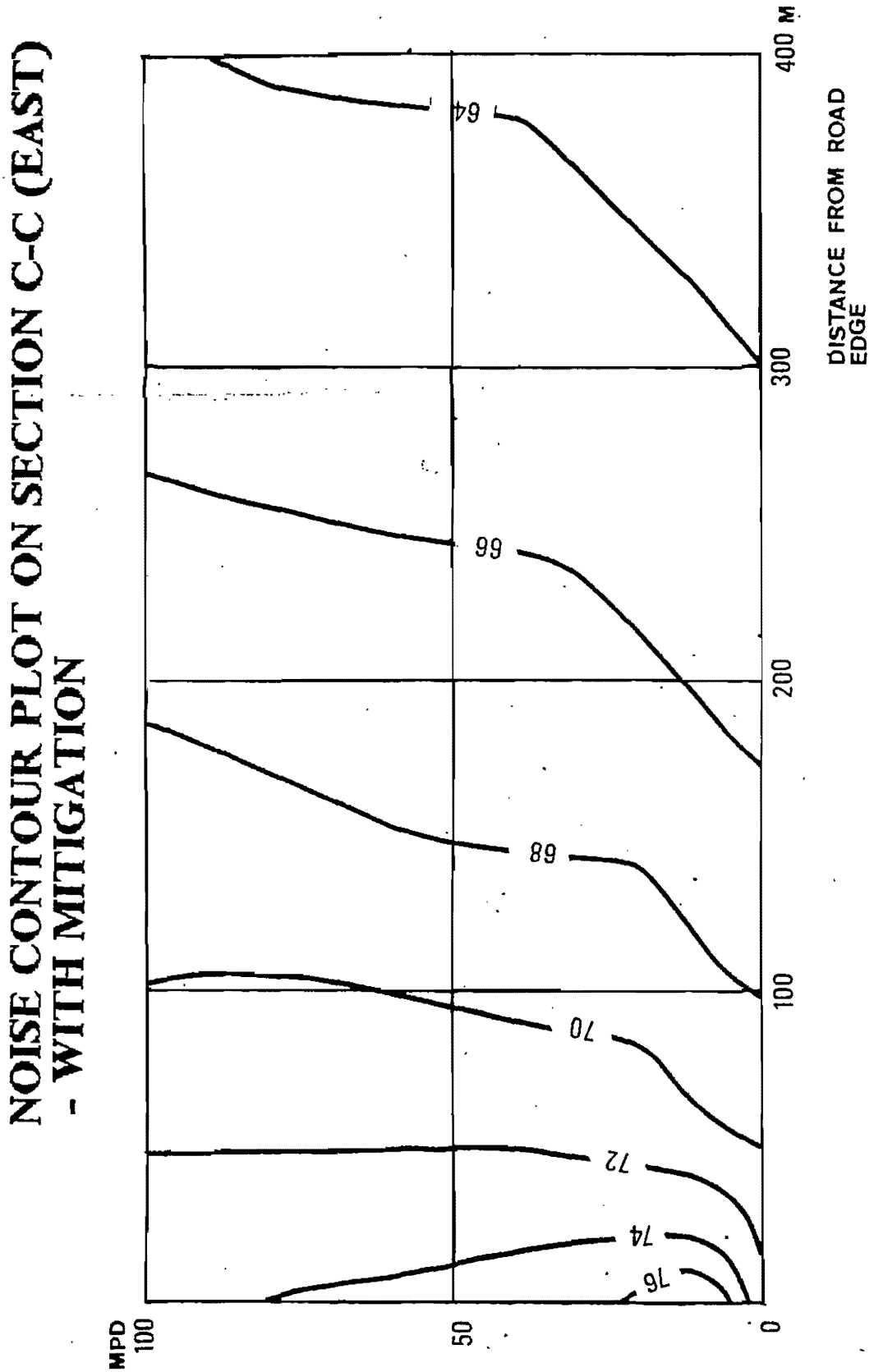

NOISE CONTOUR PLOT ON SECTION C-C (EAST)
- WITH MITIGATION
64
66
68
70
72
74
76
MPD
100
50
0
400 M
300
200
100
DISTANCE FROM ROAD EDGE

Fig. 4.16

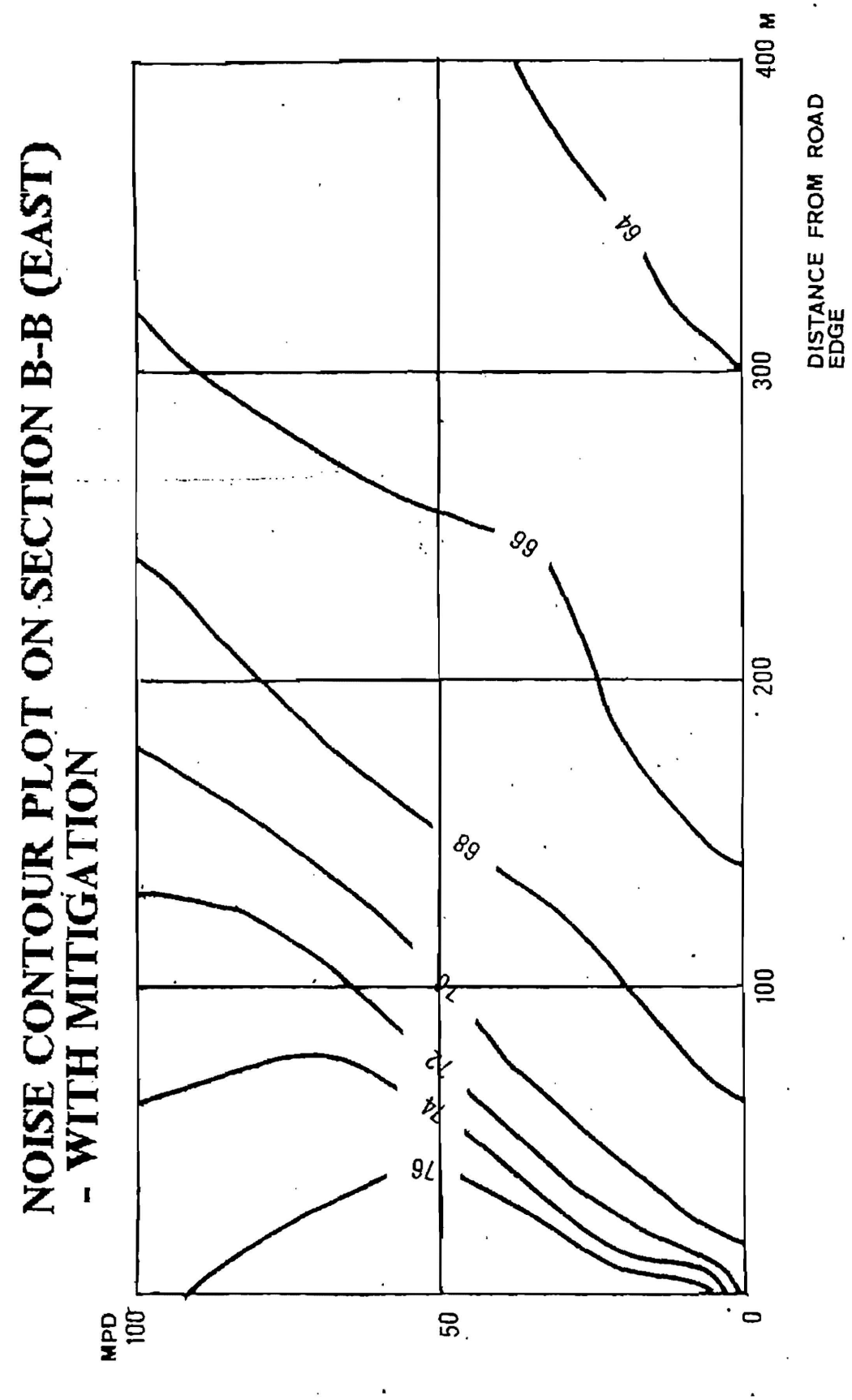
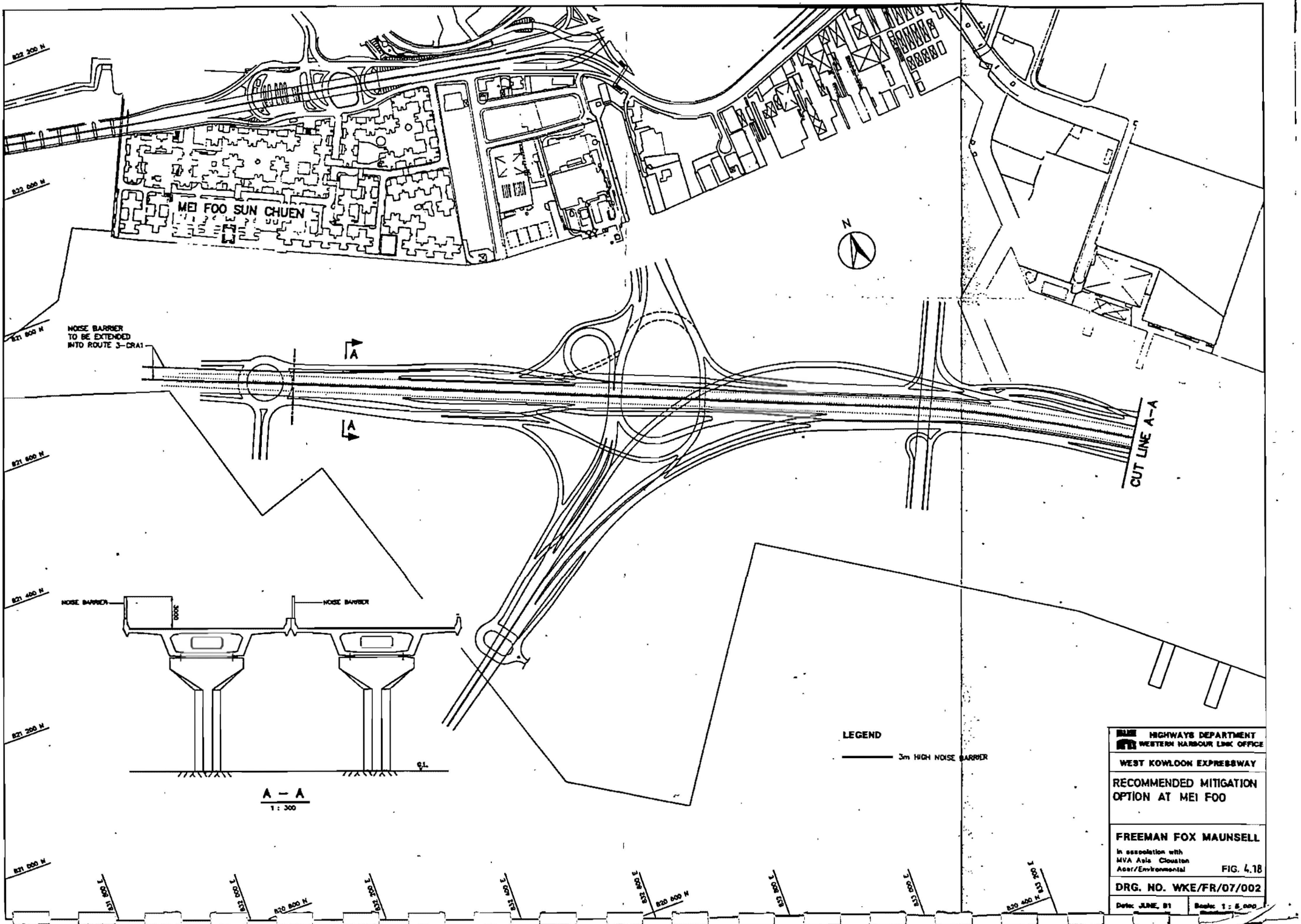
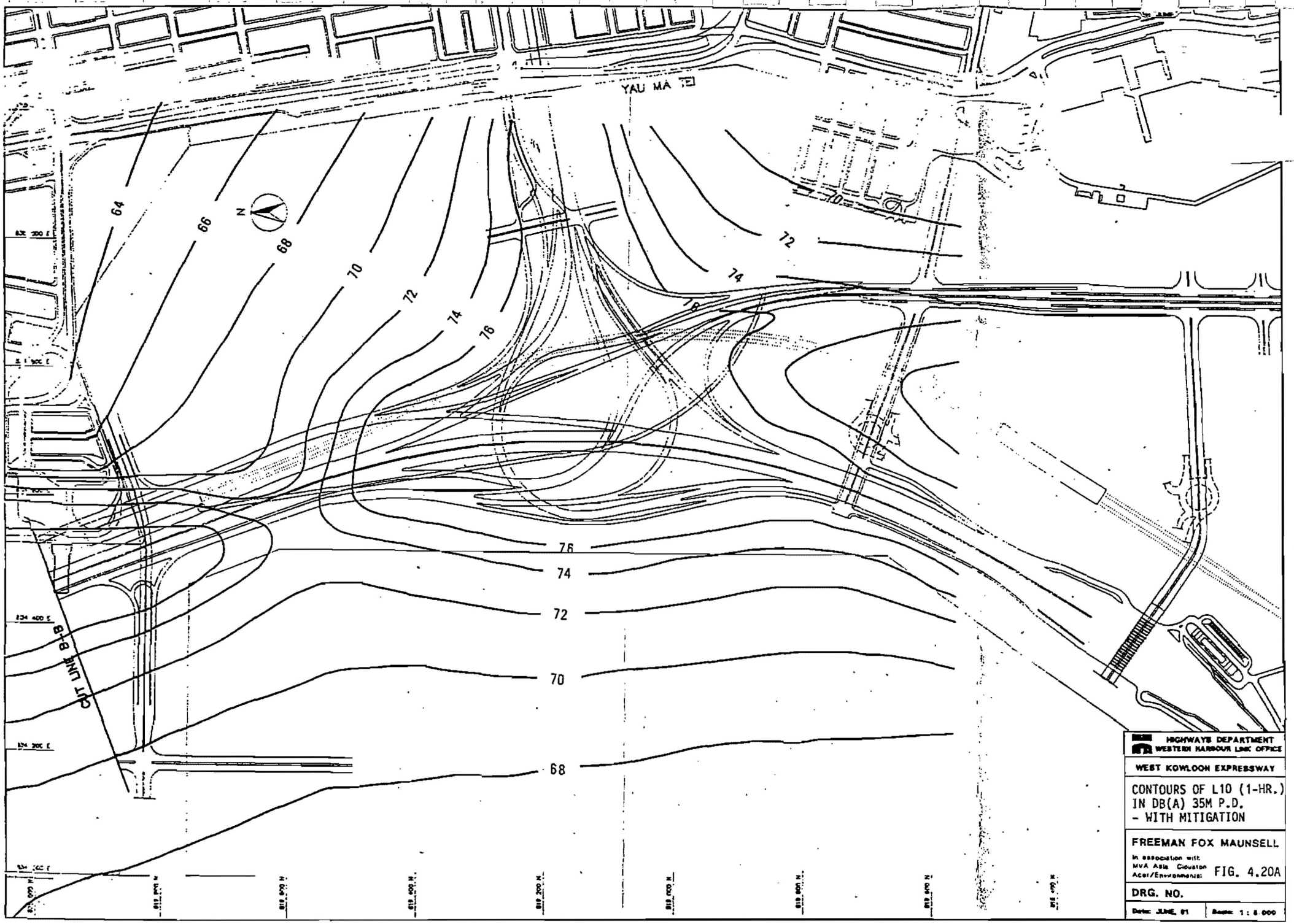
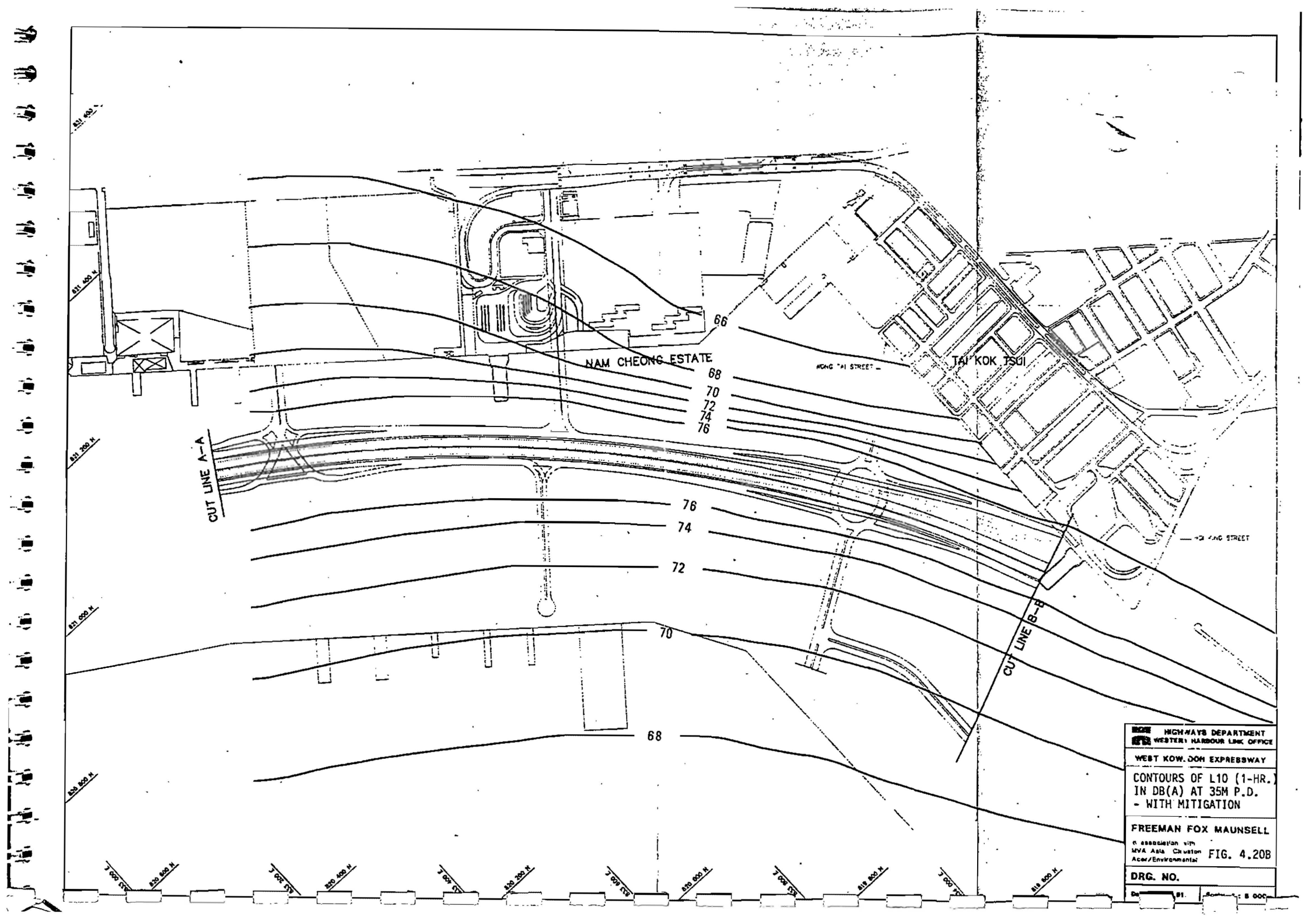
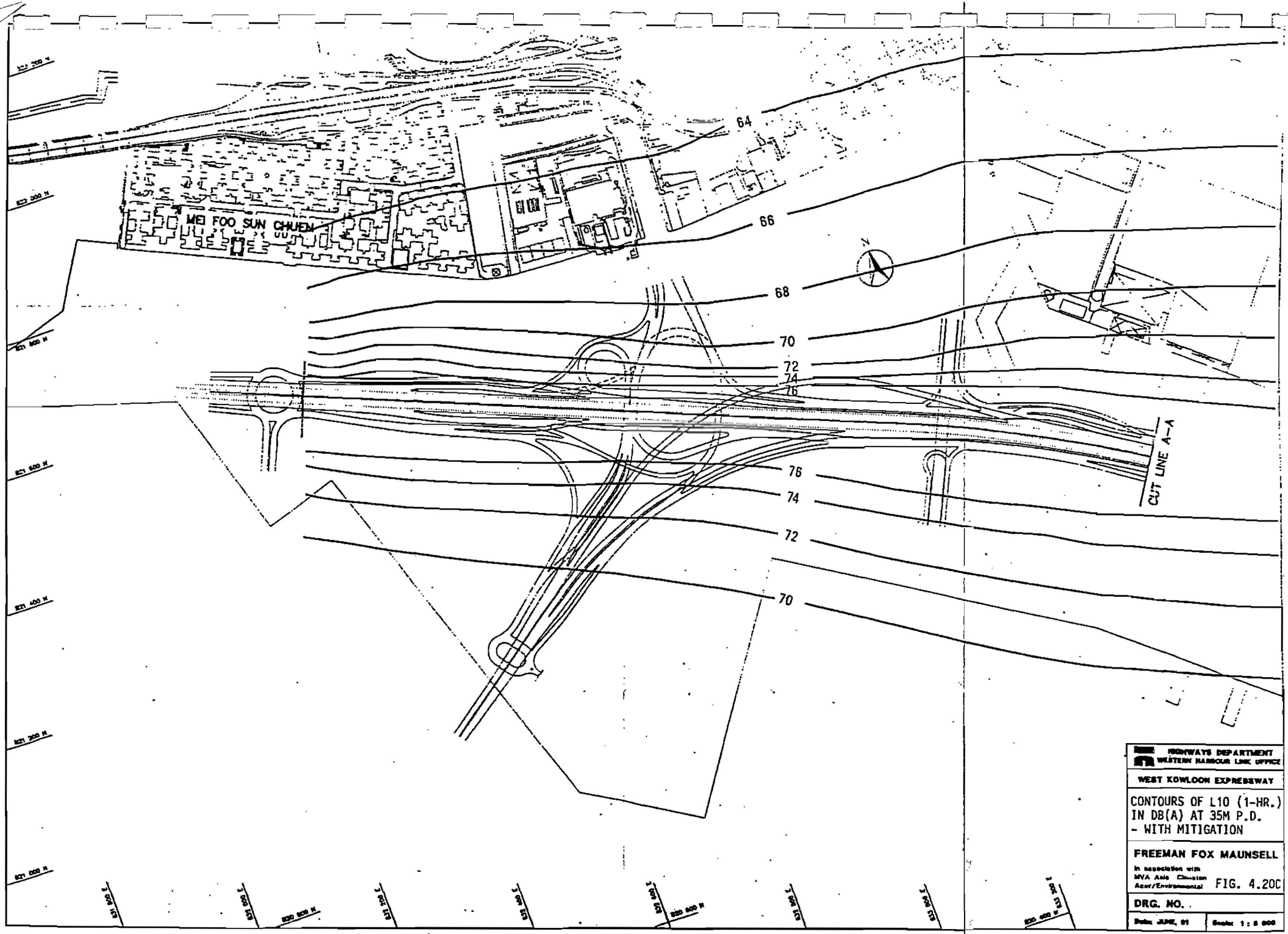

NOISE CONTOUR PLOT ON SECTION B-B (EAST)
- WITH MITIGATION
MPD
100
50
0
400 M
300
200
100
DISTANCE FROM ROAD EDGE
64
66
68
70
72
74
76

Fig. 4.17


MEI FOO SUN CHUEN
NOISE BARRIER TO BE EXTENDED INTO ROUTE 3-CRA1
A
A
CUT LINE A-A
N
822 200 N
822 000 N
821 800 N
821 600 N
821 400 N
821 200 N
821 000 N
820 800 N
820 600 N
820 400 N
NOISE BARRIER
3000
NOISE BARRIER
G.L.
A – A
1 : 300
LEGEND
3m HIGH NOISE BARRIER
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
RECOMMENDED MITIGATION OPTION AT MEI FOO
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental
FIG. 4.18
DRG. NO. WKE/FR/07/002
Date: JUNE, 91
Scale: 1 : 5,000


YAU MA TEI
64
66
68
70
72
74
76
78
72
74
76
74
72
70
68
CUT LINE 8-8
834 400 E
834 200 E
819 600 N
819 400 N
819 200 N
819 000 N
818 800 N
818 600 N
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF L10 (1-HR.) IN DB(A) 35M P.D. - WITH MITIGATION
FREEMAN FOX MAUNSELL
In association with:
MVA Asia Clouston Acer/Environmentis
FIG. 4.20A
DRG. NO.
Date: JUNE, 91
Scale: 1 : 5,000


NAM CHEONG ESTATE
TAI KOK TSUI
66
68
70
72
74
76
CUT LINE A–A
CUT LINE B–B
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF L10 (1-HR.) IN DB(A) AT 35M P.D. - WITH MITIGATION
FREEMAN FOX MAUNSELL
in association with MVA Asia Ltd/Weston Acer/Environmental
FIG. 4.20B
DRG. NO.



HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

WEST KOWLOON EXPRESSWAY

CONTOURS OF L10 (1-HR.) IN DB(A) AT 35M P.D. - WITH MITIGATION

FREEMAN FOX MAUNSELL

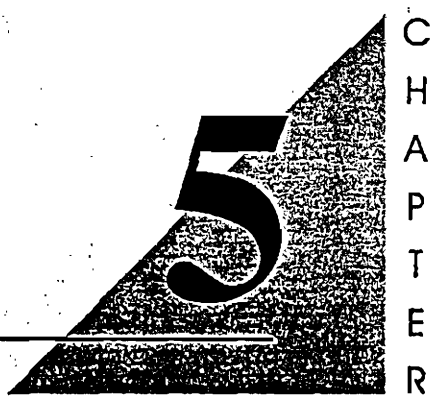
In association with
MVA Asia Division
Acer/Environmental

FIG. 4.20C

DRG. NO.

Date: JUNE, 91 | Scale: 1 : 5 000

Air Quality Impacts



5. AIR QUALITY IMPACTS

5.1 BACKGROUND

5.1.1 Gaseous and particulate pollutants will be emitted during both construction and operation of the WKE and these will have a detrimental effect on the air quality. This Chapter presents an assessment of the likely impacts on the air quality along the proposed alignment of the WKE during the construction and operational phases.

5.1.2 During the construction phase of the project, extensive earth-moving activities from north to south may cause dust nuisance to the sensitive receivers along the whole length of the route. However, worst-case situations which occur predominantly on dry and windy days in winters may be avoided because the WKE is aligned westward of the sensitive development in West Kowloon. As concluded in the Initial assessment - Working Paper 8 "Environmental", gaseous emissions during the construction phase are not expected to present air quality problems for the reclamation.

5.1.3 As discussed in the Working Paper, the key issue in the operational phase is the vehicle emissions from road traffic and these could reduce the air quality at certain road junctions and the heavily trafficked sections of the WKE. However, it is generally considered that for the open sections of the Expressway, air quality is unlikely to constrain the development in the adjacent land given the dominating effect of road traffic noise which has been discussed in Chapter 4.

Existing Air Quality

5.1.4 As the area under study is currently open sea, no baseline air quality data is available apart from those collected routinely at EPD's fixed-site air quality monitoring station in Sham Shui Po. Background air quality data are important not only as an indicator of the existing air quality of the area but as an input to certain air quality models, particularly for the calculation of nitrogen dioxide levels.

5.1.5 According to EPD's monitoring results at Sham Shui Po, the annual average concentrations of Nitrogen Oxide (NO) and Nitrogen Dioxide (NO2) in 1989 were 0.033 ppm and 0.025 ppm respectively. The level of NO_2 was within the Air Quality Objective (AQO) for annual average NO_2 concentration which is 0.043 ppm. There is currently no standard for NO.

5.2 CONSTRUCTION PHASE

Identification of Potential Dust sources

5.2.1 Substantial particulate emissions could arise from the following activities which are likely to be involved in the construction of WKE. Emission factors for these activities are based on "Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition, 1985. Detailed calculations of the emission factors and emission rates are given in Appendix D.

Excavation and Earthworks

5.2.2 Dust emissions are associated with pile cap construction for the elevated structures and earthworks for the at-grade sections, depressed sections and the interchanges. Both operations will involve ground excavation and backfilling. The amount of dust emitted will vary from day to day depending on the level of mechanical disturbance and the prevailing weather.

5.2.3 Pile cap construction will involve one excavator, one backhoe and one roller working around each foundation point from north to south. Earthworks for the Northern Section will involve two excavators, two backhoes, and two rollers working along the transport corridor from north to south. It has been proposed that twice as much equipment will be working for the slightly depressed section and at the Yau Ma Tei Interchange in the south. AP-42 quotes an approximate figure of 1.2 tons of dust emissions per acre of construction per month of activity, applicable to medium activity level, moderate silt content (30%) and semi-arid climate.

Concrete Batching

5.2.4 It is likely that a concrete batching plant will be used in each of the Works Areas near Mei Foo Sun Chuen and Yau Ma Tei Interchange (see Figure 2.1 for the proposed locations). Concrete batching will create fugitive dust from cement silos, aggregates stockpiles, cement and aggregate conveying, and during the transfer of pre-mixed concrete to the receiving hoppers of the transit mixing trucks if uncontrolled. The movement of concrete mixers over unpaved surfaces within the works area is also a significant source of fugitive dust. For an uncontrolled operation, the emission factor is about 0.12 kg/m^3 of concrete processed.

Aggregate Stockpiling

5.2.5 It is assumed that stockpiles of aggregate material will be kept within the two works area mentioned above. Stockpiling will involve adding aggregate material to a storage pile or removing it using front end loaders in a batch drop operation or using a conveyor stacker in a continuous drop operation. It has been estimated that the emission factors for Total Suspended Particulates (TSP) is 35g/Mg and Respirable Suspended Particulates (RSP) is 17 g/Mg of material transferred.

Truck Movements Over Unpaved Haul Roads

5.2.6 Trucks travelling on unpaved haul roads pulverize the surface material, causing dust plumes to trail behind. The quantity of dust emissions depends on the silt content of the roads, mean vehicle speeds, weights of vehicles and the volume of construction traffic.

In the construction of the Northern Section, it has been estimated that 120 vehicles per hour in both directions travel on Po Lun Street and 30 vehicles per hour in both directions on D5. There will also be 150 trips per hour on a haul road running north to south along the transport corridor.

For the construction of the Southern Section, it has been estimated that about 45 vehicles per hour in both directions will travel on Man Cheong Street extension and through area D7 in the reclamation area. There will also be about 170 trips per hour on a haul road running between work sites along the transport corridor.

Based on typical silt content, vehicle speed, and vehicle weight, etc., it has been estimated that the emission factors are 3800 g/veh-km for TSP and 1700 g/veh-km for RSP.

Assessment Methodology and Impact Assessment Criteria

Air Quality Models

5.2.7 Dust concentrations from stationary dust sources have been calculated using the ISC Short Term Gaussian Dispersion Model and those from unpaved haul roads have been calculated using the CALINE4 model.

5.2.8 Stationary dust sources have been modelled as square sources for which the ISC model requires as input the source strengths, the co-ordinates of their south-west corners and the widths of the squares.

5.2.9 Given the rate of dust generation, the impacts on the air quality at sensitive receivers will depend primarily on the settling rates of the particulate in air and the wind. Particles with sizes > 30um (i.e. greater than 30 microns) tend to settle out within a few metres of the sources under typical wind conditions because of greater rates of settling. Conversely, smaller particles have much slower rates of settling and therefore tend to be more affected by wind turbulence.

5.2.10 One category of particle size (0-30 microns) with a particle density of 2500 kg/m3 was assumed. According to the predictive equation in the User's Guide of ISC, the gravitational settlement velocity should be 2.7 cm/s and reflection coefficient 0.68.

5.2.11 Dust emissions from unpaved haul roads have been modelled using the CALINE4 model which is a line source model developed by the California Department of Transportation. The model uses given dust emissions from the unpaved haul roads, alignment of the haul roads and meteorology to predict the dust concentrations near the haul roads.

Meteorological Conditions

5.2.12 Meteorological conditions play an important role in the dispersion of the dust particles. Dry and windy conditions have the potential to enhance wind erosion. Typical worst-case meteorological conditions have been assumed and they are :

Wind speed : 2 m/s
Wind direction : worst-case wind direction
Stability class : D
Mixing height : 500m
Temperature : 25 degrees celsius
Standard Deviation of Horizontal : 20 degrees
Wind Direction Fluctuations (applicable to CALINE4 only)

5.2.13 In urban areas, surface wind varies considerably in direction. According to the USEPA's "Guideline of Air Quality Models (Revised)" (EPA-450/2-78-027R, 1986), the standard deviation of the horizontal wind direction fluctuations varies between 14 and 23 degrees for neutral stability with an aerodynamic surface roughness length of 3m which is typical of that in urban areas. Whilst no routine measurements of this parameter is available in Hong Kong, results of short-term horizontal wind measurements at specific sites, such as the two-week air quality measurements at Lai King Estate by the Route 3 Consultant and the meteorological studies at Junk Bay by the Royal Observatory ("Final Report of Meteorological Studies of the Junk Bay Air Shed") tend to agree with the USEPA's range and, in fact, suggest that this parameter seldom drops below about 20 degrees. The assumption of a 2m/s wind is considered to be appropriate since winds blowing below about 1m/s tend to be highly variable in direction and enhance dispersion of air pollutants.

5.2.14 The CALINE4 model takes into account wind meandering effect explicitly through the directional variability parameter but ISC does not. In practice, wind meandering effect is very common in Hong Kong because of the complex urban setting and the highly inhomogeneous surface roughness and thermal properties. Hence the ISC results should be viewed with caution.

Impact Assessment Criteria

5.2.15 For construction dust, the maximum acceptable TSP level in air over the period of 1 hour is 500 ug/m^3, according to the EPD guideline. There is currently no guideline for the hourly RSP during construction.

Impact Assessment

5.2.16 Table 5.1 presents the predicted dust concentrations in TSP levels at the worst-affected sensitive receivers along the waterfront in West Kowloon due to concrete batching and aggregate stockpiling within the two works areas. The land uses associated with these receivers have been described in Table 4.1 and the locations have been shown in Figure 4.1. As the emission factors of dust for excavation and earthworks are varied and uncertain, the predicted dust concentrations are unreliable, hence no prediction results have been presented here.

5.2.17 As shown in the Table, concrete batching could create dust nuisance at Mei Foo Sun Chuen, and residential buildings in Ferry Street and Man Cheong Street under worst-case winds if the batching operations are uncontrolled. On the other hand, aggregate stockpiling is unlikely to result in major dust impact.

5.2.18 Predicted dust concentrations from unpaved haul roads during the construction of the Northern Section and the Southern Section are shown in Table 5.2. These results show that the worst-case dust concentrations are very much higher than the acceptable level for construction dust.

5.2.19 Furthermore, the results show that the main contribution to the dust concentration at each identified receiver would be from the northern section. It should be noted that the dust concentrations for the northern and southern sections in Table 5.2 were obtained under different worst-case wind directions and therefore are not additive. However, based on the results obtained, it is unlikely that the combined contributions from both sections should be very different from the sole contribution of the northern section.

Table 5.1 Predicted Dust Concentrations in Air Due to Stationary Activities

SR*	Dust Conc. (ug/m^3)	
	Concrete Batching	Aggregate Stockpiling
MFSC	500	2
HWTI	300	1
FS	610	3
MCS	560	3

* The full names for these abbreviations of sensitive receivers (SR) are given in Table 4.1 and in a list of abbreviations at the front of this Volume.

Table 5.2 Predicted Dust Concentrations in Air Due to Unpaved Haul Roads

SR	TSP (mg/m^3)		RSP (mg/m^3)	
	Northern Section	Southern Section	Northern Section	Southern Section
MSFC	5.15	0.32	2.21	0.13
HWTI	3.96	0.52	1.69	0.22
FTS	7.47	0.91	3.30	0.39
NCE	7.13	1.65	3.06	0.71
WTS	8.53	4.72	3.67	2.02
HKS	7.72	5.67	3.31	2.43
CS	3.89	2.67	1.67	1.14
FS	2.69	3.10	1.15	1.33
MCS	1.94	6.58	0.83	2.82
KGV	1.51	3.37	0.65	1.44
CR	1.10	2.23	0.47	0.96

Evaluation of Mitigation Measures

5.2.20 As far as the existing sensitive receivers along the route are concerned, the worst-case wind directions are likely to be south-easterlies through south-westerlies. In Hong Kong, easterly winds blow over 75% of the time in a year so that Mei Foo Sun Chuen could be in a downwind position over a substantial period of the construction. Dry and windy days which occur more often in winters when the prevailing winds are northerlies may have less detrimental effect on the receivers since the WKE is aligned westward of the sensitive development in West Kowloon.

5.2.21 Notwithstanding this, mitigation measures are considered necessary for concrete batching and truck movements on haul roads. Under the Air Pollution Control Ordinance, concrete batching is classified as a specified process and is controlled by the EPD if the cement silo capacity exceeds 10,000 tonnes. In any case, for good site practice dust control measures should be implemented as far as is practicable.

The best practical means to control dust emissions from batching plants is to store the cement in closed silos fitted with a fabric filter and all conveyor belts and transfer points should be covered. The surface within the works areas should be paved and frequently watered. Vehicles leaving the works areas should be wheel-washed. It has been estimated that with proper control measures, as much as 90% dust reduction can be achieved.

This should bring the fugitive dust levels at Mei Foo Sun Chuen and the residential buildings in Ferry Street and Man Cheong Street down to an acceptable level even if worst-case meteorological conditions occur.

5.2.22 Haul road emissions can be controlled by hard-surfacing all haul roads and keeping the surface clean with frequent water spraying. Vehicle speeds should be limited to a maximum of 15 km/hr. Wheel-washing should be provided for all vehicles leaving the works site. Materials having the potential to create dust should not be loaded to a level higher than the side and tail boards of the vehicles and should be dampened and covered. A control efficiency better than 90% is required to reduce the dust levels at residential buildings in Wong Tai Street and Hoi King Street to an acceptable level under worst-case meteorological conditions.

The dust control and mitigation measures discussed above as well as simple control measures such as covering or wetting of material stockpiles should be incorporated into the construction contracts wherever appropriate and practicable.

Compliance Monitoring

5.2.23 Dust levels at the worst-affected sensitive locations along the proposed alignment should be monitored at regular intervals such as once every six days to check for compliance of the dust level with the established standard and the effectiveness of dust control measures adopted. A dust monitoring programme should be developed and this should include sampling prior to the construction in order to establish the baseline dust level.

5.2.24 High volume sampling methods should be used and the parameters measured should include TSP and RSP in air over periods of 24 hours.

5.2.25 Suitable locations for monitoring are Mei Foo Sun Chuen, Fat Tseung Street THA, and some of the residential buildings in Ferry Street, Wong Tai Street, and Man Cheong Street.

5.2.26 An action plan should be developed by the Contractor. This should include actions to be taken if the dust standard is exceeded.

Regular checking that suitable dust control and suppression measures are being carried out by the Contractor should be made by the Resident Site Engineer.

5.3 OPERATIONAL PHASE

Assessment Methodology and Impact Assessment Criteria

Air Quality Model

5.3.1 The main source of air pollution during the operational phase of the WKE will be vehicle emissions. Principal components include carbon monoxide (CO), nitrogen oxides (NOx), lead, hydrocarbon and particulate. Gasoline-powered motor vehicles contribute more carbon monoxide and lead, while diesel-powered heavy vehicles contribute more nitrogen oxides and particulate. The Air Quality Objectives (AQO) stipulate maximum acceptable concentrations of some of these pollutants in air.

5.3.2 The traffic-related air pollutant concentrations have been calculated using the CALINE4 model described above. Unlike the earlier versions, CALINE4 has a NO_2 option which allows direct prediction of NO_2 using a NOx emission factor. The method of calculation is the discrete parcel method which assumes that initial tailpipes NOx emission are 92.5% NO and 7.5% NO_2 by mass. As such, no assumption about the conversion efficiency of NO to NO_2 is required. On the other hand, additional input about the background concentrations of NO, NO_2, and O_3 is required to model the reactions between these gases and as a result, the predicted NO_2 concentrations are sensitive to the ambient concentrations adopted. Unlike the calculation for a non-reactive species such as CO, ambient concentrations cannot simply be added to the modelled results as an incremental element.
As will be clear from the discussion below, site specific ambient pollutant concentrations of O_3 and other pollutants in 2011 are unavailable for calculating the NO_2 concentrations using CALINE4. (It has been agreed with the EPD that a conservative method should be used for the calculations. This is to assume that NO_2 behaves as an inert gas and therefore may be calculated like CO using the CALINE4 model and the emission factors of NOx. It further assumes that 20% of the emitted NOx from the vehicles will be converted to NO_2 at some distances from the sources.)

Ambient Pollutant Concentrations

5.3.3 Ambient pollutant concentrations for the study area have been adopted from three sources since the study area is currently open sea. For NO and NO_2, the annual average concentrations measured in 1989 at EPD's station in Sham Shui Po have been adopted as the best estimates of the background levels of these two pollutants in the study area. In addition, the O_3 measurements at EPD's Central Western station in 1989 has also been adopted. Ambient CO data is unavailable from EPD's fixed site monitoring stations and for the purpose of this study has been obtained from a 6-week baseline air quality measurement in the Mid-Levels in early 1988. No attempt has been made to project the background concentrations for 2011 because of the uncertainty in the projection methodology. Table 5.3 summarizes the ambient concentrations adopted.

Table 5.3 Ambient Pollutant Concentrations

Pollutant	Concentration (ppm)
NO	0.033
NO_2	0.025
O_3	0.076
CO	0.51

Meteorological Conditions

5.3.4 Similar worst-case meteorological conditions as for the construction dust calculation have been assumed. In particular, the same assumption about the directional variability of the wind has been used.

Emission Factors

5.3.5 Impacts from vehicle emissions will depend primarily on the rates of emission of the above air pollutants, the traffic volumes, the dispersion potential of the air and the wind. By 2011, it is likely that because of more stringent emission control on new and old gasoline vehicles, the rates of emission of certain pollutants such as lead, carbon monoxide and nitrogen oxides will be much reduced. For example, the introduction of cheaper unleaded petrol for gasoline-powered vehicles on 1 April 1991 has encouraged users to switch to unleaded petrol which contains no more than 0.013 gram of lead per litre of petrol. Also, catalytic converters which reduce CO, NOx and Hydrocarbon emissions by 80-90% will be required to be installed on all new imported cars in order to comply with the stringent emission standards by 1 January 1992.

5.3.6 However, old cars are generally not fitted for the installation of catalytic converters. The Government has estimated that only by 1999 will existing old cars be phased out and the overall emissions from gasoline vehicles be reduced by 50%. Also, unleaded petrol and catalytic converters cannot be applied to diesel vehicles which account for some 65% of the vehicle population in Hong Kong.

5.3.7 A composite emission factor for each air pollutant to be calculated must be provided for each CALINE4 link. It is defined as an average exhaust emission factor weighted by vehicle mix, vehicle speed, operating mode, age and the percentage of cold vehicle operations on the link. The operating mode includes acceleration, deceleration, cruise, and idle modes of operation and each will result in a different rate of emission. Start-up operations, particularly from cold, will result in excessive emissions. On the Expressway and the Road P1, it can be assumed that all vehicles are cruising in a hot stabilized engine condition.

5.3.8 In general, CO emissions decrease with increasing vehicle speed, while NOx emissions increase with an increase in speed. Also, gasoline vehicles emits more CO while heavy diesel vehicles emit more NOx on a vehicle-mile basis. Table 5.4 gives the estimated vehicle mix on different sections of the alignment in 2011 for the purpose of emission factor calculations. It should be noted that this traffic mix is different from that for noise calculations because of different definitions for heavy vehicles (see notes in Table 5.4). Anticipated vehicle speeds on different roads have been presented in Table 4.8.

Table 5.4 Composition of Traffic in Percentage for Air Quality Assessment

Vehicle Type*	WKE	P1 Mei Foo	Nam Cheong	Tai Kok Tsui
Motor Cycle	3	3	3	3
Car/Taxi	60	35	63	63
Light Duty	20	22	19	19
Heavy Duty	17	40	15	15

* Light-duty trucks are any motor vehicles rated at 3,856 kg GVW or less.
Heavy-duty vehicles are any motor vehicles rated at 3,856 kg GVW or more.

5.3.9 The calculation of composite exhaust emission factors is based on the "Compilation of Air Pollutant Emission Factors", (AP-42, Third Edition, 1977) for model year 1972 vehicles in the U.S.A. No corrections have been made for the age of vehicles as no statistics on the distribution of model years are available for the estimation.

5.3.10 According to the AP-42, light duty diesel vehicles such as taxi, PLB, emit very little CO and NOx compared with other categories of vehicles. As a worst-case situation, all vehicles are classified as automobiles in the calculation of emission factors apart from heavy-duty vehicles which are taken to be all heavy diesel. In view of the current and future vehicle emission control and the high percentage of light duty diesel vehicles in Hong Kong, the adoption of these emission factors and worst-case meteorological conditions should result in a worst-case scenario for the air quality in the vicinity of the WKE. Composite emission factors for automobiles and heavy-duty trucks as a function of vehicle speeds are given in Appendix E.

Impact Assessment

5.3.11 Figure 5.1 shows the contours of the worst-case hourly CO concentrations at ground level along the whole length of the WKE due to vehicle emissions. The background concentration of CO has not been included in the contours, but this could be added on later with a better estimation of the background concentration in 2011. As the CALINE4 iteratively selected the worst case wind direction and therefore the highest concentration for each receiver point, the contours do not necessarily represent the results under the same meteorological conditions.

5.3.12 Local air quality is likely to be reduced within the Yau Ma Tei Interchange because of the close proximity to the sources and lower vehicle speeds near the interchange. Slightly higher concentrations have also been predicted on the west side of the section between Prince Edward Road Roundabout and Yen Chow Street extension because of the road geometry.

5.3.13 In any event, CO levels are unlikely to impose a constraint on land use development on WKR since the predicted concentrations are no higher than about 9,000 ug/m^3 outside the road edges and no higher than about 12,000 ug/m^3 within the Yau Ma Tei Interchange whereas the AQO for hourly CO concentration is 30,000 ug/m^3.

5.3.14 A similar plot of the predicted hourly NO_2 concentrations under worst-case situations at ground level is given in Figure 5.2. This plot shows that the AQO for hourly NO2 which is 300 ug/m^3 may be exceeded near the road edges and at the boundary of the development site at Yau Ma Tei. The impact can be visualized by the displacement of the 30 contour line from the road edge. Concentrations of NO2 can be expected to exceed the AQO within 40m of the road edge on the east side and 50m of the road edge on the west side of the alignment between Cherry Street and Mei Foo because of the road geometry. The use of this land for sitting-out areas, active playgrounds and similar uses should be avoided.

5.3.15 It can be argued that close to the carriageway, vehicle emissions are rapidly dispersed by the trailing wake of each vehicle. Further initial dispersion occurs through the action of turbulence generated by other passing vehicles. This effect is implicit in the calculations and in fact CALINE4 treats the region directly over the highway and extending 3m from the edge of carriageway as a zone of uniform emissions and turbulence.

5.3.16 On the other hand, the effect by enclosing a short section of the slightly depressed Expressway and Road P1 southbound between Yau Ma Tei Interchange and Cherry Street and the southbound carriageway of the elevated Expressway between Cherry Street and Boundary Street/Prince Edward Road roundabout near Tai Kok Tsui on noise grounds (see Figures 4.13 and 4.15 for locations) has not been taken into account in the calculations. This is mainly because there is as yet no acceptable and well-proven air quality model for estimating the effect from a short tunnel. However, it is envisaged that any detrimental effect should only be apparent within the immediate vicinity of the portal because of the length of the enclosure under consideration. Certainly, the AQO for CO should not be threatened by the additional emissions from the tunnel portals.

5.3.17 The variations of CO and NO_2 concentrations with height at the planned and existing sensitive receivers along the alignment are shown in Figures 5.3-5.6. In general, the concentrations decrease with height. At Yau Ma Tei, no exceedance of the AQO with respect to both pollutants is predicted at all heights at the south-western corner of the development site and 30m inward from the site boundary. Similarly, no exceedance of the AQO in respect of both pollutants is predicted at all heights at the existing residential development at Tai Kok Tsui, Nam Cheong Estate and Mei Foo Sun Chuen.

5.3.18 Lead pollution has not been a major problem in Hong Kong although some local studies do indicate higher lead levels in the blood and teeth of school children being educated close to major roadways. With the introduction of unleaded petrol, it is unlikely that lead will be of concern. Also, particulate emissions from vehicles are not considered to cause a major problem.

Evaluation of Mitigation Measures

5.3.19 Traffic-related air pollution can only be tackled effectively at source. Alignment geometry could have some effect on the roadside pollutant concentrations. Although the air quality prediction does not indicate any exceedance of the AQO except within short distances of the road edges, long term commitment by the Government to progressively reduce vehicle emissions is strongly supported.

Post-project Auditing

5.3.20 Regular monitoring of the air pollutant levels in Sham Shui Po by the EPD should be continued to provide ambient NO and NO_2 data in the area. It is recommended further that ambient CO level should be included as part of the monitoring programme at the station to reflect the change in the CO level after the operation of the major transport link in West Kowloon. As the major source of CO is from vehicles, CO data from the station could provide an indication as to whether further vehicle emissions control are warranted.

5.3.21 It is understood that the station is far from the Expressway and the monitoring results may only represent the general air quality of that area. However, the setting up of a new air quality monitoring station for the purpose of post-project monitoring the emissions from WKE will involve a major commitment of the Government.

5.4 SUMMARY OF KEY ISSUES

Construction Phase

5.4.1 Concrete batching and truck movements on unpaved haul roads have been predicted to have the potential to cause dust nuisance at some of the sensitive receivers along the whole route of the WKE if the operations are uncontrolled. Mei Foo Sun Chuen could be in a downwind position over a substantial period of the construction although the detrimental effect of dry and windy days could be largely avoided because of the alignment of the WKE relative to the sensitive receivers on the existing waterfront of West Kowloon.

5.4.2 Notwithstanding this, practical dust control measures have been recommended to reduce dust emissions to the air. Also, a dust monitoring programme has been recommended to check for compliance with the established dust standard and the effectiveness of the dust control measures adopted.

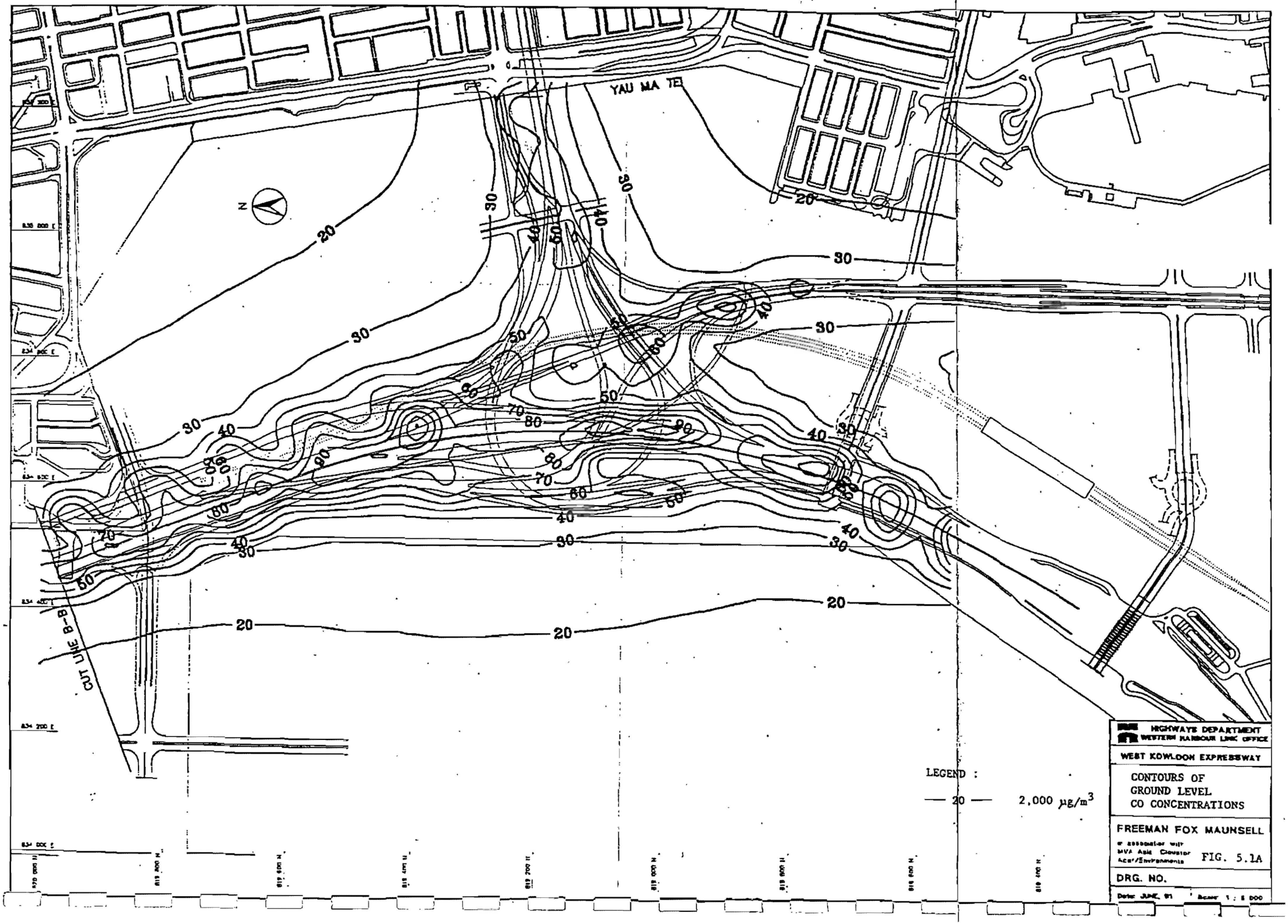
Operational Phase

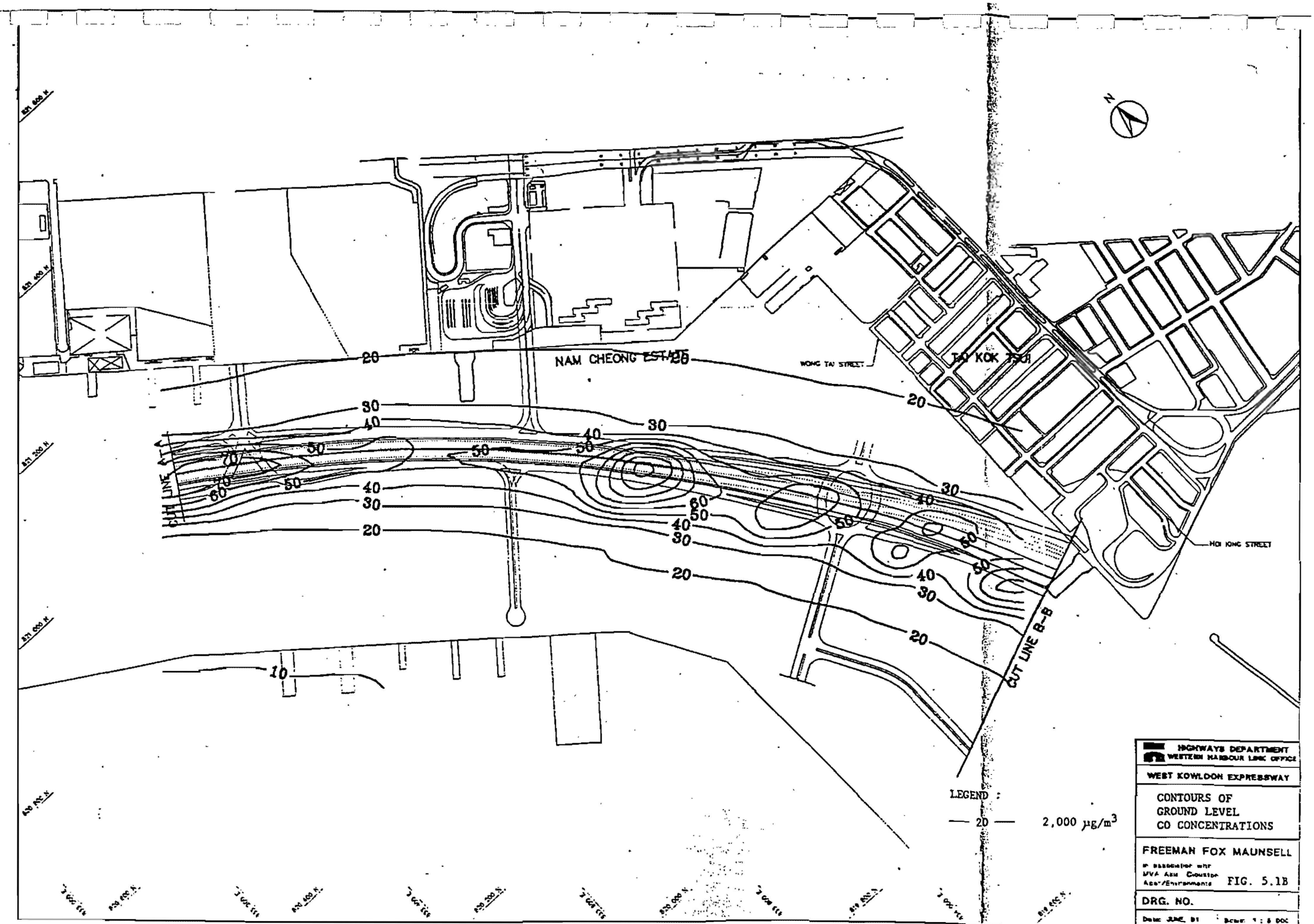
5.4.3 Future vehicle emissions are unlikely to result in major impact on the air quality. In view of the dominating effect of noise, it is unlikely that air quality will impose a constraint on land use development on WKR. However, it has been predicted that within 40-50m either side of the road edge, and within the Yau Ma Tei Interchange, the NO_2 concentrations may exceed the AQO. Sitting-out areas, active playgrounds and similar uses of the land within this region should be avoided.

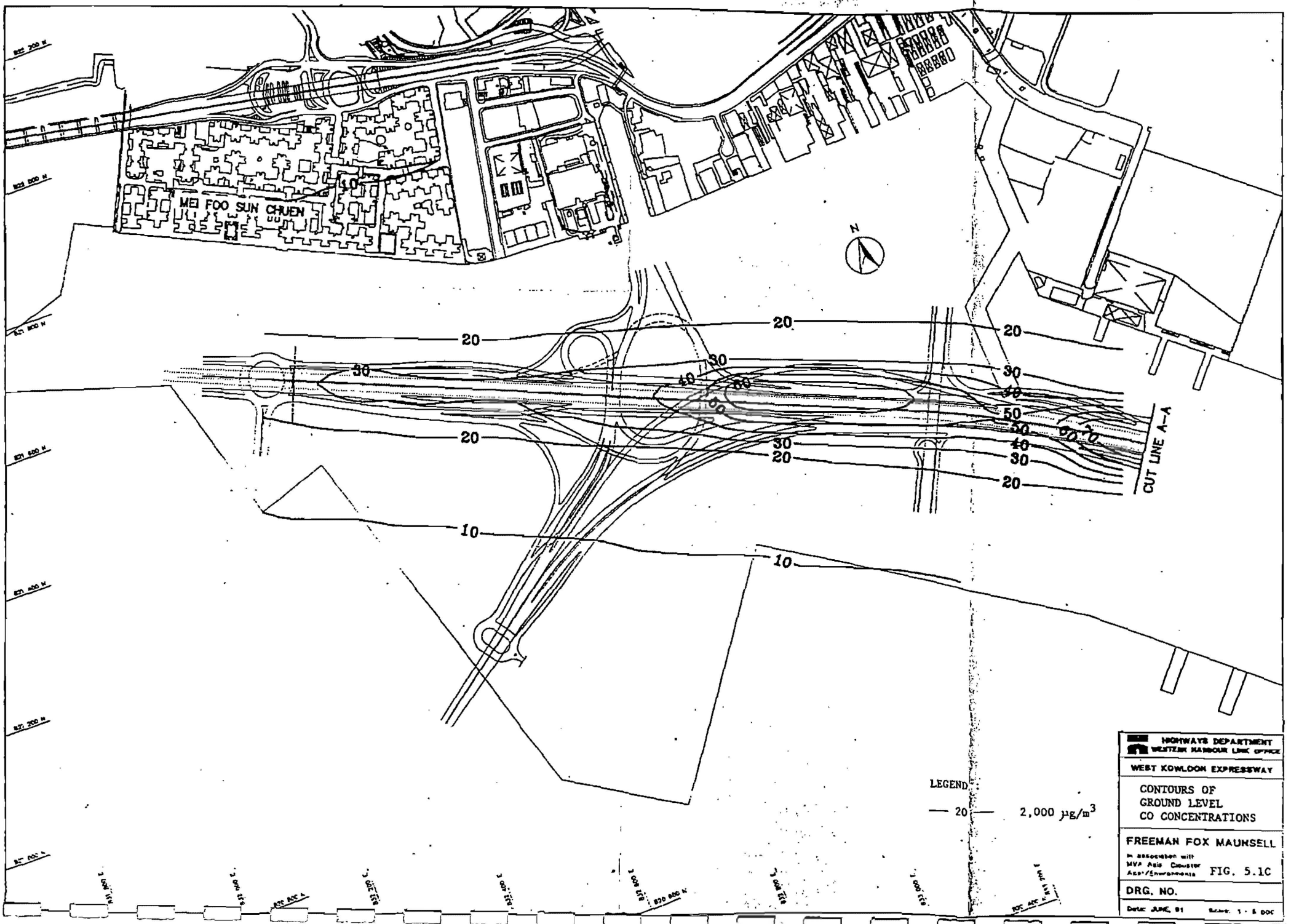
5.4.4 The effect of enclosing short sections of the Expressway and Road P1 has not been considered because of the unavailability of a well-proven air quality model for the calculation. However, it is envisaged that any detrimental effect on the air quality should only be apparent in the immediate vicinity of the tunnel portals. No sensitive development should be planned near tunnel portals as a good environmental planning guideline.

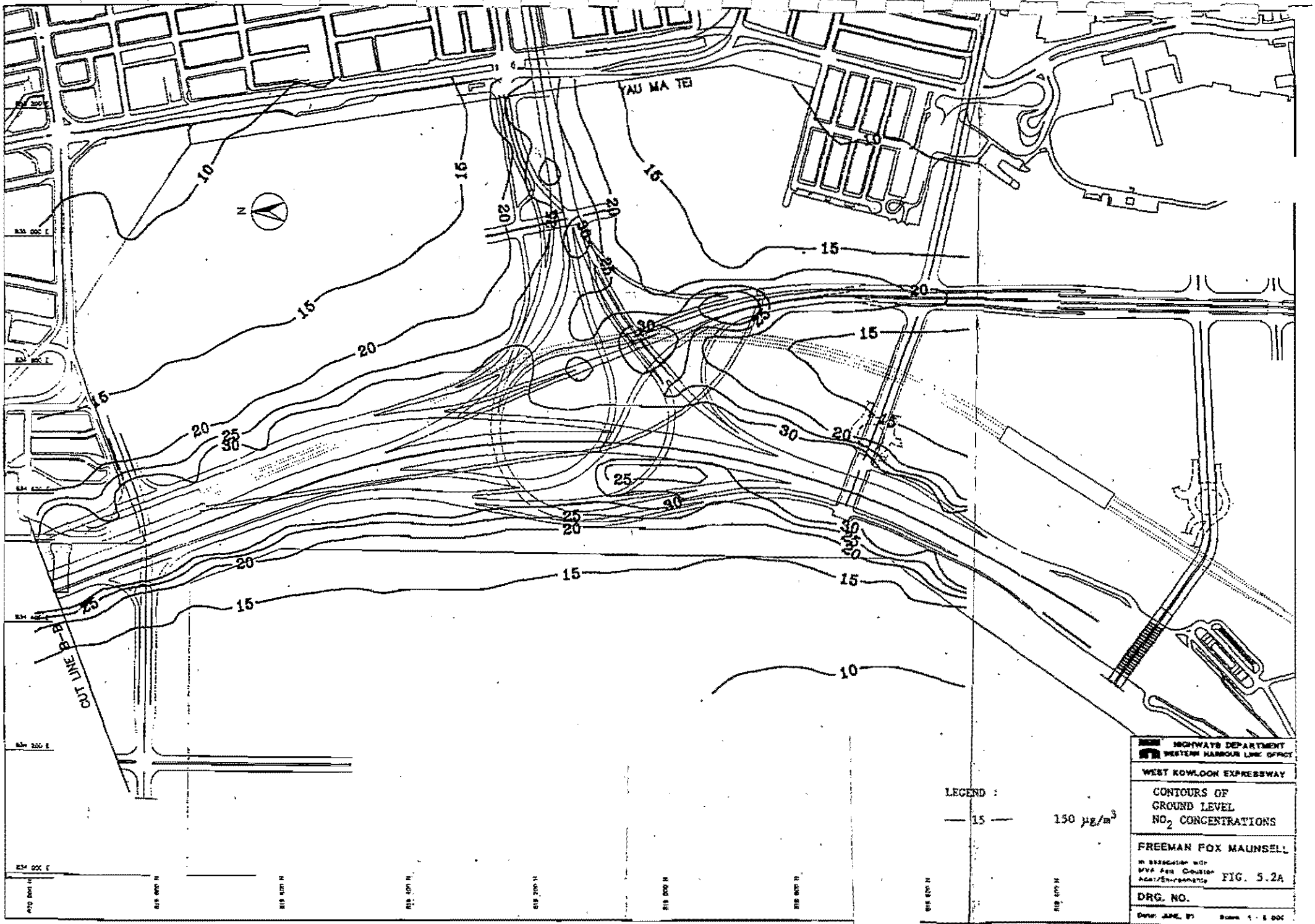
5.4.5 Air quality generally improves with an increase in height along the Expressway. Air pollutant concentrations have been predicted to be higher at ground level than at upper levels.

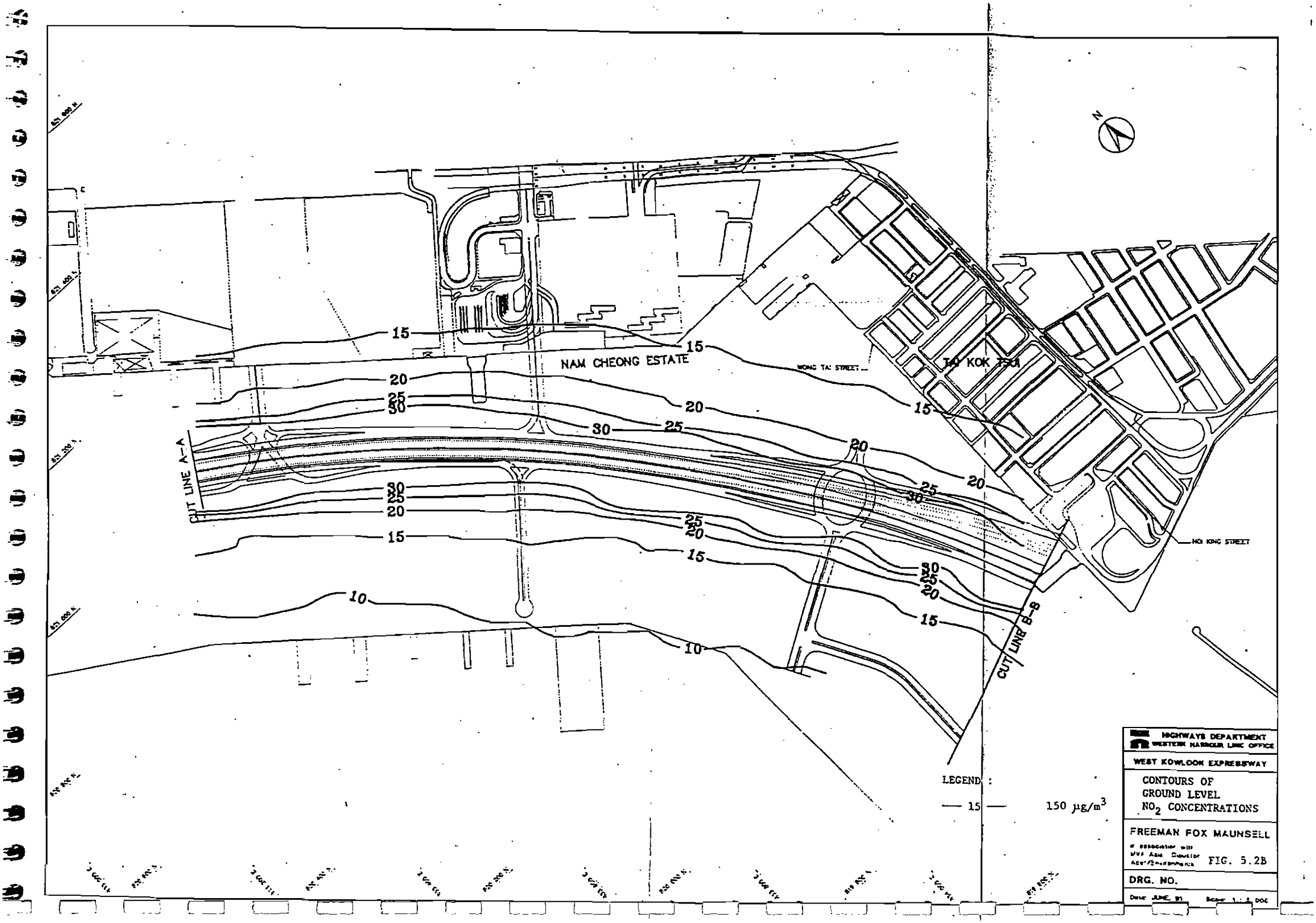
5.4.6 Efforts by the Government to progressively reduce vehicle emissions are strongly supported, although the study does not indicate any substantial exceedance of the Air Quality Objectives under worst-case scenarios.

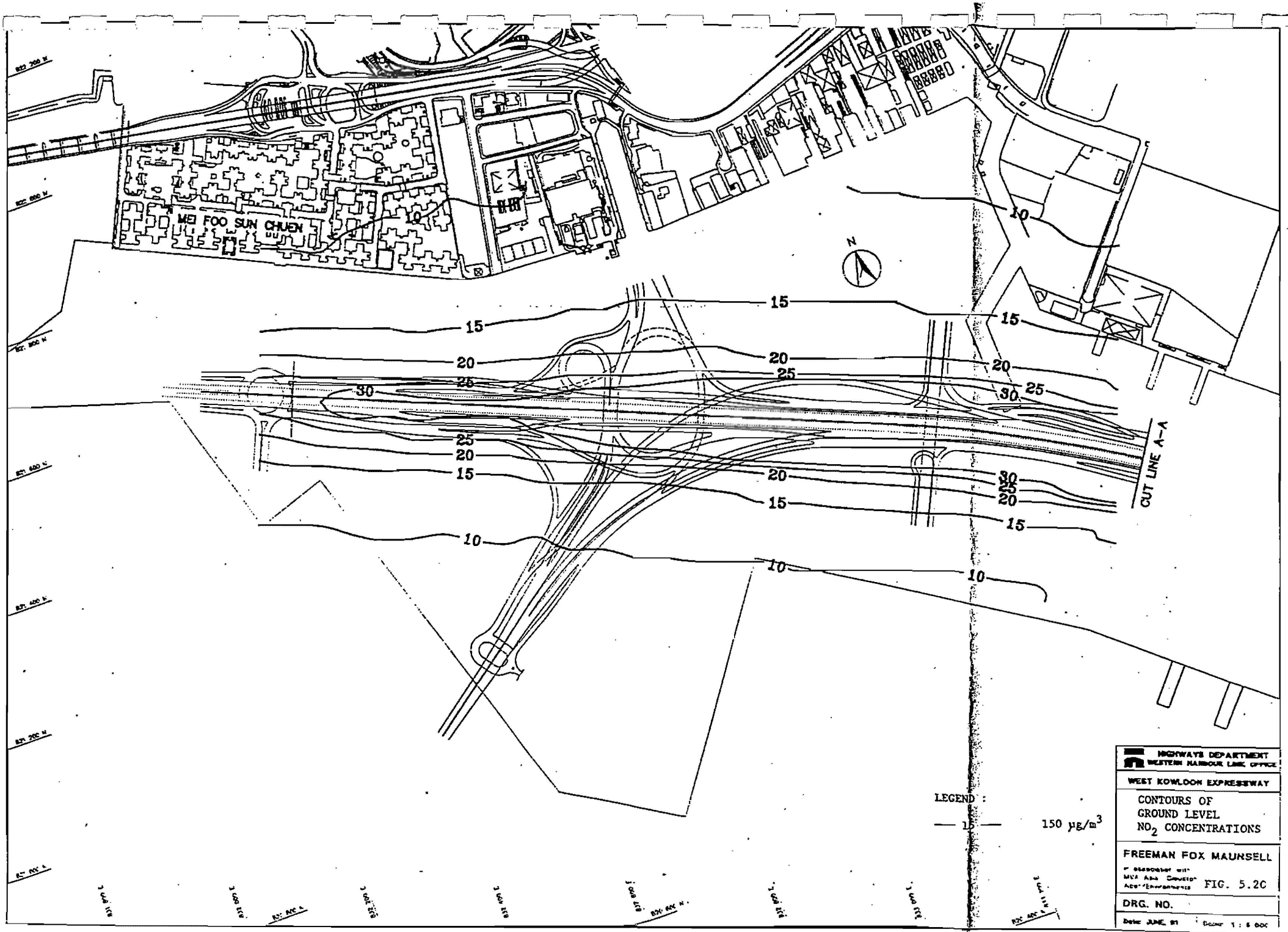

YAU MA TEI
CUT LINE B-B
LEGEND :
20 2,000 µg/m3
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF
GROUND LEVEL
CO CONCENTRATIONS
FREEMAN FOX MAUNSELL
FIG. 5.1A
DRG. NO.


NAM CHEONG ESTATE
WONG TAI STREET
TAI KOK TSUI
HOI KONG STREET
CUT LINE A-A
CUT LINE B-B
10
20
30
40
50
60
70
LEGEND :
— 20 — 2,000 μg/m3
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF
GROUND LEVEL
CO CONCENTRATIONS
FREEMAN FOX MAUNSELL
FIG. 5.1B
DRG. NO.


MEI FOO SUN CHUEN
N
20
30
40
50
60
10
CUT LINE A-A
LEGEND
20 2,000 µg/m³
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF
GROUND LEVEL
CO CONCENTRATIONS
FREEMAN FOX MAUNSELL
In association with
MVA Asia Consultor
Asst/Environmenta
FIG. 5.1C
DRG. NO.
Date: JUNE, 91


LAU MA TEI
CUT LINE B-B
LEGEND :
15 150 μg/m³
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF GROUND LEVEL NO_2 CONCENTRATIONS
FREEMAN FOX MAUNSELL
FIG. 5.2A
DRG. NO.


NAM CHEONG ESTATE
WONG TAI STREET
TAI KOK TSUI
HOI KONG STREET
CUT LINE A-A
CUT LINE B-B
15
20
25
30
10
N
LEGEND :
— 15 — 150 μg/m³
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF
GROUND LEVEL
NO2 CONCENTRATIONS
FREEMAN FOX MAUNSELL
FIG. 5.2B
DRG. NO.


MEI FOO SUN CHUEN
10
15
20
25
30
N
CUT LINE A-A
LEGEND :
15
150 μg/m³
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
CONTOURS OF
GROUND LEVEL
NO_2 CONCENTRATIONS
FREEMAN FOX MAUNSELL
FIG. 5.20
DRG. NO.
Date: JUNE, 91
Scale: 1 : 5 000

Carbon Monoxide and Nitrogen Dioxide concentrations at Yau Ma Tei

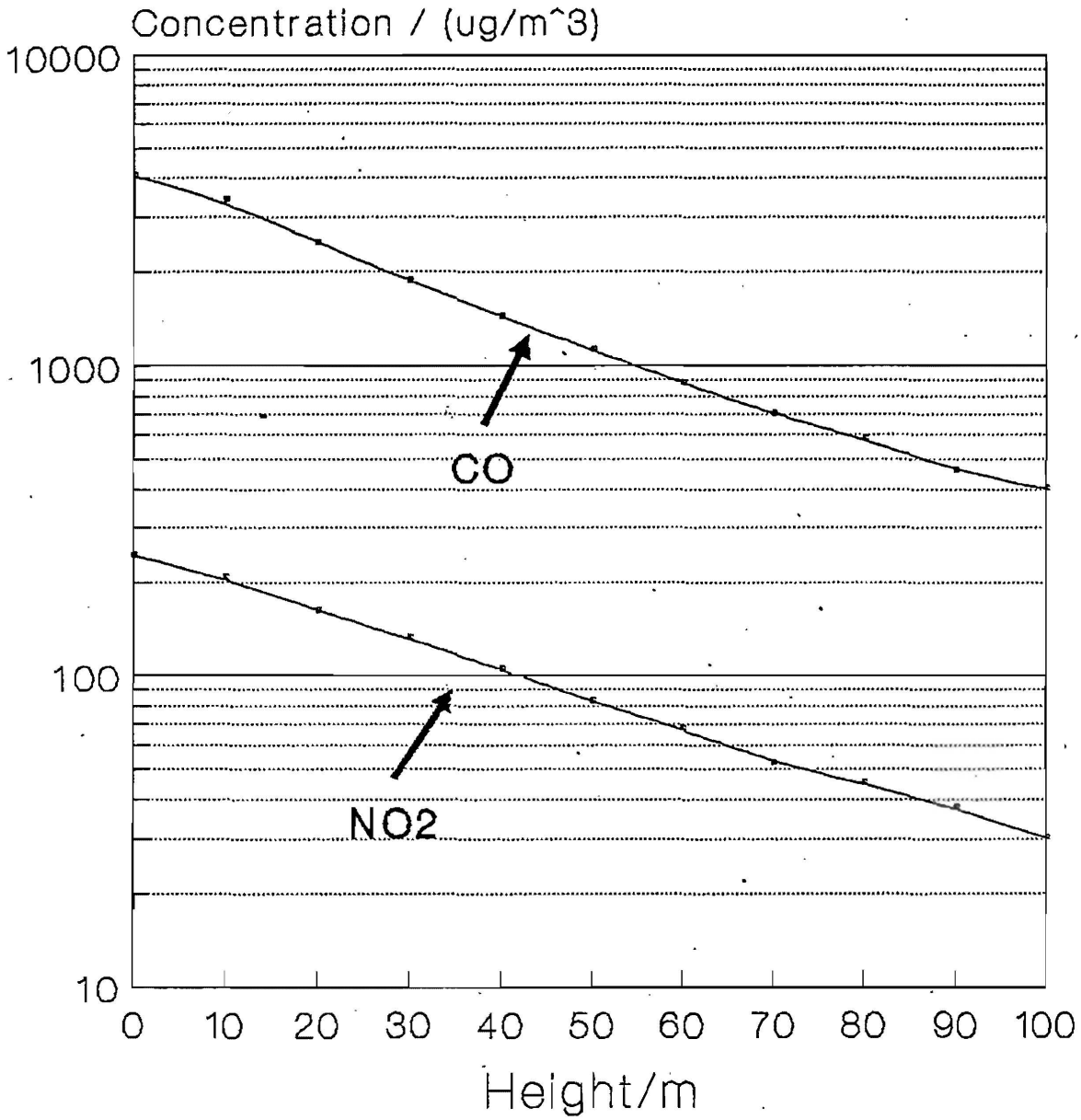


Fig. 5.3

Carbon Monoxide and Nitrogen Dioxide concentrations at Tai Kok Tsui

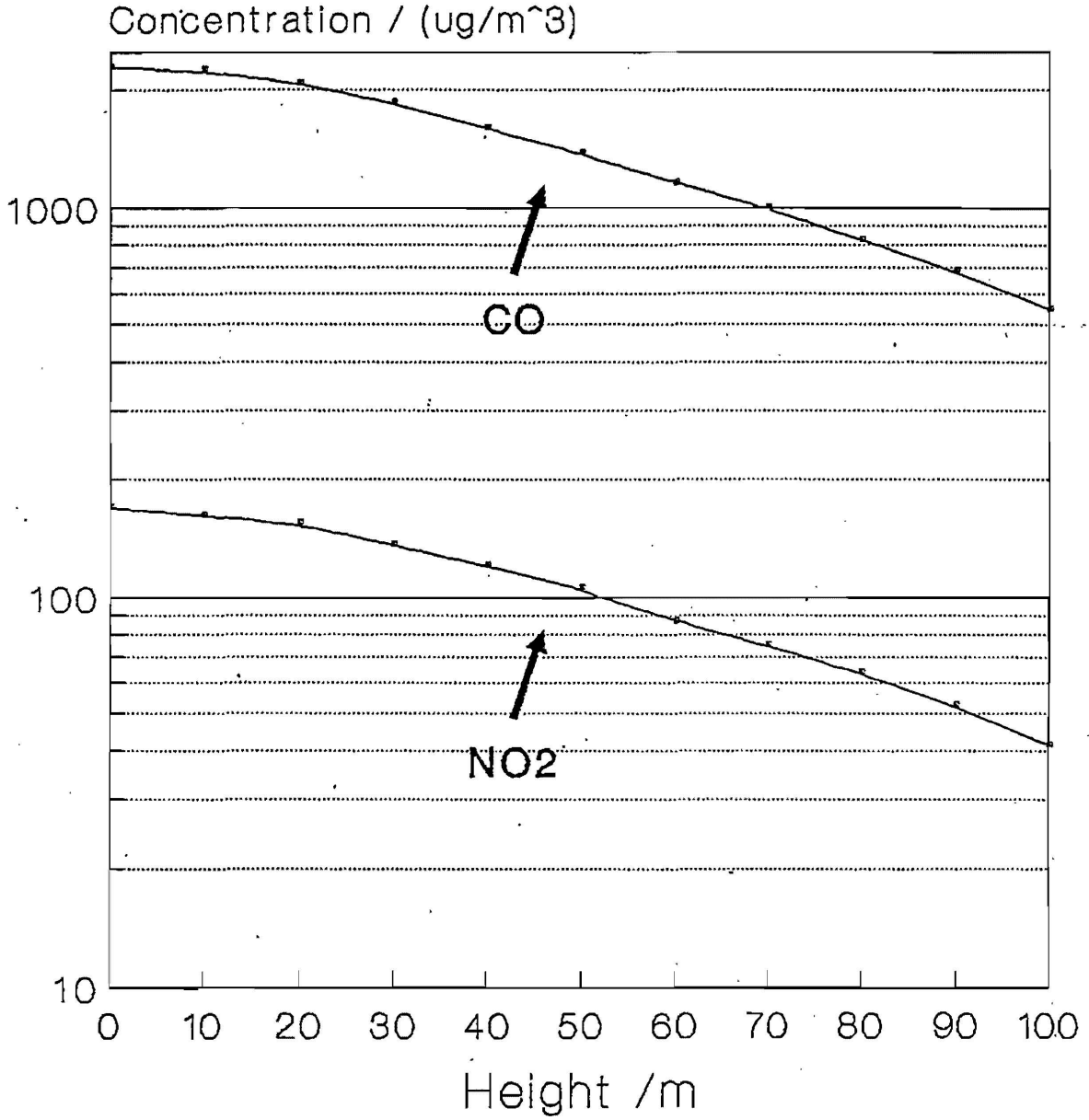


Fig. 5.4

Carbon Monoxide and Nitrogen Dioxide concentrations at Nam Cheong

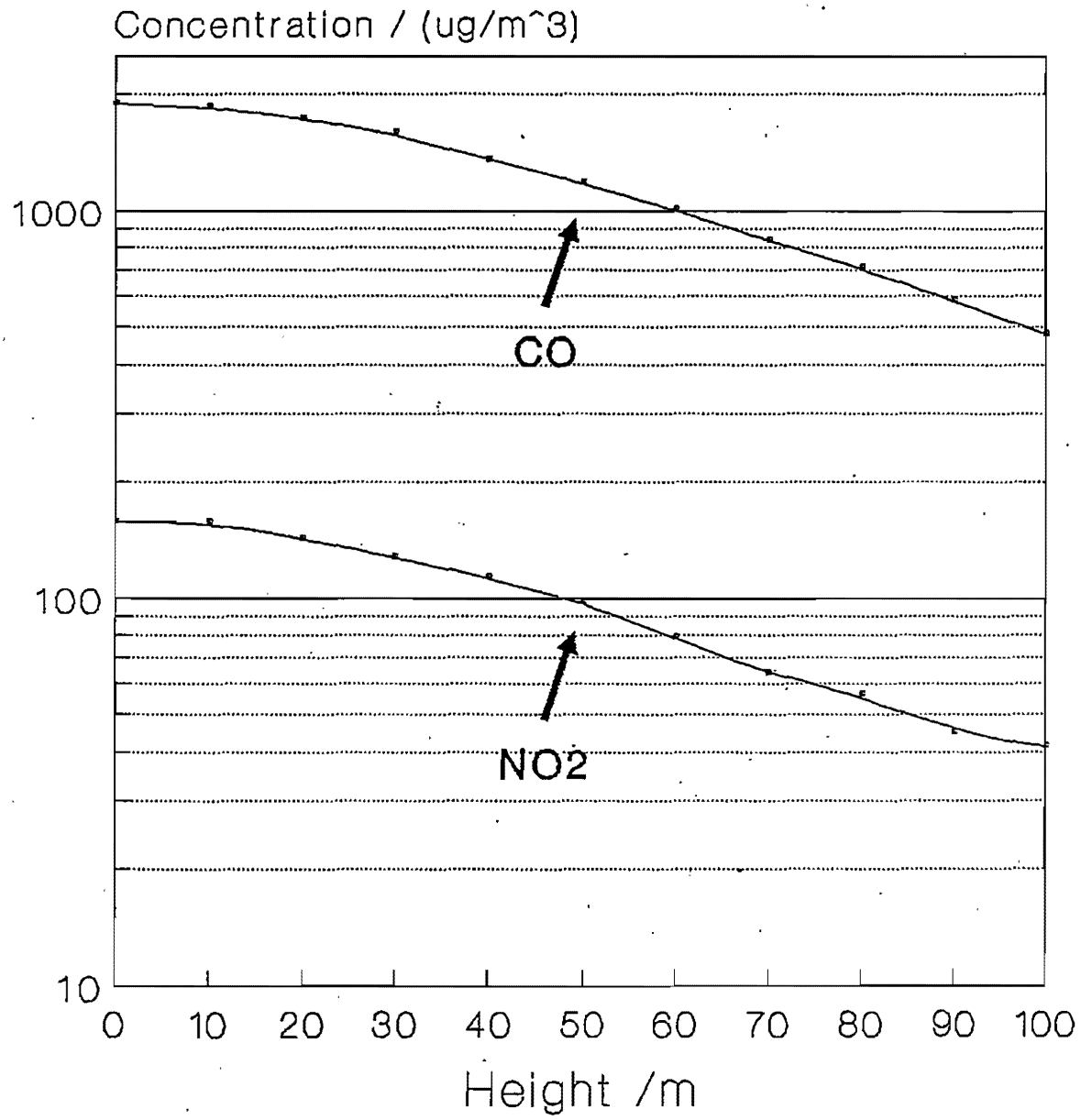


Fig. 5.5

Carbon Monoxide and Nitrogen Dioxide concentrations at Mei Foo

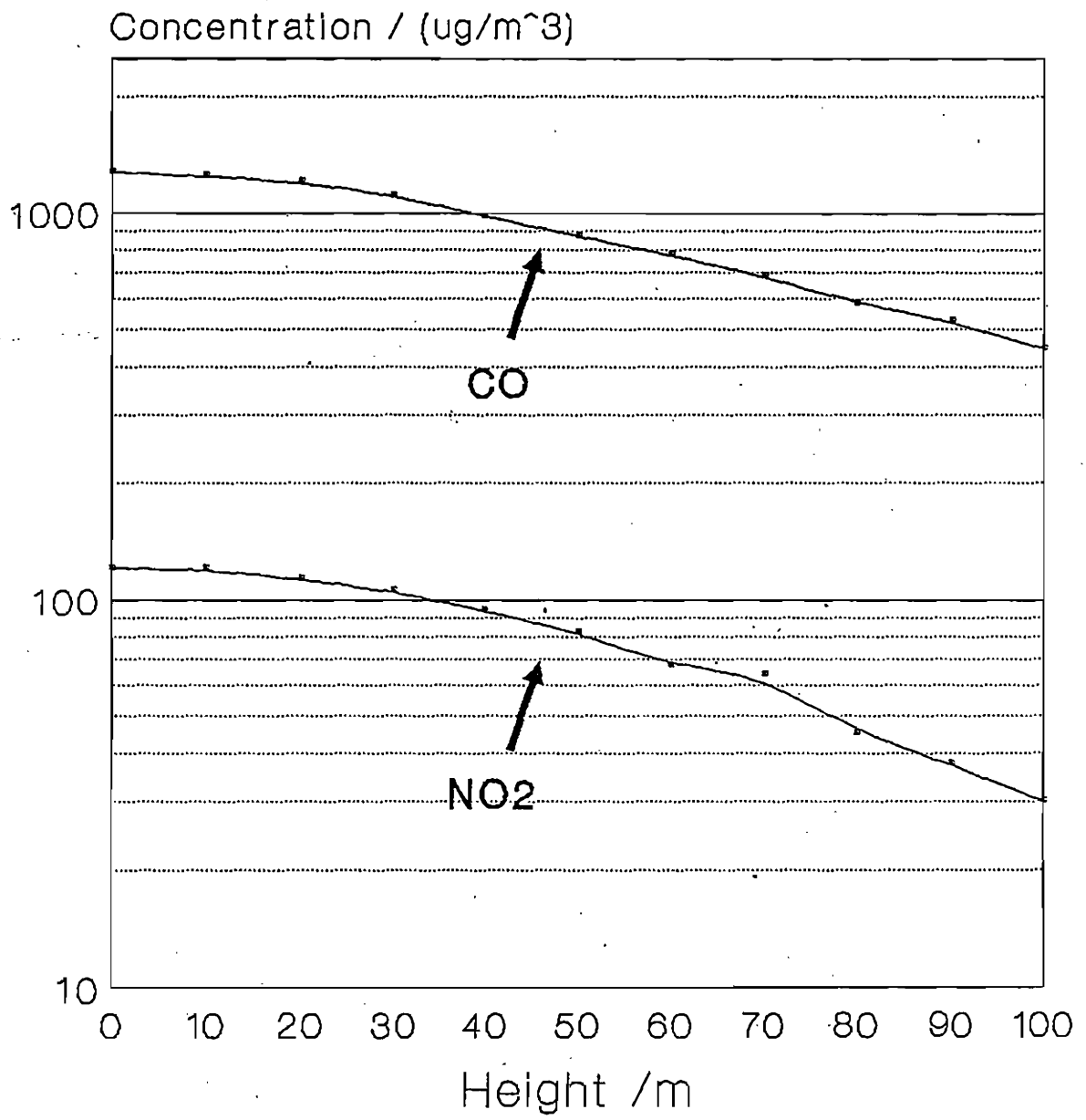


Fig. 5.6

6. WATER QUALITY IMPACTS

6.1 BACKGROUND

6.1.1 As stated earlier this EA is made on the assumption that construction will be completely on reclaimed land and the programme for the completion of the WKR is therefore not considered to be a key issue.

6.1.2 The existing water quality of the marine water off North West Kowloon which will be the receiving waters from the WKE is known to be generally poor. The area is impacted by a large number of discharges from sewage and stormwater outlets. Many of these discharges contain both domestic and industrial wastes.

6.1.3 As a result the area is eutrophic and sediments have high concentrations of metals. Levels of E. coli and nutrients in the area are high and exceed Water Quality Objectives (WQOs) proposed for the Victoria Harbour Water Quality Control Zone by EPD. As a result of high organic loadings, values of dissolved oxygen are also low in certain areas and values of pH are known to vary within the study area but are generally within the range of pH 6.5 - 8.5 proposed by EPD as a WQO.

6.1.4 These conditions are unlikely to improve prior to the implementation of the Strategic Sewage Disposal Scheme and are in fact likely to deteriorate when reclamation work effects the closure of the channel between Stonecutters Island and Lai Chi Kok. The reduced capacity for dilution and dispersion resulting from reduced tidal flushing will lead to a situation of deteriorating water quality particularly to the east of Stonecutters Island.

6.1.5 No commercial fishing or mariculture activities take place in the area and the marine waters are not used for recreational purposes. A change of usage appears to be unlikely in the construction period of the WKE.

Water Quality Criteria

6.1.6 Any possible water quality impacts resulting from the WKE need to be considered and evaluated with reference to the WQOs proposed by EPD for the Victoria Harbour Quality Control Zone. The WQOs proposed for particular Beneficial Uses which are considered relevant to the study are summarised in Appendix F for reference purposes.

6.2 CONSTRUCTION PHASE

6.2.1 There are numerous potential sources of pollution associated with the various anticipated construction activities. These can lead to contamination of run-off waters which could have detrimental effects on local water quality. The general drainage from the work areas and unwanted surface water can become contaminated with some or all of the following.

- o washout from concrete mixing/batching or ready mixed deliveries;
- o soil and spoil;
- o fuel and oil spillage;
- o construction chemicals;
- o domestic sewage from site canteen, toilets and washrooms;
- o bentonite slurries;
- o silt from dust suppression activities.

6.2.2 Whilst in open coastal waters the quantities and type of material involved would be unlikely to cause quantifiable impact, the weak tidal forces which will exist will restrict dilution and dispersion of all discharges to the area and further increase the stress on an already highly stressed area.

6.2.3 A potential source of impact will be the release to marine waters, via run-off or other routes, of liquors containing significant quantities of cement derived materials. In the course of the construction some 340,000m^3 of concrete will be required for the WKE. The precasting site where sections will be manufactured is an obvious major source, but smaller quantities of similar materials might be anticipated to enter marine waters via the drainage reserves serving other parts of the WKE construction.

6.2.4 A favoured location for the precasting site is in section LC1 (see Figure 2.1) on reclamation at the northern limit of the embayment formed by the closure of the channel between Stonecutters Island and Lai Chi Kok. This area will probably be the most quiescent and the discharge or run-off of lime based materials if uncontrolled would be likely to cause the following primary effects:

- o localised increases in turbidity and discoloration;
- o localised elevations in pH;
- o accretion of high pH solids.

6.2.5 As well as possible toxic effects to marine biota resulting from contact with elevated pH values in the water column and in sediments a number of secondary effects are also likely.

- o decrease in solar radiation induced decay rates of faecal micro-organisms due to decreased light penetration;
- o localised increases in the proportion of un-ionised ammonia, the un-ionised form being favoured at elevated pH values.

6.2.6 In addition to concrete and cement derived materials it is possible that quantities of fill material from construction site run-off could also be carried to marine waters via the drainage system. Such solids have the potential to cause blockages in the drainage system and also, on reaching marine waters, to cause localised increases in turbidity, discoloration, increases in biochemical oxygen demand (BOD), nutrient enrichment and smothering of benthic fauna.

6.2.7 As in the case of turbidity increases resulting from discharge of run-off of cement materials, turbidity increases resulting from general site run-off would also reduce solar radiation induced die off of faecal bacteria. These potential effects are, however, relatively small when considered in relation to the increases in suspended solids and turbidity which are likely to result from the reclamation work.

6.2.8 Potential impacts also exist from spillage, leakages and indiscriminate disposal of fuel oils, lubricants and hydraulic fluids used by construction vehicles and plant. These hydrocarbons are potentially toxic to marine biota and persist in marine sediments.

6.2.9 A further potential impact exists from any uncontrolled discharge of domestic wastes from canteen, washroom and toilet facilities which would be provided at construction sites. The additional BOD, nutrient and faecal bacteria loadings are obviously undesirable in this already impacted area and would further prejudice compliance with WQO criteria.

6.2.10 Marine waters could receive additional impacts associated with barge moorings and the transport and handling of construction and waste materials by sea. The main potential impacts will be due to accidental spillage of various materials such as spoil or potentially toxic liquids such as diesel fuel, construction chemicals etc. The likely effect of accidental spillage of materials from barges or other vessels will depend on the materials themselves which in turn depends on construction methods adopted.

Sensitive Receivers

6.2.11 The marine biota of the area are currently impoverished due to pollution-induced stresses. Superimposition of further stresses resulting from smothering, exposure to elevated pH conditions or exposure to toxins would therefore be particularly undesirable.

6.2.12 Sea water intakes within the study area will be resited in the course of the reclamation works. This scheme will lead to a situation where four reprovisioned intakes are constructed to provide a source of sea water for six existing intakes (see Figure 6.1). Increase in suspended solids contents of intake water especially by lime-based suspended solids originating from concrete casting and grouting operations could have adverse effects particularly where the water is used for cooling purposes. The most potentially sensitive of these reprovisioned intakes in terms of its proximity to the favoured precast yard location is the intake serving the MTR at Lai Chi Kok.

Mitigation of Impact

6.2.13 Although the Victoria Harbour Water Quality Control Zone is likely to be gazetted prior to the start of WKE construction it is understood that construction site run-off will not be subject to discharge consents.

6.2.14 In view of the potential impacts described controls should be applied and site run-off treated wherever practicable and clauses should be included in construction contracts requiring these measures to be carried out.

6.2.15 Control and treatment should include the following:

- o site compounds should be designed to take account of contaminated surface water. This will involve provision of drainage channels and settlement lagoons to allow interception and controlled release of settled/treated waters, ;
- o discharges from concrete batching should be settled and if necessary pH adjustment made to the supernatant liquor. In the event of settlement alone being insufficient to settle colloidal materials consideration should be given to further treatment with settling agents prior to discharge;
- o oil interceptors should be provided in site compounds and regularly emptied, to prevent release of oils and grease into the surface water drainage systems after accidental spillages. Oil and fuel bunkers should be bunded to prevent discharges due to accidental spills or breaching of tanks;
- o any stockpiles of soil, spoil or construction materials should be treated to reduce erosion of the stockpile and sediment release. In some cases it may be prudent to provide a separate settlement system for larger stockpiles to collect contaminated surface water prior to release to the site drainage system;
- o bentonite, if used on site, will probably be recirculated for re-use after cleaning. Interception channels should be provided to prevent discharge into the site drainage;
- o where possible connection of sewage discharges should be to the existing foul sewage system. Alternatively chemical toilet facilities with appropriate disposal arrangements could be considered and provided where necessary;
- o careful location of discharge points to avoid quiescent embayments and reprovisioned sea water intakes.

Monitoring

6.2.16 Inspections should be carried out periodically to ensure that good site practice is being observed and that settlement tanks and lagoons are managed and maintained to ensure optimum performance.

6.2.17 In the case of wastes containing cement-derived materials, periodic checks should be made on the pH values of the liquor discharged and the receiving waters in the immediate vicinity of the discharge.

6.2.18 Discharges should be monitored and managed to achieve compliance with the WQO in respect of pH in sea water.

6.2.19 Periodic inspections of oil interceptors should also be made to ensure that these are working satisfactorily and that oil derived wastes are collected regularly for appropriate off-site disposal.

6.3 OPERATIONAL PHASE

6.3.1 The operational phase impacts should be significantly less than the construction stage impacts.

6.3.2 The main area of potential impact is from run-off from the WKE and the transport of materials to marine waters.

6.3.3 Three main sources of contamination exist:

- o sediment from accumulation on the Expressway;
- o hydrocarbons, and other contaminants resulting from vehicular usage of the WKE;
- o hazardous materials (possibly environmentally persistent chemicals or wastes) resulting from spillage following road traffic accidents.

6.3.4 Sediment burdens in run-off water from elevated sections of the WKE are likely to be small. The most likely sections of the WKE for the incidence of sediment build up would be the slightly depressed and at grade sections where silt and debris from adjacent developments could be carried to the area.

6.3.5 The quantities of sediment involved would not be significant and would be similar to those which might be expected for the surrounding area. Impact on marine waters would therefore be slight.

6.3.6 As well as oil and petroleum resulting from drippage and spillage from motor vehicles it is also known that urban run-off contains quantities of other contaminants including lead, zinc and cadmium which are present largely as a result of vehicular use. The quantities present in WKE run-off would not be expected to be different to those found in any urban run-off.

6.3.7 The discharge of this run-off would be unlikely to produce any quantifiable adverse effects.

6.3.8 Significant spillage of hazardous materials as a result of traffic accidents would be anticipated to be an infrequent occurrence. The incidence of such events is difficult to predict and assess. The impact on the marine environment would obviously depend on the quantity and composition of any spillage.

Mitigation of Impact

6.3.9 The transport of the albeit small quantities of sediment to the marine environment would be minimised by the installation of appropriate sediment traps within the drainage system.

6.3.10 Reduction or prevention of impact resulting from spillage of hazardous materials could be effected by the installation of 'close-off' valves at strategic points within the drainage system. This regime would allow interim storage of a liquid waste or a solid waste carried to the system by wash down procedures. Recovery of materials could be made subsequently and appropriate measures taken for disposal.

6.3.11 The infrequency of such events however makes the additional costs, practicality and complications created by such a system questionable. In the absence of the system described, spillages should where possible be contained and recovered. In the case of liquid wastes or chemical spillage the use of inert absorbant materials might usefully be considered as an alternative to wash down procedures.

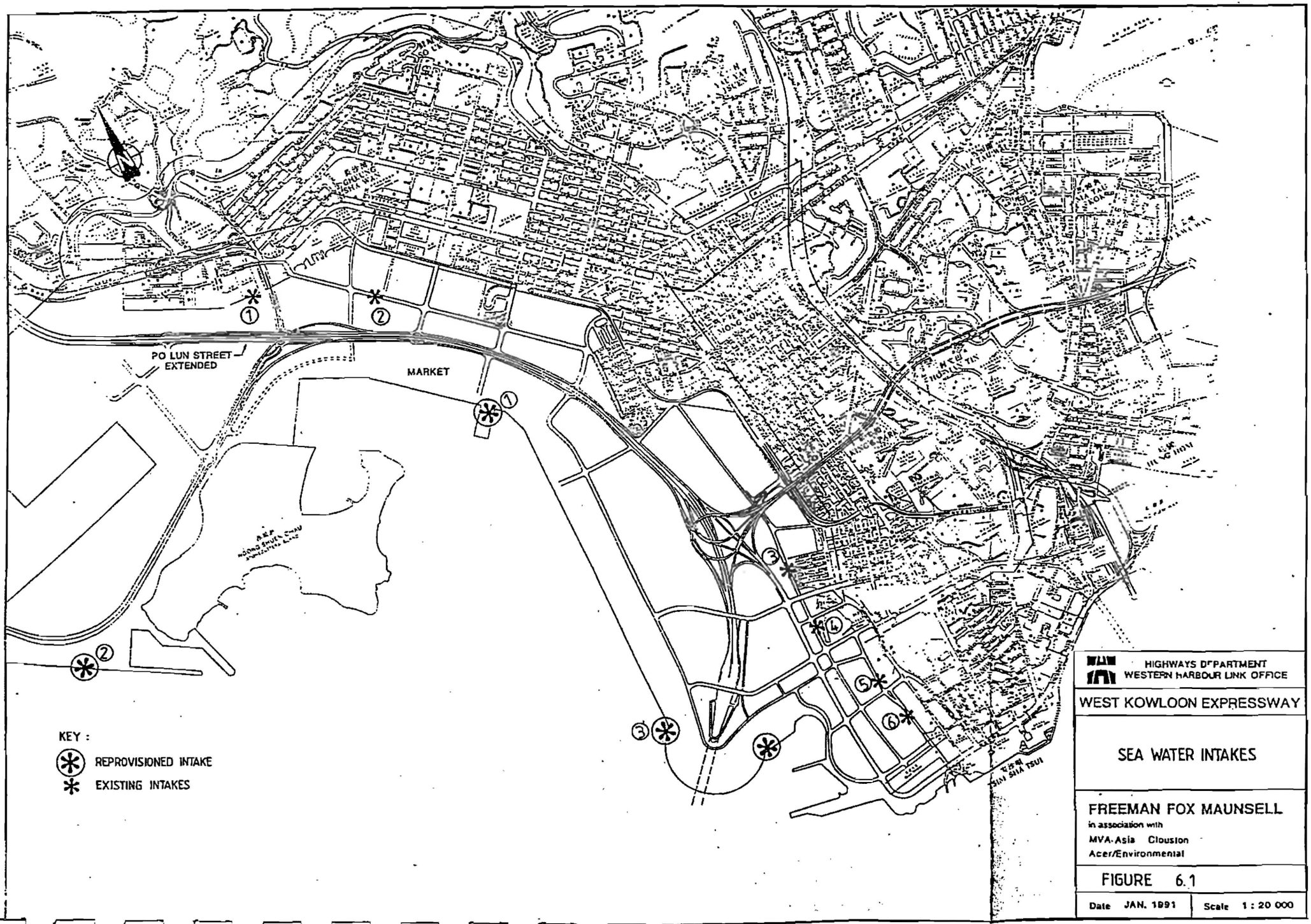
Monitoring

6.3.12 With the exception of routine inspection and maintenance of the drainage system to ensure that sediment traps within the system are regularly cleared, no other monitoring will be required.

6.4 SUMMARY OF KEY ISSUES

6.4.1 During the construction phase the key issues will be the prevention of materials, chemicals, sewage, etc. from entering the harbour waters via the drainage system, suitable clauses should be identified for inclusion in contract documentation to limit impacts.

6.4.2 During the operational phase the key issues are spillages both routine or accidental.



HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

WEST KOWLOON EXPRESSWAY

SEA WATER INTAKES

FREEMAN FOX MAUNSELL
in association with
MVA-Asia Clouston
Acer/Environmental

FIGURE 6.1

Date JAN. 1991 | Scale 1 : 20 000

7. LAND USE IMPACTS

7.1 BACKGROUND

Objective

7.1.1 The study brief for the EA states that one of the objectives should be to identify and evaluate net impacts in relation to community and neighbouring land uses. This Chapter aims to fulfil that objective. Assessment of the land use impacts of the WKE is especially important because the WKR, within which the Expressway will be sited, is a very valuable new land area for Hong Kong. It is vital that its environment should be designed to the highest possible standard.

7.1.2 The first section of this Chapter is a summary of the land use planning background to the WKR. The second section is an overview of likely land use issues. The third section describes the assessment methodology. The fourth and fifth sections present detailed assessments of land use impacts during construction and operation, together with proposals for mitigation. The final section is a summary of residual impacts and key issues.

Land Use Planning History

7.1.3 Land use planning for West Kowloon is being undertaken as part of Metroplan - a strategic plan for the development and improvement of Hong Kong's metropolitan area up to the year 2011. Documents prepared so far by the Planning Department include:

- o the Draft Preliminary Development Plan for West Kowloon Reclamation (March 1990);
- o the Metroplan Interim Development Statement (MIDS) for West Kowloon Reclamation (July 1990, revised October 1990).

Figure 3.1 presents the MIDS schematic land use pattern for the reclamation in 2011.

7.1.4 Currently, as part of the WKRS, consultants are reviewing the overall strategy for the development of the reclamation and its hinterland. Studies have been carried out on commercial, environmental and urban design aspects. Land use budgets are being examined, with eight different options under consideration. One of these will be selected and developed into a Draft Outline Development Plan accompanied by a landscape master plan. This will cover the whole of the reclamation, excluding the Yau Ma Tei typhoon shelter and Kowloon Point, but including existing land areas at Man Cheong Street, Tai Kok Tsui, and Sham Shui Po.

7.1.5 In parallel with the consultants' work, Planning Department will prepare a full Development Statement for West Kowloon, to translate aims and concepts into specific district targets and identify action by planning and development agencies.

7.1.6 In the preparation of this report, meetings have been held with representatives of the Planning Department, and with the WKRS Consultants, and note has been taken of views expressed on the likely land use impacts of the WKE (see later sections). The WKE is recognised to be one of the principal constraints upon future land use, and the findings of this EA will need to form an important input to future work by both the Planning Department and the WKRS Consultants.

Planning Concept

7.1.7 The most complete picture of future land use in WKR is provided by MIDS. Although this is schematic, it does give a clear idea of the long term land use and urban design strategy for the reclamation. The main purpose of the reclamation is to provide land upon which to build the WKE and AR, which are essential new transport links for the territory. However, a second and equally important purpose is to help solve the environmental problems of the hinterland, which include congestion, incompatible land uses, and poor design. The majority of the development shown in MIDS is programmed to occur by 2001. The exception is development within the reprovisioned Yau Ma Tei typhoon shelter, which is envisaged to take place post-2006.

Land Use - Southern Section

7.1.8 Broadly, south of Cherry Street, the area east of the WKE is designated for commercial and residential development, including high density private housing just north of the Yau Ma Tei Interchange.

7.1.9 This will be the main new housing area for West Kowloon, at least in the short term. To the west, it is envisaged that in the longer term the reprovisioned typhoon shelter and PCWA will also be used for high density private housing.

Land Use - Northern Section

7.1.10 North of Cherry Street the land uses to the east comprise (south to north):

- o landscape buffer next to existing residential development at Tai Kok Tsui;
- o high density commercial/residential;
- o buffer next to Nam Cheong Estate;
- o low density high-tech manufacturing;
- o medium density manufacturing;
- o a sports centre;
- o landscape buffer next to Mei Foo Sun Chuen.

7.1.11 To the west most uses are marine related, and include:

- o housing;
- o reprovisioned ferry terminals;
- o manufacturing including neighbourhood workshops;
- o Cherry Sha Wan Wholesale market;
- o refuse transfer station;
- o a government depot;
- o shipyards.

Open Space

7.1.12 The open space framework for the reclamation foresees major structural open spaces along the southern waterfront, and west-east into Kowloon at Yau Ma Tei and Sham Shui Po. There are also buffers of varying widths along most of the WKE's length, separating the new road from other land uses. The area west of the Yau Ma Tei Interchange is seen as a major gateway and view corridor from the harbour into the hinterland, with open space and pedestrian links.

Built Form

7.1.13 In the southern part of the reclamation the intention is that buildings will generally be high, over 140m at focal points such as the proposed new commercial centre housing the Airport Railway terminal. Heights will step up inland from the water's edge. North of Tai Kok Tsui there will be a strong visual break between the housing to the south and the port and industrial development to the north, reflected in a reduction in building heights.

7.1.14 The WKRS Topic Report No. 6 gives a preliminary indication of urban design, form and layout for different types of development within the reclamation. For commercial development, towers of 35 to 60 storeys are envisaged, probably with low level retail podia, and upper storey office or hotel use. For residential development, smaller buildings of around 25 storeys are likely, again with retail at podium level. Considerable stress is laid on the need for good grade-separated pedestrian links from existing urban areas through to the new waterfront and ferry piers, and on the integration of open space with development. For industrial development, which is seen as being 3 to 16 storeys in height, mixed industrial/office development is encouraged, with open space and pedestrian areas wherever possible.

Likely Future Changes to Planning Concept

7.1.15 Discussions with the Planning Department and the WKRS Consultants have highlighted a number of changes to the planning concept for the reclamation that may be reflected in the Draft Outline Development Plan.

7.1.16 It is noted that the 2011 population target for the reclamation could be increased from 90,000 to 130,000 by implentation of Phase II to help relieve the population pressures being experienced in the hinterland. This can only be achieved by applying higher residential densities (which would tend to defeat the purpose of the exercise) or by increasing residential land allocations.

7.1.17 A second important factor is that there is uncertainty as to whether it will in fact be feasible to relocate the Yau Ma Tei typhoon shelter post-2006, as no suitable alternative site has been identified.

7.1.18 As a result of these two factors, the need for residential land within the reclamation is very much greater than was foreseen in MIDS. The consultants are reviewing overall land use budgets with the aim of maximising residential allocations. The scope to increase residential use at the extreme southern end of the reclamation is thought to be limited: this is the area where the main commercial demand lies, associated with Kowloon Station. In the northern half of the reclamation new residential allocations to the east of the Expressway at Sham Shui Po have been considered but are now understood to be unlikely.

7.2 OVERVIEW OF ISSUES

Types of Impact

7.2.1 It is inevitable that a road proposal of this scale will have significant land use impacts. These will include not only direct effects such as disruption, land take and severance, but also constraints imposed on future land use and urban design due to noise, air and visual impacts in particular. In general, impacts during construction should be fairly limited, as few land uses will be in place at that time. However impacts during operation may be more severe.

7.2.2 For newly reclaimed land, the single most important factor in determining the land use impact of a trunk road is its vertical alignment. In urban design terms, at grade and depressed alignments are generally preferred to elevated alignments. Noise impacts can be more readily controlled; visual impact is less; and road, landscape and building design can be satisfactorily integrated.

7.2.3 Conversely, elevated roads tend to have more serious noise and visual impacts, and by their very nature are not readily integrated with surrounding uses. Set against this, they are economical in land take, and severance effects may be less than for at grade and depressed roads.

7.2.4 In the case of the WKE, both horizontal and vertical alignments were broadly fixed by Government prior to the start of the study, and as noted in Chapter 1, this significantly constrains the scope to prevent or mitigate adverse environmental impacts.

The decision that the Southern Section should be slightly depressed, and the Northern Section elevated, was taken largely on cost and programming grounds. An additional factor is the proposed siting of the AR beneath the elevated WKE, making good use of land that would suit few other purposes. However, the decision also reflects the relative environmental sensitivities of the southern and northern halves of the reclamation, as shown in the MIDS. The southern area, proposed for commercial and residential use, obviously demands a higher quality environment than do the port and industrial uses of the Northern Section.

Issues Arising From Previous Studies

7.2.5 Two previous studies have addressed the land use impact of the WKE, at least in a preliminary way. Both have drawn attention to what is probably the major issue: impact upon proposed residential land north-east of Yau Ma Tei Interchange.

7.2.6 The first study, WKRTS, highlighted the visual problems of an elevated Expressway, and potential noise and air quality impacts upon adjacent developments. To overcome these problems it proposed a depressed Expressway with land use setbacks. The constraint this would place upon development potential was recognised and accordingly additional measures such as podium development, louvres or cover were recommended for noise control.

7.2.7 In the second study, WKRS Working Paper No. 2 on West Kowloon Expressway Vertical Alignment Options considered the issue in more detail. Five different options were examined and compared on environmental, engineering, planning, cost and revenue grounds. The conclusion was that a depressed, covered Expressway would have significant environmental and planning benefits. Specifically it would:

- o permit physical continuity and the creation of public open space above the Expressway;
- o minimise setbacks and free more land for development.

It was also pointed out that the siting of commercial rather than residential development next to the Expressway could result in reduced setbacks, because commercial development is less noise sensitive.

7.2.8 This issue is explored in full later in the Chapter, in light of findings from the noise, air quality and visual impact assessments.

Issues Raised By the Planning Department

7.2.9 In addition to the issues described above, a number of specific issues were raised by the Planning Department (in comments on the Issues Report and Working Paper No. 8 - Environmental) as being of relevance to this study. These include:

- o putting Tai Kok Tsui Station undreground which the Department argues would facilitate pedestrian links across the WKE and AR and avoid the eastward displacement (by around 40m) of the P1 distributor;
- o the fact that P1 between Yau Ma Tei Interchange and Cherry Street is proposed to be at grade, unlike the adjoining Expressway, which will be slightly depressed;
- o the desirability of covering the slightly depressed section, with the roof designed as a passive open space and pedestrian linkage across the WKE.

7.2.10 Other points made by the Planning Department are that the land use impact assessment should address effects on development potential, land value, land take and integration between land uses; and consider land use under elevated structure, the need for buffer zones, and ways to counteract severance effects. Many of these issues are also under consideration by the WKR consultants.

7.3 METHODOLOGY

General

7.3.1 The assessment that follows identifies, separately, land use impacts during construction and operation, taking account of noise, air and visual factors. Where possible and appropriate, mitigation measures are proposed for incorporation in construction planning or Expressway design.

7.3.2 For construction phase impacts a qualitative indication is given of the significance of impacts upon sensitive receivers. Impacts include temporary disruption, land take and severance.

7.3.3 For operational phase impacts the approach follows the principles outlined in Chapter 9 of the revised Hong Kong Planning Standards and Guidelines (HKPSG) of August 1990. The main impact will be a constraint upon land values and development potential. Where environmental problems cannot be fully overcome through good design land use setbacks and changes to proposed land use patterns must be considered. Where possible, the scale and extent of this constraint is quantified.

HKPSG

7.3.4 The HKPSG provide a framework for including environmental considerations in land use planning. An overall policy objective of the guidelines is:

"to avoid creating new environmental problems by ensuring the consequences for the environment are properly taken into account in site selection, planning and design of all new developments."

7.3.5 The HKPSG set out a procedure for ensuring that proposed land uses in particular development areas are environmentally suitable and compatible with each other. However, it is recognised that in some cases, there may be unavoidable incompatibilities. In such circumstances, it is recommended that adverse impacts be limited to acceptable levels through proper land use zoning and site layout, or that development restrictions or controls be imposed to achieve required standards.

7.3.6 The HKPSG give few specific guidelines on buffer distances. However, with regard to noise, they recommend a separation of approximately 300m between trunk roads and residential developments. This may be reduced to approximately 50m, given appropriate screening. It is also stated that, if an adequate buffer distance cannot be provided, design guidelines should be adopted to reduce noise exposure, such as self-protecting design, integrated building and noise source design, purpose built noise barriers, and insulation of buildings. However, acoustic insulation is seen as a last resort because it precludes open windows and fresh air, and because it is costly to implement.

7.3.7 With regard to air quality, the guidelines recommend buffer distances of:

- o 50m between construction activities and open air recreational uses;
- o 20m in between trunk roads and active open air recreational uses.

7.4 CONSTRUCTION PHASE

Sources of Impact

7.4.1 Land use impacts during construction will generally be concentrated at a limited number of points within the existing hinterland, where established land uses may be affected by:

- o construction activities at nearby works areas and sites;
- o construction traffic, generating noise, dust and general nuisance and also entailing local traffic diversions;
- o temporary land take and severance.

7.4.2 Construction sites, accesses and traffic volumes are described in Chapter 2; their noise and air quality impacts are presented in detail in Chapters 4 and 5.

7.4.3 In addition to these impacts, there may also be some conflicts between Expressway construction and reprovisioning of ferry piers and other marine activities, especially in the Northern Section. These are covered in the Engineering Investigation Report.

Sensitive Receivers

7.4.4 The main sensitive receivers will be on the existing waterfront, where there are a number of densely populated residential areas. These areas already suffer from environmental problems such as traffic noise from Ferry Street and the West Kowloon Corridor proximity to industrial uses, and lack of public open space, so the greatest care needs to be taken to ensure that disruption during WKE construction is minimised.

7.4.5 At Yau Ma Tei the waterfront has a mix of commercial and residential uses. The main sensitive receiver is the prominent, 16 storey residential development at Man Cheong Street, which protrudes physically and visually into the reclamation area. Also affected will be small - but intensively used - areas of open space at the junction of Man Cheong and Ferry Streets.

7.4.6 Tai Kok Tsui, similarly, protrudes into the reclamation area. Although there is commercial use at its southern end, and industrial use to the north, it is largely residential. A school and college are also found on Cherry Street. Further north, at Sham Shui Po, are Tung Chau Street Park and public housing at Nam Cheong Estate.Building height at both Tai Kok Tsui and Nam Cheong Estate is around 15 storeys. On Fat Tseung Street, Sham Shui Po, there is a temporary housing area.

7.4.7 Mei Foo Sun Chuen, a 20-storey high private housing estate, is the most important sensitive receiver in the Lai Chi Kok vicinity. In addition to housing, a school and waterfront walkway will be affected.

Scope for Mitigation

7.4.8 The scope for mitigation of land use impacts during construction is often limited. The best mitigation is to avoid siting construction activities close to sensitive receivers, and this principle has been applied in choice of construction sites and accesses. For example, the precasting yard for the Northern Section has been sited as far west as possible, and an additional works access from Cherry Street into reclamation area D7 has been proposed to help alleviate impacts at Man Cheong Street. Additional mitigation measures are largely confined to controls over noise and dust emissions, and enclosure or screening of works and haul routes.

Impacts by Area

Southern Section

7.4.9 Man Cheong Street will be adversely affected both by proximity to the Yau Ma Tei construction site and by heavy construction traffic with 44 vehicle movements per hour on Man Cheong Street. Construction noise will be close to acceptable limits, and traffic noise will be very high - up to an Leq (1-hr) of 72 dB(A). Dust impacts from the construction site, especially from haulage, could be severe.

7.4.10 These impacts will be hard to avoid as the only alternative to use of Man Cheong Street for access to the southern part of the WKE works is Cherry Street, Tai Kok Tsui, which will experience similar problems. Controls over haulage noise and dust should be strict. Planted earth bunds or (failing that) temporary barriers should be used to give some low level protection from the noise, air and visual impacts of the access road.

7.4.11 At Tai Kok Tsui, proximity to the Expressway itself and to the Cherry Street flyover, will mean high construction noise levels at residential properties and schools. Noise sources may include percussive piling. Without mitigation acceptable noise levels will be exceeded. In addition, Cherry Street will be a major construction access, experiencing traffic volumes similar to those on Man Cheong Street. Hence fairly high levels of traffic noise, as well as severe dust impacts and general disruption, can be expected. Control measures including, paving spraying and wheel washing will be essential.

Northern Section

7.4.12 Nam Cheong Estate and Tung Chau Street Park in the Northern Section should suffer limited direct disturbance as they will be around 150m from the alignment, in an area with no construction access. Nonetheless there will be construction noise, plus noise from traffic along the works site (150 vehicles movements per hour), and serious dust impacts. All these impacts could be mitigated by the early implementation of ground modelling and advance planting in the open space between the housing and the Expressway as well as by appropriate controls over noise and dust emissions.

7.4.13 At Fat Tseung Street the temporary housing area will suffer from construction noise, high dust levels and traffic on the Tonkin Street (D5) site access with 30 vehicle movements per hour. Impacts at the eastern end of Mei Foo Sun Chuen will be similar due to the proximity of the precasting yard and the fact that Po Lun Street has been chosen as the main haul road for the Northern Section of the Expressway. There will be a possible 120 vehicle movements per hour plus 150 movements on the works site.

It is recommended that careful attention be given to temporary noise screening and dust controls, and that ground modelling and advance planting be undertaken at an early date in the open space to the south.

7.5 OPERATIONAL PHASE

Source Of Impact

7.5.1 The main direct sources of land use impact are noise, air quality and visual impacts, which in turn create impacts in terms of development potential, land values, land take and severance. Although there will be some impacts upon existing land uses that will be retained in future (especially at Man Cheong Street, Tai Kok Tsui, Nam Cheong Estate and Mei Foo Sun Chuen), the most important sensitive receivers will be the future planned land uses of the reclamation.

Noise

7.5.2 Noise impacts will be by far the most significant constraint upon development potential. The HKPSG recommend that residential developments should not be situated within line of sight of trunk roads, but obviously it will be very difficult to adhere to this principle given the distribution of land uses shown in MIDS.

7.5.3 The HKPSG identify as noise sensitive uses domestic premises, hotels, offices, educational institutions, places of worship, hospitals etc. Of main interest for the purposes of this assessment are residential, hotel and office uses, for which an L10 (1 hour) traffic noise standard of 70 dB(A) applies, or 68 dB(A) with allowance for the facade effect as described in Chapter 4. However, in practice this only applies to residential uses, as sealed windows are considered acceptable for hotels and offices.

Air Quality

7.5.4 The main source of potential air quality problems is vehicle emissions. The HKPSG recommend that trunk roads should be sited to the west of major urban centres wherever possible, given prevailing easterly winds. Again there is an inevitable conflict with MIDS, which proposes major residential developments to both east and west of the WKE. As shown in Chapter 5, carbon monoxide emissions should not be critical, but there may be some constraint due to nitrogen dioxide emissions near the road edges. Open air activities are particularly susceptible to air pollution, and for this reason it is generally recommended that there should be no active recreational uses within 20m of trunk roads.

Visual

7.5.5 Urban expressways can be a major source of visual intrusion, from elevated structures, bridges, overhead walkways and noise barriers. These elements affect views from nearby buildings, and also the internal visual quality of adjoining landscape buffer zones. Although buffer zones are a useful means of containing noise, air quality and visual impacts, in land use terms they may present a problem. Their environmental quality is often so poor that they are unsuited to even low key recreational usage.

7.5.6 For properties to the east of the WKE all sea views are also likely to feature the Expressway. In addition, sea views may be curtailed by measures to reduce line of sight to the Expressway for reasons of noise mitigation.

Development Potential

7.5.7 The greatest impact upon development potential will apply to residential use, as this is the most sensitive to noise impacts. Potential may be restricted in two ways: through height restrictions, and through development setbacks. Noise barriers can effectively screen low but not high level receivers, so close to the noise source low level development is possible. Typically a much greater setback is required before the height restriction can be fully lifted. There is little noise constraint upon development potential for hotels or offices, as acoustic insulation can achieve noise attenuation of up to 15 dB(A).

7.5.8 Development potential is also affected by the general quality of surrounding urban environment. Here good integration between building and road design is of prime importance. As noted earlier, integration is easiest to achieve for at grade and depressed alignments.

Land Values

7.5.9 Any restriction upon development potential will also be reflected in a loss of potential land value. As the future land use of the reclamation is known only in outline, it is impossible to put any precise figures upon the land value impacts of the Expressway.

7.5.10 However, as a guide, land values per gross hectare of development land (i.e. 100m by 100m) in the vicinity of Tai Kok Tsui has been estimated to be in the region of HK$285M for private high density residential, and HK$440M for commercial. These figures are taken from the consultants' report to the Planning Department, entitled Special Study on Development Aspects Associated with the Provision of Rail Services to North Lantau. In general, there are strong arguments for the best possible noise mitigation, on grounds of maximising revenue from land sales.

Land Take and Severance

7.5.11 The direct, permanent land take of the Expressway, its distributors and associated works will be in the region of 100ha, out of a total of around 330ha of new land to be created within the reclamation. This represents a very sizeable land area, but can hardly be counted as an adverse impact in that one of the purposes of the reclamation is to accommodate the Expressway.

7.5.12 At grade and depressed sections create physical severance effects that must be overcome through the use of bridges and grade separated pedestrian links. Elevated sections theoretically create less severance. However, in practice there will be considerable severance associated with the elevated Expressway, due partly to the use of embankments at junctions for landscape design reasons, the P1 running at grade and the proposed siting of the AR beneath the WKE.

Scope for Mitigation

7.5.13 As the land use pattern for the reclamation has not yet been finalised, possible mitigation measures include not only aspects of Expressway design, but also suggestions as to how future development and zoning plans can deal with the environmental constraints imposed by the Expressway. It is hoped that these findings will be considered in future work by the WKRS consultants and the Planning Department.

Land Use Zoning

7.5.14 The best means for minimising noise impacts upon land use is through zoning to separate noise sensitive uses from noise emitters. Hence there may be some scope to achieve improvements by adjusting the layout and distribution of proposed land uses within the reclamation. For example, it may be possible to:

- o accommodate more residential development at the southern end of the reclamation where noise issues are somewhat less critical;
- o distribute commercial development more widely and use it to shield noise sensitive residential development.

Shielding

7.5.15 The principle of shielding or self protecting design is well known, and entails the siting of non-sensitive uses between the noise source and the sensitive receiver. Possible shields include not only commercial development but car parking, lifts and corridors. Physically, the shield can take various forms, from the use of small non-sensitive buildings or podia to create a noise shadow, to courtyard or enclosed design where the building's windows all face away from the noise source. The orientation of building facades is also important: if the angle of view to the noise source can be reduced, noise levels will also be substantially reduced. In the case of development east of the WKE, shielding will inevitably result in the loss of sea views for sensitive receivers.

Integration with Noise Source

7.5.16 A further development of shielding is the integration of building structures with the noise source itself, through cover or decking over. This solution is particularly well-suited to the Hong Kong context, because it offers a substantial measure of noise protection to high level receivers, and hence optimises development potential. A further advantage is in urban design terms, because with retail and open space uses at podium level above the road, there is no physical severance and an attractive new urban environment can be created.

Buffer Zones

7.5.17 Where development potential and land value are not the overriding considerations, the use of buffer zone; between trunk roads and adjoining development is highly desirable for noise, air quality and visual reasons. Given an adequate level of noise screening, a 150m wide buffer is generally adequate. Ideally the buffer should include mounding and advance planting next to the Expressway itself. Where the Expressway is at grade or slightly depressed the mounding can have a dual role, providing noise screening and also the structure for future open space.

7.5.18 Within buffer zones, every effort should be made to identify positive land use functions that can be accommodated. Possibilities include noise insulated sports centres and other community uses, as well as active outdoor sporting uses, as long as these are at least 20m from the road, In this way overall pressures upon land within the reclamation can be reduced.

Other Measures

7.5.19 Finally, land use impacts can be prevented or mitigated through a variety of detailed design and management measures, which include:

- o selective use of acoustic insulation for residential properties, where no other solution is feasible;
- o maintenance of ventilation corridors to help minimise air quality constraints;
- o high quality landscape and urban design for decked areas, roadside landscape and buffer zones;

- a positive commitment to the management and maintenance of roadside landscape and buffer zones, as these areas will greatly enhance future development potential;

- good east-west pedestrian links with minimum change of level, to reduce severance effects.

Impacts by Area

7.5.20 Table 7.1 at the end of this section summarises the main noise, air quality and visual issues affecting different route sections, and makes some overall planning recommendations. Key impacts and proposed mitigation are described below.

Southern Section

7.5.21 Between the WHC and the Yau Ma Tei Interchange, noise, air and visual issues are generally less critical than further north, essentially because of the greater width of the reclamation at this point, and the fact that the Expressway is proposed to be at grade. No major impacts upon development potential or land values are expected, although there will be severance effects from both P1 and the WKE, which will require footbridge or overhead walkway linkages.

7.5.22 East of P1 in the vicinity of Man Cheong Street noise assessment has shown that traffic noise levels in 2011 may exceed the HKPSG guideline by about 2 dB(A). No effective mitigation can be provided. The possibility of using new non-sensitive government or commercial development as a noise shield should be explored.

7.5.23 Government and commercial uses between the WKE and P1 should be unaffected by the Expressway, provided there is good acoustic insulation. Only a narrow buffer between roads and buildings will be needed.

7.5.24 West of the Expressway, where long term housing development within the reprovisioned PCWA is possible, noise constraints could be serious: the noise assessment shows that a 200-350m setback would be necessary without mitigation. If housing proceeds in this area, a minimum 150m buffer zone, is recommended. In addition, appropriate earthbund or other noise barriers will be required.

7.5.25 Between Yau Ma Tei Interchange and Cherry Street is the main area of land use impact, where noise issues are likely to dominate future land use and urban design of the major new housing area to the east. Chapter 4 examined in some detail the noise mitigation options for this section. An important constraint upon the ability to mitigate noise impacts is that enclosure or barriers are only possible for about 250m north of the interchange, and not for the interchange itself, nor for the elevated alignment beyond Cherry Street. This leads to edge effects that significantly reduce the mitigation that would otherwise be achieved (See Figure 4.20A).

7.5.26 Essentially the findings of the noise assessment were that:

- there is considerable benefit in providing noise mitigation not only to the WKE, but also to P1 southbound;

- there is little difference in the terms of noise mitigation between an enclosed box structure and noise louvres, although the former gives slightly better protection for high level receivers;

- the mitigation achieved by noise barriers alone is significantly less than that of enclosure or louvres;

- the best way of overcoming the 'edge effect' at the northern end of this section is to build non-sensitive commercial development above Tai Kok Tsui Station, effectively using this building as a noise barrier for the elevated road to the north;

- in addition, at the southern end of this section, where noise from the interchange predominates, non-sensitive commercial or other development will need to be used as a noise shield.

7.5.27 Given the importance of maximising the development potential of this area, very effective noise mitigation is essential. Enclosure of the WKE and P1 southbound is strongly recommended, the cost is only slightly greater than for louvres. A further advantage of enclosure over louvres is that it permits full integration of building structures and landscapes with the road. The cover can be landscaped over, or indeed built upon.

7.5.28 Figure 4.20A shows that through enclosure coupled with commercial development above Tai Kok Tsui Station, the net impact of the WKE on development potential can be minimised, and residential setbacks reduced from 340m to 210m on average, giving an considerable saving in land value. If additional commercial development can be incorporated north and east of the interchange, impact upon development potential and land values will be further reduced as no residential setback will be required.

7.5.29 For the area to the west of the Expressway, the main question is whether or not the relocated PCWA will in fact be used for housing development. If it is, enclosure or barriers for P1 northbound will also be needed for noise mitigation, Enclosure will offer a much better solution because it will permit good east-west links at podium level between the two halves of the reclamation, and will reduce the necessary width of any buffer. If housing development is not proposed, enclosure will not be required and land use impacts should be minimal.

Northern Section

7.5.30 To the east of the section between Cherry Street and Prince Edward Road there inevitably will be serious impacts on both existing development (some of which is very close to the alignment) and any new development. The noise assessment has shown that even with 3m high noise barriers there will still be a need for a setback of around 150m. In addition, there will be severe visual intrusion from the WKE and its noise barriers rising onto viaduct, and from the Cherry Street flyover. Finally, there will be severance due to the presence of P1 at grade.

7.5.31 Any proposal for new commercial or housing development in this area would be unwise on environmental grounds. Although new development here was shown in MIDS, it is understood that is now considered unlikely. Instead, efforts need to be concentrated on upgrading the existing urban environment, and as part of this we recommend the creation of a buffer zone to existing housing (see Chapter 8). Provision should also be made for good pedestrian links to housing to the west, and to the new waterfront and ferry piers.

7.5.32 To the west of the road in this section is another major proposed housing area, for development in the short term. This will suffer similar or more severe noise, visual and severance impacts to Tai Kok Tsui and there will be an adverse impact upon residential development potential and land values. If this area is to be developed, nosie barriers will need to be added to P1 northbound and a very substantial setback and landscape buffer will need to be provided.

7.5.33 Between Prince Edward Road and Tonkin Street the principal issue is the impact upon Nam Cheong Estate. Noise impacts for the estate can be satisfactory mitigated, but there will still be visual intrusion from the Expressway itself and its 3m high noise barriers. A well designed buffer, with provision for active recreation, will be the best means of redressing the problem and making productive use of the land, and could be designed as an extension of Tung Chau Street Park. It will also be important during detailed design to provide for pedestrian access beneath the Expressway to the waterfront and ferry piers.

7.5.34 There is little scope for introducing additional housing development to this part of Sham Shui Po, as even low rise development would not meet noise standards.

7.5.35 Further north, and to the west of the Expressway, proposed light industry and Cheung Sha Wan wholesale market should not be adversely affected by the Expressway, although the space available for the Wholesale Market may be somewhat constrained.

7.5.36 Between Tonkin Street and Route 16 Roundabout industry and offices are proposed to the east, and government uses and shipyards to the west. None of these uses should suffer significant impacts from the Expressway, although sound insulation will be required for offices, and at least a narrow buffer is desirable.

7.5.37 From Route 16 roundabout to the interface with Route 3 the proposed land uses east of the Expressway comprise a sports centre and the large residential estate of Mei Foo Sun Chuen. A sports centre is a sensible and cost effective land use of this site, adjacent to the roundabout. At Mei Foo Sun Chuen, the issues are similar to those for Nam Cheong Estate.

There should be no unacceptable noise impact, but the estate will lose its views of, and access to, the harbour front, and instead experience direct views of the elevated Expressway (including noise barriers) and container port backup. An attractive buffer, will be the best means of alleviating this impact. Again, there is no scope for additional residential development on noise grounds. To the west of the alignment the container port backup will be unaffected by the Expressway.

7.6 SUMMARY OF KEY ISSUES

7.6.1 Given that the WKE's horizontal and vertical alignments were largely fixed prior to the start of the study, the ability to prevent or mitigate land use impacts through design of the Expressway is very limited. In addition, as the WKE and its distributors are essential to the future transport network of the reclamation, many of its land use impacts are inevitable. Nonetheless, there is some scope to mitigate land use impacts through good road design - particularly through integral noise mitigation and landscape measures.

7.6.2 As the land use pattern for the reclamation is not yet finalised, there is also scope to adjust the layout of land uses to help mitigate the impacts of the WKE. It should be noted that this type of mitigation, although very effective, is beyond the remit of the Highways Department, and will require the agreement and cooperation of other departments if it is to be implemented. Cooperation of the Planning Department and Urban Services Department will be especially important in respect of suggested changes in land use zoning and the future adoption and maintenance of adjacent landscaped buffers.

7.6.3 In addition, there will be significant potential during the detailed design of developments next to the Expressway to further mitigate land use impacts, for example through noise shielding and acoustic insulation. This will require action by developers and their architects and engineers.

7.6.4 The main conclusion of the assessment is that the Expressway does significantly constrain development potential within the WKR. The overriding constraint is noise, which places fairly severe limitations upon land availability of residential and other noise-sensitive development.

7.6.5 The area of greatest impact is north-east of Yau Ma Tei Interchange. However, problems can largely be overcome through enclosure, commercial development above Tai Kok Tsui Station, and development of a non-snesitive commercial shield close to the interchange.

7.6.6 A second area of major potential impact is the land to the west of Expressway between Cherry Street and Prince Edward Road, which is proposed for public housing in the short term. As development proposals stand at present, housing would need to be set back from the Expressway by around 400m, with a great loss of potential housing land. Further noise assessment and land use planning work to address this problem should form part of the WKRS.

7.6.7 Other areas of residual impact upon development potential occur:

- o west of Expressway at Tai Kok Tsui, where a 150m setback for housing development is recommended;
- o at Sham Shui Po, where additional housing is considered inadvisable on noise grounds.

The impacts are avoidable given an elevated alignment.

7.6.8 The chief residual impacts upon existing land uses near the Expressway are fairly severe noise, visual and severance effects upon housing at Tai Kok Tsui, and similar but less severe impacts upon Nam Cheong and Mei Foo Sun Chuen estates. These will be offset at least in part if recommendations on landscape buffers are implemented.

Table 7.1 : Land Use Impacts during Operation (1/3)

	Main Proposed Land Use(s)	Noise Issues				Air Quality Issues	Visual Issues	Overall Planning Recommendations
		Setback Without Mitigation	Proposed Mitigation	Height Restriction at 150m (with mitigation)	Distance at which Height Restriction Lifted (with mitigation)			
WHC to Yau Ma Tei Interchange								
East	Existing residential at Man Cheong Street (180m)	170m	None at present	4 storeys	170m		Views of P1 and interchange	Given noise screening and commercial shield, may be scope for reduced setback and additional residential development
Between	Government and commercial	Total	Acoustic insulation	None	None		Views of Jordan Road flyover	Narrow buffer acceptable
West	PCWA, then private housing in future	250m	None at present	Total	250m			If housing is to be developed, and 150m landscape buffer with earthbund noise screen
Yau Ma Tei Interchange to Cherry Street								
East	Private housing (plus possible commercial)	250m	Enclosure of WKE and P1 southbound. Development above Tai Kok Tsui Station	None	90m	Slight air quality degradation near tunnel portals	Visual intrusion from Interchange and elevated CKR	Integrate building and expressway design. Use podium development, commercial shield building orientation,acoustic insulation to further reduce impacts.

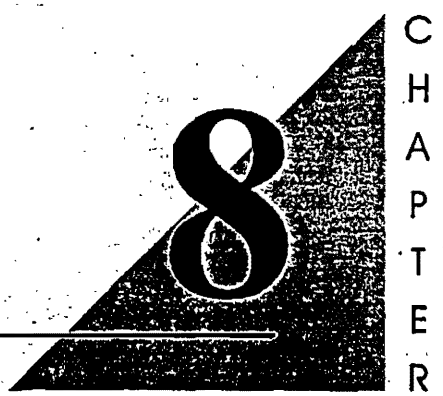
Table 7.1 (Continued) : Land Use Impacts during Operation (2/3)

	Main Proposed Land Use(s)	Noise Issues				Air Quality Issues	Visual Issues	Overall Planning Recommendations
		Setback Without Mitigation	Proposed Mitigation	Height Restriction at 150m (with mitigation)	Distance at which Height Restriction Lifted (with mitigation)			
West	PCWA, then public housing in future	340m	Enclosure of WKE and P1 southbound. Development above Tai Kok Tsui Station	3 storeys	170m	Slight air quality degradation near tunnel portals		If housing is to be developed, enclosure to P1 northbound.
Cherry Street to Prince Edward Road								
East	Existing residential at Tai Kok Tsui (20-180m). Proposed commercial/ residential	235m	3m high barriers WKE and P1 northbound	12 storeys	200m		Visual intrusion from elevated WKE, noise barriers and Cherry Street flyover	Create landscape buffer to existing housing. Avoid new development in this vicinity if possible.
West	Public housing	235m	As above	12 storeys	200m	Potential NO_2 exceedance within 130m in unusual worst case weather		Allow 150m landscape buffer.
Prince Edward Road to Tonkin Street								
East	Existing residential at Nam Cheong Estate (170m) and Light Industry	250m	3m high barriers to WKE and P1 southbound	12 storeys	210m		Visual intrusion from elevated WKE and noise barriers	Create landscape buffer as extension of Tung Chau Street Park, with ground modelling and planting

Table 7.1 (Continued) : Land Use Impacts during Operation (3/3)

	Main Proposed Land Use(s)	Noise Issues				Air Quality Issues	Visual Issues	Overall Planning Recommendations
		Setback Without Mitigation	Proposed Mitigation	Height Restriction at 150m (with mitigation)	Distance at which Height Restriction Lifted (with mitigation)			
West	Light Industry and wholesale market	N/A	3m high barriers to WKE and P1 southbound	N/A	N/A	Potential NO_2 exceedance within 130m in extreme worst case weather		Narrow buffer acceptable.
Tonkin Street to Route 16 Roundabout								
East	Industry and offices	220m	Acoustic insulation for offices	None	None			Narrow buffer acceptable
West	Government uses and shipyards	N/A	None at present	N/A	N/A			Narrow buffer acceptable
Route 16 Roundabout to Route 3								
East	Existing residential at Mei Foo Sun Chuen (175m)	160m	None at present	N/A	160m		Visual intrusion from elevated WKE	Create landscape buffer with ground modelling and planting
West	Container port backup	N/A	None at present	N/A	N/A			Narrow buffer acceptable

Visual Impacts



8. VISUAL IMPACTS

8.1 OBJECTIVES

8.1.1 Visual impact assessment aims to identify the significance of changes to the visual resource, that may arise from new development. This Chapter sets out to :

- o assess the visual impact at the construction phase on existing land uses;
- o assess the visual impact at the operational phase: residual impacts will be identified, firstly, on existing and reprovisioned land uses in 1996 (day of opening) after landscape measures are in place, and secondly, on proposed land uses in 2011 after these measures have matured;
- o provide guidelines for additional mitigation to any remaining visual impacts that are identified.

8.2 METHODOLOGY

8.2.1 The basis for the appraisal is the subjective evaluation of visual intrusion of the WKE and associated construction activities and sites within the urban landscape. In order to determine the extent and level of impacts on receivers, the full length of the route corridor and viewpoints outside the immediate alignment were examined.

8.2.2 The evaluation in the field took into consideration the following factors :

- o the extent and visibility of the works and structures, which are recorded as the visual envelope;
- o the character of the area and the sensitivity of the individual receivers within it;
- o the proximity of individual receivers to the WKE and to construction activities;
- o the type and source of impact.

Visual Envelope

8.2.3 The visual envelope of the WKE on Kowloon is shown in Figure 8.1. The high rise developments of the urban areas of Kowloon make it difficult to accurately determine the full extent of the visual envelope. Consequently, the boundary of the envelope should not be regarded as a definite limit but as an indication of areas from which the WKE can be seen and where the impact may be significant.

Sensitive Receivers

8.2.4 Figure 8.1 also shows the location of sensitive receivers. Most sensitive receivers include residential areas, public open space, and institutions such as schools and hospitals. Moderately sensitive receivers include commercial and office developments. Least sensitive receivers include transport corridors, industrial and manufacturing areas.

Proximity of Receivers

8.2.5 The significance of visual impact is very dependent upon proximity. Residential areas will be more severely affected by close proximity to the alignment than less sensitive industrial developments.

Type of Source and Impact

8.2.6 It is anticipated that the WKE will have significant visual impacts during the construction phase, and that these impacts will extend beyond the immediate route corridor as large working areas and construction accesses are required. Once the WKE is operational, visual impacts will also be significant but will be more localised.

8.3 CONSTRUCTION PHASE

8.3.1 With construction activities concentrated on the reclamation zone, visual receivers will be largely restricted to land uses located on the present water front. Little permanent land use will be in place on the reclamation at the time of construction, although a number of current activities will be reprovisioned during the construction period to the west of the WKE.

These include the PCWA, Wholesale Market and shipyards, all of which require a waterfront location. The visual envelope is not confined to the immediate area and will extend to embrace distant views from Hong Kong Island.

Sources of Impact

8.3.2 The principal sources of impact arising from construction activities will be :

- o works areas;
- o general construction activity along the route corridor;
- o temporary construction access.

Works Areas

8.3.3 Two principal works areas are proposed. The largest in the Northern Section is between 3-4 ha to accommodate the precasting yard for the production of viaduct segments and will be located in LC1 to the west of the Expressway. If 24 hour operations are involved there is an additional impact of night time lighting to be taken into consideration.

8.3.4 The second works area, associated with the Southern Section, is much smaller, as a large precast yard is not required. This will be approximately 0.5 ha in size, sufficient to cater for site staff, workshops, batching plant and materials for the production of in-situ concrete. This will be located within the Yau Ma Tei interchange and will have much less impact than its counterpart to the north.

General Construction Activity

8.3.5 Inevitably there will be considerable activity along the whole length of the route. However, the construction of the Yau Ma Tei Interchange will be the single most dominant feature. It is also expected that significant activity will take place at roundabouts, the Cherry Street Flyover and Jordan Road extension. With the majority of the route on elevated structure, large pieces of equipment such as cranes, will be required. These will extend above the height of the alignment and increase the visual impact.

Construction Access

8.3.6 Significant local impacts arising from construction access are anticipated at :

- o Man Cheong Street, which forms the temporary access to the PCWA;
- o Cherry Street extension, which will also serve the Tai Kok Tsui ferry terminal;
- o Tonkin Street extension;
- o Po Lun Street extension, which will serve the newly located shipyard activities.

Impacts By Area - Southern Section

8.3.7 Dense housing characterises the existing land use in this area. Ferry Point forms a dominant urban promontory adjacent to Jordan Pier. South of Jordan Road the character changes as the government buildings and hotel developments of Tsim Sha Tsui are approached. Typically the visual envelope follows the line of the waterfront buildings, although long views are possible down east-west routes. The visual envelope extends as far south as developments on Hong Kong Island.

Sources of Impact

8.3.8 Construction of the Yau Ma Tei interchange will be a major source of impact in this area. To the south of the interchange, construction activities will be divided into two areas, firstly associated with the P1 distributor road adjacent to Man Cheong, and secondly with the WKE which runs further to the west adjacent to the relocated typhoon shelter. The Austin Road extension and the elevated lengths of the new sections of Jordan Road will also significantly contribute to the overall construction impact. North of the interchange, activities will be more localised with the major impacts arising from the construction of the Cherry Street flyover and the depressed section of the WKE. In addition to the general construction activity works traffic entering at Man Cheong and Cherry Street will have impact on local receivers.

Visual Receivers

8.3.9 The magnitude of the interchange development, both in terms of height of structure and area under construction, will not only have a significant impact upon immediate receivers, but will cause it to be visible from more distant areas, including Hong Kong Island.

8.3.10 At a local level it will have a severe impact on housing and motorists on Ferry Street and the southern end of Tai Kok Tsui. The most severe impact, however, will be experienced by the housing area at Man Cheong, partly due to the construction of the interchange but also as a result of the proximity of the P1 distributor and the Jordan Road extension. The impact will be reinforced by the construction traffic entering the reclamation area along the northern end of Man Cheong. However, the overall visual impact in this area will be reduced by the proposal to carry out earthworks at the Yau Ma Tei interchange during the initial stages of the contract, to create embankments for future road connections. This will break up the apparent mass of the construction site and provide a screen to certain areas of activity.

Impacts By Area - Northern Section

8.3.11 The present land use comprises a number of different waterfront activities, ranging from small shipyards to wholesale markets. Some of these activities, for example, the market, will be relocated to new waterfront locations with the advent of the reclamation programme. There are visually sensitive housing areas at Tai Kok Tsui, Nam Cheong and Mei Foo Sun Chuen. The visual envelope generally follows the edge of development along the existing waterfront.

Sources of Impact

8.3.12 The level of impact associated with the construction of the elevated structure will be relatively uniform. However, areas of concentrated activity are likely around the proposed interchanges at Prince Edward Road, Tonkin Street and at the interchange with Route 16. Tonkin and Po Lun Streets will form access routes for construction traffic reinforcing impacts in these areas. The major works area will be located south-west of the Expressway.

Visual Receivers

8.3.13 The most sensitive receivers in this area are the residential developments at the northern end of Tai Kok Tsui, Nam Cheong (and adjacent Tung Chau Park) and Mei Foo Sun Chuen. The visual impact during the construction period on these areas will be severe. The impact on Mei Foo Sun Chuen will be reinforced by the location of the works area to the south and by the scale of activity associated with the Route 16 interchange. A further concern is the impacts on these areas at night if 24 hour operations are necessary, requiring extensive lighting in both the works area and construction zone.

8.3.14 A buffer 150m wide, is proposed between the alignment and housing at Nam Cheong and Mei Foo Sun Cheun. However, it is unlikely that the development of this open space will be completed prior to construction.

8.3.15 At Sham Shui Po, more distant views will be possible from the upper levels of the housing areas of the Lai Kok Estate on Lai Chi Kok Road.

Mitigation of Construction Impacts

8.3.16 There will be intense activity throughout the reclamation zone as construction takes place and it will be therefore difficult to isolate activities and minimise their impact. However, there is particular concern regarding impacts associated with the large work sites required at interchanges, roundabouts and flyovers. To some degree this can be reduced by adopting the following measures :

- o attention to site layout and organisation;
- o advanced planting;
- o ground modelling;
- o off-site mitigation measures such as temporary screen planting.

Site Layout and Organisation

8.3.17 The following measures should be considered and adopted wherever practicable :

- o restrict area to a minimum; this is particularly important where large working areas are required or where adjacent construction zones may coalesce;

- o enclose site with hoardings where adjacent to sensitive receivers; this provides a definable boundary edge and a degree of uniformity;
- o avoid visually obtrusive elements, such as tall machinery, close to sensitive receivers;
- o minimise erection time of equipment;
- o restrict heights of storage material, stock piles and spoil heaps to low levels;
- o minimise haulage roads and restrict unnecessary movements of construction traffic to and from site;
- o minimise night time lighting; where applicable low level lighting is preferred;
- o choice of haul routes.

Advance Planting

8.3.18 Advance planting should be adopted wherever possible to provide screening of visual impacts during the construction stage. Ultimately it will form the long term landscape treatment for the operational phase, thereby eliminating the need for temporary treatments, such as for dust suppression, whilst maximising growth opportunities for plant material by early implementation. It should not be included immediately adjacent to projected alignments for future road construction, to avoid unnecessary disruption later.

8.3.19 The Draft Preliminary Report suggested advance planting may be considered in various locations within the Expressway corridor, particularly at the Yau Ma Tei interchange. This will contribute towards reducing the impact on adjacent receivers, although it may prove difficult to successfully protect the planted areas from construction activity. It will be essential to select species that are tolerant of dust and other sources of pollution. Careful maintenance will be required during the establishment period.

8.3.20 Advance planting need not be restricted to the route corridor and should also be implemented in the buffer strips at Mei Foo Sun Chuen and Nam Cheong.

Ground Modelling

8.3.21 Grading and ground modelling prior to and during construction phase activities will help to reduce the scale of the structures being built, and act as a screen to construction activities where space permits mounding in the peripheral areas. The surplus fill from excavation carried out in order to depress the Expressway may be utilised for earthmounding in the vicinity, particularly at the Yau Ma Tei interchange. Early implementation of this work will also allow advance planting to take place.

Temporary Screen Planting

8.3.22 Temporary screening may be justified where particularly sensitive receivers are close to the works. This treatment will not be necessary in many places as much as the adjacent land will not be developed at the time of Expressway construction. However, it would be beneficial to implement measures at Man Cheong, along Ferry Street and Tai Kok Tsui where impacts from construction of the interchange will be severe. These measures may take the form of fencing or hoarding, planting or mounding or a combination of the aforementioned.

8.4 OPERATIONAL PHASE

8.4.1 Apart from the relocation of the PCWA, wholesale market and shipyards, land use development will be little more than embryonic when the Expressway is completed in 1996. This is reflected in the boundary of the visual envelope, which generally follows the present waterfront.

8.4.2 As overall development proceeds, the extent of the visual envelope will change, being drawn in towards the route corridor. It would be unrealistic to attempt to pinpoint its precise location as this will be largely dependent upon the type of development and the form it takes.

8.4.3 In assessing the impacts at the operational stage it will be necessary, therefore, to establish the impact not only on proposed land uses (or suggested alternations to these if appropriate), but also the impact during the interim period of development upon those existing land uses that fall outside the reclamation area.

Sources of Impact

8.4.4 While the proximity of the alignment to receivers will generally determine the visual impact, the vertical alignment and the form it takes will also contribute significantly. The following elements have been identified.

Slightly Depressed Section

8.4.5 This is now limited to the section running through the Yau Ma Tei Interchange.

At Grade Section

8.4.6 Understandably the alignment at grade (uncovered section) will prove less obtrusive than the elevated structure. However, this is a relatively small component of the overall length and is restricted to a short section south of the Yau Ma Tei Interchange.

8.4.7 The WKE Steering Group (April 1991) directed that a section of the Expressway and P1 southbound should be covered for a length of 230m south of Cherry Street. From a visual standpoint, while an enclosed structure will have an impact, it is preferred to other optiions which was considered ie. noise barriers and noise louvres, as it permits landscape measures or possibly open space development to be included which would be a visual benefit to adjacent areas.

Elevated Structure

8.4.8 This represents the principal component in the Expressway and will extend from the Container Port roundabout to Prince Edward Road before reaching grade at Tai Kok Tsui. The height of the structure varies between 11 and 16m above ground level. The structure reaches its lowest points at Mei Foo Sun Chuen and Nam Cheong. In general terms the structure will create a distinct visual barrier, separating the two halves of the reclamation.

8.4.9 This change in elevation will create a slightly undulating effect which under normal circumstances would be visually significant, particularly as panoramic views of the whole alignment will be possible. However, this is a relatively short term issue since the variation in height will become less apparent as adjacent land uses develop, ultimately restricting wide reaching views of the alignment.

The location of the low points adjacent to the sensitive residential areas of Nam Cheong and Mei Foo Sun Chuen is advantageous as this will reduce the level of visual intrusion.

Interchanges and Roundabouts

8.4.10 These features are expected to form the most dominant visual elements. Not surprisingly the complex interchange network at Yau Ma Tei will be the most significant. By forming embankments to slip roads rather than using elevated sections will enable planting to take place which will reduce the visual impact of the roundabout.

Noise Mitigation Measures

8.4.11 It appears that noise barriers may be required at Tai Kok Tsui, Nam Cheong and Mei Foo Sun Chuen. The addition of a vertical noise barrier will significantly increase the depth of the elevated structure, forming a more dominant element in the landscape.

Landscape Proposals

8.4.12 The landscape strategy recognises that one of the principal aims of the design process is to "assist the mitigation of visual impact". It also recognises, amongst other considerations, the need to integrate roadside planting with adjoining open space, planting belts and buffer zones, while maintaining and emphasising view corridors and pedestrian routes. It is the role of this assessment to determine the residual visual impacts arising from the Expressway after landscape design and mitigation proposals are in place.

8.4.13 Given the scale of likely development on the reclamation it is not expected that landscape proposals will provide more than a partial screen to the WKE and then principally to receivers at low levels. These may include pedestrians, motorists or the lower floors of adjacent development. More importantly the landscape measures will soften the visual impact of the Expressway, helping to integrate it with the surrounding, as yet unknown, land use framework.

8.4.14 The landscape proposals, outlined in the Preliminary Report, include both planting and grading measures. Planting falls into two basic types, amenity and woodland. Amenity planting will be restricted to "narrow strips adjacent to the Expressway and associated roads" and "at the edge of buffer zones", while woodland planting will be reserved for "large areas such as interchanges and large buffer zones". Woodland planting - which is the landscape treatment proposed for the most extensive area - is relatively cheap to implement and maintain.

8.4.15 Planting is concentrated around the interchanges at Yau Ma Tei and Route 16 and to a lesser extent at the smaller roundabouts. Planting between these areas, although continuous, is relatively narrow, some 2-5m, and while it will provide a means of separation, it is unlikely to provide complete visual protection. It will, nevertheless, provide a reduction in visual impact, softening the edges of the Expressway. It is difficult to judge the impact of these narrow strips as the setbacks of proposed land uses, and the extent and location of adjacent landscape areas, have yet to be determined. The exception is the 150m buffer strips identified at Mei Foo Sun Cheun and Nam Cheong.

8.4.16 Grading measures are seen as an integral part of the landscape design and will be used to integrate the interchanges/roundabout, segregate pedestrians from distributor roads, and elevate planting to provide more effective and more immediate screening. Extensive grading proposals have been made for the Yau Ma Tei interchange.

Impacts By Area - Southern Section

.4.17 The Expressway, and in particular the Yau Ma Tei interchange, will visually dominate this area. South of Cherry Street, the proposed land use will comprise mainly housing areas. These are regarded as sensitive receivers and their proximity to the WKE will be a significant factor in determining the visual impact experienced.

Sources of Impact

8.4.18 The decision to run the WKE approximately 2.5m below grade within Yau Ma Tei Interchange will allow the general level of the interchange to be significantly lower than would otherwise be possible. This is naturally advantageous in visual terms, reducing potential impact. Nonetheless, the interchange will remain the single most dominant feature associated with the WKE.

8.4.19 The WKE is at grade south of the interchange, while to the north of the semi-depressed section it continues at-grade as far as the Cherry Street flyover. At widths of between 6 and 11 lanes, it will result in considerable impact on proposed development that lies directly adjacent. Immediately north of the interchange, various noise mitigation measures are being considered which will affect development setbacks.

Landscape Proposals

8.4.20 Embankments have been proposed extensively throughout the interchange to restrict the lengths of elevated road. They have formed the basis for comprehensive ground modelling proposals which in places will extend well above road level, and will provide visual interest but more importantly break up the visual mass of the interchange. Extensive woodland planting will reinforce this effect. Figures 8.2 - 8.4 show proposed ground modelling for the interchange and typical woodland planting relative to roads at high levels within the interchange.

8.4.21 Planting beyond the interchange is confined to narrow belts of amenity planting adjacent to the Expressway, railway and distributor roads. In the Man Cheong area it has been used to provide physical separation between pedestrians and the P1 distributor.

Residual Impacts at Day of Opening

8.4.22 With little new land use in place, the visual receivers will be as noted during the construction period. Ground modelling will noticeably break up the scale and visual mass of the interchange, and in particular provide a screen to the WKE running below grade, but planting will still be in the establishment period and will have limited effect. Therefore, the interchange will remain a dominant feature and have a severe impact on receivers on Ferry Street, Man Cheong and the southern end of Tai Kok Tsui.

8.4.23 At Man Cheong, particular attention is drawn to the changes in vertical alignment both of the P1 distributor and the Jordan Road extension. Initially P1 passes over Jordan Road to return to grade before passing beneath Austin Road further to the south; while Jordan Road itself rises onto elevated structure to pass over the Kowloon Station roundabout. Significant changes in elevation create a lack of visual continuity within the area. The present proposals will have a severe impact on the Man Cheong area and the government buildings to the south. Distant views will be possible from Hong Kong Island.

8.4.24 North of the interchange, the Cherry Street flyover will represent a major visual intrusion, and will result in a severe impact on Tai Kok Tsui and the northern end of Ferry Street at day of opening.

Residual Impacts at 2011

8.4.25 As the development of land uses on the reclamation proceeds, the impact of the WKE on existing receivers will gradually diminish. Moreover, woodland planting will have developed sufficiently to reduce the visual intrusion of the Yau Ma Tei interchange. However, this will only prove effective at lower levels and there will remain severe impacts upon upper levels of housing at Man Cheong and the south end of Ferry Street. This will be reinforced by the elevated structures of the P1 and Jordan Road extensions and result in a severe impact on these receivers. In addition, there will be long views down the CKR route. More distant views from Hong Kong Island will be largely obscured by new development. Planting will provide an effective barrier between pedestrians and the road, although the narrow widths will require careful management to ensure a continuous screen. The Cherry Street flyover will continue to have an impact on Tai Kok Tsui, although planting proposals will screen the lower levels.

8.4.26 In visual terms it is unfortunate that visually sensitive residential areas are proposed in the area where the visual intrusion of the WKE, in the form of the Yau Ma Tei interchange, is greatest. The impact would be less significant on areas of manufacturing or commercial development. The impacts on proposed public and private housing, as already noted, will depend largely upon their setback from the WKE and the depth of buffer that is provided.

The development of screen planting within such areas, combined with the WKE landscape proposals, will again only prove effective at lower levels. The WKE and Yau Ma Tei interchange will remain highly visible from upper storeys and it is anticipated that the visual impact will be severe.

8.4.27 While planting will not provide an effective screen when viewed from above, it will provide much needed visual separation between the complex network of roads running throughout the area, particularly at the interchange, and as such reduce their apparent mass and uniformity. The screening effect of these proposals will be mainly experienced at ground level, where they will provide a visual buffer between the WKE and the distributor roads and a physical separation between motorists and pedestrians.

8.4.28 Noise mitigation methods will also influence the level of impact experienced. From the Jordan Road area to the interchange there are no visual implications from noise mitigation measures. However, to the north of the interchange as far as Cherry Street, three alternatives have been examined. The options are :

- o noise barriers;
- o noise louvres;
- o enclosed box structure.

8.4.29 The first option incorporates a noise barrier, approximately 3m high, along the east side of the WKE, with screen planting and earth mounding directly adjacent. From adjoining housing the impact of the barrier would be relatively low, with planting providing an effective screen. Of more significance, however, would be the severe impact due to the WKE itself, which would be highly visible from housing to the east. The planting buffer between the railway and the Expressway would provide a degree of visual protection but again this would be principally at low levels. To the west the alignment would be partially screened at ground level by a narrow band of planting between P1 and the pedestrian footpath.

8.4.30 Noise louvres would form part of an enclosed structure which would extend approximately 8m above ground level. Planting and mounding again would provide a low level visual screen, but when viewed by housing from above, the structure would form a highly intrusive element. However, louvres would largely screen traffic flow which is regarded as a significant visual benefit. The western edge of the structure would form a solid barrier abutting the northbound P1 and would be an obtrusive feature visible from both the road and pedestrian footpath adjacent to the PCWA. Proposed future housing in the reclaimed Typhoon Shelter would be similarly affected by this structure.

8.4.31 Though a structure enclosing the WKE will form a significant visual element it allows the development of open space on top of the structure, providing visual relief from the surrounding area and enables pedestrian links to be successfully established across the route corridor. The extent to which all of this will be possible will depend upon the type of cover proposed. Of variations suggested, a lightweight or partial cover would either preclude or restrict landscape treatment on the surface of the structure, and would be therefore of only marginal visual benefit. A full box cover would allow more extensive landscape treatment with the obvious visual benefits to the adjacent receivers. Furthermore, if the cover was extended across the northbound P1, mounding and screen planting might then be included against the western wall of the box, removing an otherwise obtrusive feature.

Impacts By Area - Northern Section

8.4.32 The WKE rises at a gradient of approximately 2.5% onto elevated structure at Cherry Street. Once land use has become established, the alignment will pass adjacent to areas of commercial, residential and open space development in the Tai Kok Tsui area. This will give way to areas of light/medium density manufacturing and the reprovisioned Wholesale Markets to the north towards Mei Foo Sun Chuen. Substantial buffers of open space may be allowed between the alignment and the existing housing areas at Nam Cheong and Mei Foo Sun Chuen.

Source of Impact

8.4.33 Two sources have been identified at the operational stage. The first is the elevated structure, which undulates in level along its length and secondly, the roundabouts/interchanges at Prince Edward Road, Tonkin Road and Route 16 accommodating the slip roads to the P1 distributor. While the CRA4 southbound link does not form part of this study, it is noted that it will extend some 22m above ground level at the Route 16 interchange, and as such will form a highly dominant element in the landscape south west of Mei Foo Sun Chuen.

8.4.34 The second is the noise barriers that this study suggests will be required at Tai Kok Tsui, Nam Cheong and Mei Foo Sun Chuen.

Landscape Proposals

8.4.35 Earthmounding has been used to provide embankments to the slip roads and roundabouts, which will be planted to reduce their visual impact. Ground modelling has been included in the amenity areas adjacent to the P1 and may be extended into the buffer zone at Nam Cheong.

8.4.36 Screen or buffer planting is limited by available space, and is restricted to narrow amenity strips adjacent to the P1, in the reserves between the AR and the WKE, and on the embankments to the roundabouts. However, more extensive woodland planting in the areas of dead ground at the Route 16 interchange has been proposed. Planting and level change have also been used to provide a visual separation between the pedestrian footpaths and the P1. Footpaths extend from Route 16 to the Prince Edward Roundabout, and from Road D6 to Cherry Street on the east and west of the alignment respectively.

Residual Impacts at Day of Opening

8.4.37 The most severe impact during the early stages of operation will be on the residential areas of Nam Cheong, Mei Foo Sun Chuen and the northern end of Tai Kok Tsui. More distant views from housing areas on Lai Chi Kok Road are anticipated, although these may be restricted by development on sites vacated by the relocated market.

8.4.38 The reprovisioned land uses, directly adjacent to the WKE, are rated as low sensitivity receivers, and although the Expressway will be highly visible from these areas the impact is not regarded as significant.

8.4.39 The proposed buffers at Mei Foo Sun Chuen and Nam Cheong, and to a lesser extent at Tai Kok Tsui, present the opportunity to carry out substantial earthmounding and advance screen planting. If planting is well established it will significantly reduce the visual impact on receivers at low level where it is regarded as most crucial. However these measures will not provide an effective screen when viewed from above.

Residual Impacts at 2011

8.4.40 The visual impact of the Expressway on the reclamation area will be reduced as development results in progressive narrowing of the visual envelope.

8.4.41 The planting on the embankment slopes of the roundabouts and in the narrow amenity strips along the intervening sections will soften the impact of the WKE, creating a partial screen at low levels to pedestrians and adjacent land uses. It will also serve to screen the AR which is located beneath the WKE. The elevated structure of the WKE will remain visible from upper levels of the adjoining buildings, but as land use will be mainly industrial the impact should not be significant.

8.4.42 The upper levels of the proposed housing areas to the south will experience open views down the alignment to the Prince Edward Roundabout and Cherry Street flyover. Although planting will help to soften the edge of the alignment the impact is regarded as severe.

8.4.43 Planting in the buffers at Mei Foo Sun Chuen and Nam Cheong will be relatively mature, which, subject to the height of the mounding adjacent to the alignment, may be sufficient to create an effective screen to all but the uppermost housing levels.

Mitigation of Operational Impacts

Extent of Mitigation by Landscape Proposals

8.4.44 Extensive areas of planting and earthmounding within the reclamation will be generally restricted by the competition for land use. Within the limited space available landscape measures have sought to maximise the landscape impact and will provide :

- o screening at low levels between the WKE and adjoining land uses (although in many cases this will not be a solid visual barrier);
- o visual separation between the hierarchy of roads, reducing their combined mass, or for example, at the Yau Ma Tei interchange through extensive ground modelling and planting;
- o visual and physical separation between the WKE and pedestrian footpaths;
- o a landscape edge to the WKE which will soften its visual impact;
- o screening to the AR where it runs beneath the elevated structure.

8.4.45 Although screen and buffer planting will extend the full length of the alignment there remain two principal areas of concern :

- o the potential impacts on upper levels of housing;
- o the effectiveness of low level screening.

8.4.46 Throughout much of the route, the Expressway will be plainly visible from upper floors of both existing and proposed housing. These viewpoints are the most difficult to mitigate and only with substantial buffer zones can sufficient planting and earthmounding be included to provide any degree of visual protection.

8.4.48 The effectiveness of the screen at low levels is perhaps of greater importance as it will be from these viewpoints that the alignment will appear most intrusive. With the exception of embankments to the roundabout and interchanges the available areas for planting are relatively narrow, frequently no more than 2-5m width. While planting may be dense, in many places only a partial screen will be afforded between the alignment and pedestrian or adjoining land uses.

Additional Mitigation Measures

8.4.49 More extensive landscape proposals and careful consideration at the detailed design stage of the WKE could reduce the visual impact of the alignment on the most severely affected areas.

Landscape Measures

8.4.50 To ensure adequate screening it is important that narrow belts of planting close to sensitive housing areas are supplemented, either as part of the WKE proposals or by ensuring that additional buffer strips are included as land use develops. The following measures are recommended :

- o buffer zones to existing housing at Man Cheong to reduce the impact of Yau Ma Tei interchange, P1 distributor and elevated sections of the Jordan Road extension;
- o buffer zones to existing housing at Tai Kok Tsui to reduce the impact of WKE and Cherry Street flyover;
- o buffer zones to proposed housing areas between Cherry Street and Jordan Road in order to provide an adequate screen to the WKE and Yau Ma Tei interchange;
- o screen planting along southern end of Ferry Street to reduce the impact of the Yau Ma Tei interchange;
- o advance planting and grading where feasible, particularly in the buffer zones of Nam Cheong and Mei Foo Sun Chuen.

Design of the WKE and Associated Structures

8.4.51 The visual impact of the WKE will be strongly influenced by the detailed design of its structures.

8.4.52 Elevated Structure : The Preliminary Report proposes that in-situ methods be used for the Southern Section, and precast segmental methods for the Northern Section, in preference to in situ or precast U-beam decks.

8.4.53 In visual terms the in-situ and precast box girder decks are the best options, because they have the shallowest elevation. Both have a cantilevered edge which will cast shadow and break up the apparent mass of the structure. The U-beam deck provides minimal overhang and appears more massive. In-situ and precast segmental options minimise the number of piers required, which is a significant visual benefit.

8.4.54 Any design features which reduces the apparent mass of the concrete structure should be investigated in the detailed design stage.

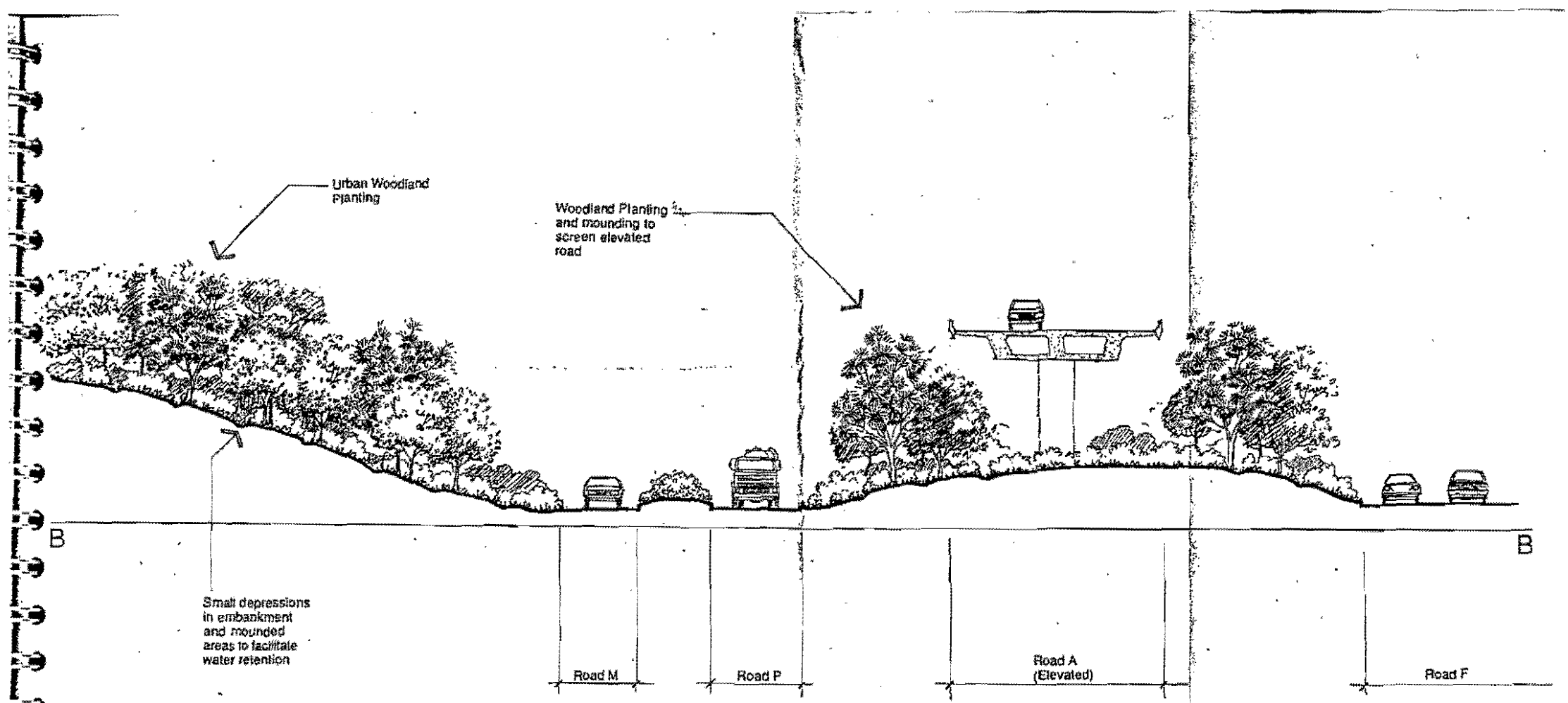
8.4.55 Elevated Interchanges and Roundabouts : Extensive earthmounding has been proposed as it is cost effective, restricts the lengths of elevated road and it elevates planting to provide a more effective screen of the alignment. At Yau Ma Tei the opportunity has been taken to vary the slopes and so avoid the monotony of a constant gradient. Where possible this variation should be extended to other areas during detailed design stage.

8.5 SUMMARY OF KEY ISSUES

8.5.1 The visual assessment has identified a number of key issues that should be addressed :

- o the severe visual impact at the construction stage on sensitive residential areas at Man Cheong, Tai Kok Tsui, Nam Cheong and Mei Foo Sun Chuen; particular attention is drawn to the construction impact of the Yau Ma Tei Interchange;
- o the severe visual impact at the operational stage on both existing and proposed housing areas; while substantial buffer areas of open space are proposed at Mei Foo Sun Chuen and Nam Cheong, it is equally important that similar provision is considered for proposed new housing areas;
- o the permanent visual intrusion of the Yau Ma Tei Interchange on adjacent receivers;
- o the need to implement advance landscape measures in the most sensitive areas;
- o the continued need to ensure environmentally sensitive design of the Expressway.

8.5.2 Final decisions regarding land use on the reclamation, development setbacks, and noise mitigation measures, have still to be made. The enclosed section of the WKE, in particular, would benefit from a more detailed visual impact study once decisions have been taken on these aspects.



SECTION B. - B. YAU MA TEI INTERCHANGE

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

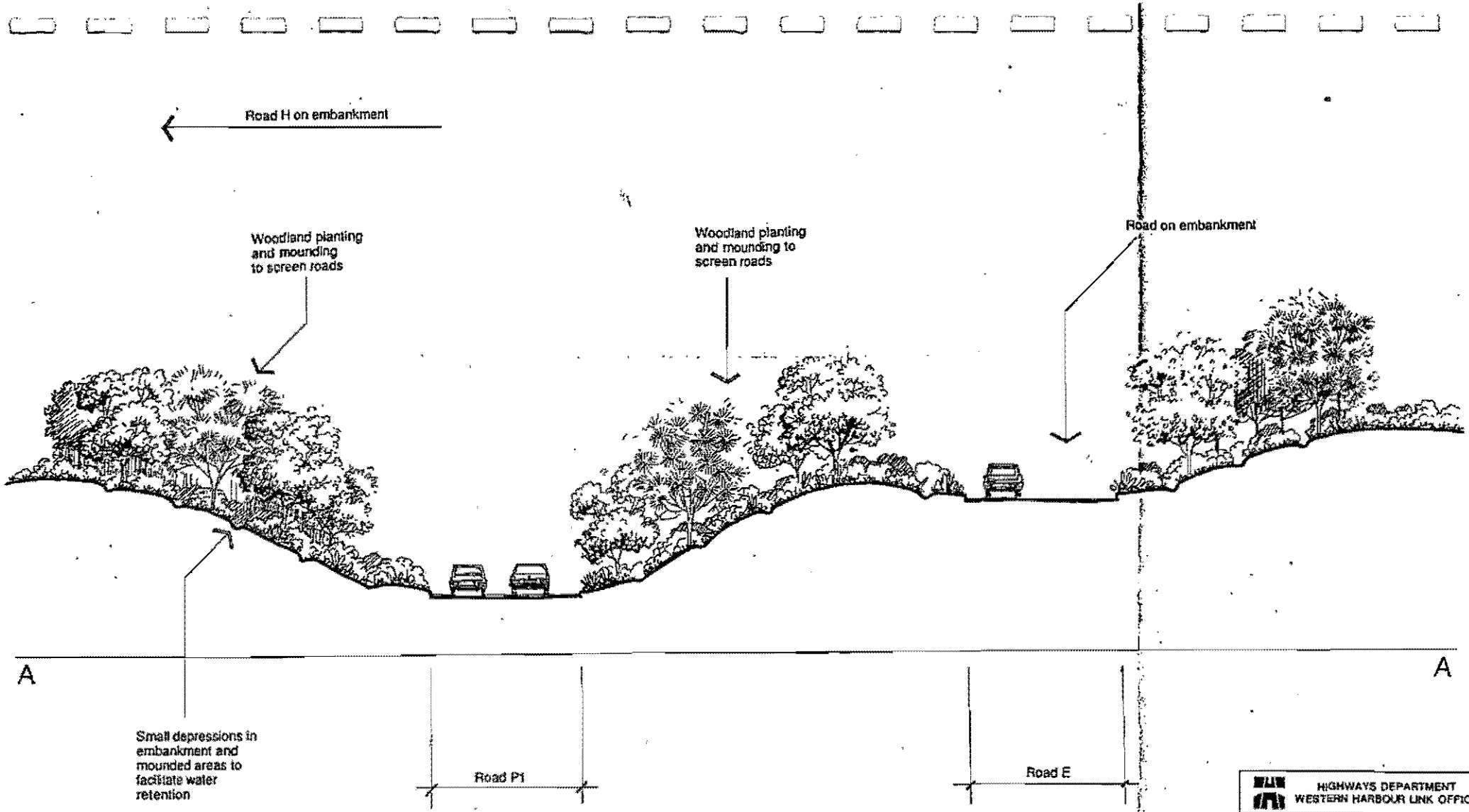
WEST KOWLOON EXPRESSWAY

YAU MA TEI INTERCHANGE
SECTION B - B

FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental

FIGURE 8.4

Date FEB 91 | Scale NTS.



SECTION A. - A. YAU MA TEI INTERCHANGE

HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

WEST KOWLOON EXPRESSWAY

YAU MA TEI INTERCHANGE
SECTION A - A

FREEMAN FOX MAUNSELL
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MVA Asia Clouston
Acer Environmental

FIGURE 8.3

Date FEB 91 | Scale NTS.

Summary of Impacts

9. SUMMARY OF IMPACTS

9.1 GENERAL

9.1.1 A proposed development of the size of the WKE will inevitably lead to some loss of amenity and will involve temporary (although still lengthy, i.e. up to 3 years) construction impacts and long term operational impacts. Much of the surrounding land in the WKR will not be developed during the construction phase and will be progressively developed during the operational phase.

9.1.2 The anticipated construction activities and traffic predictions used in this EA are estimates based on the assumed construction programme.

9.1.3 The potentially significant environmental impacts associated with the proposed construction and operation of the WKE are considered to be related to noise, air quality, water quality, land use and visual aspects. These aspects are discussed in Sections 9.2 to 9.6 and the impacts are summarised in Table 9.1 Summary of Impacts - Construction Phase and Table 9.2 Summary of Impacts - Operational Phase, and in Figure 9.1 Potential Impact Summary Map.

9.1.4 The available mitigation for the construction phase includes:

- o adoption and enforcement of good site practice (GSP);
- o control of pollution at source wherever possible;
- o use of low impact techniques (such as marine transport of construction and waste materials) wherever practicable;
- o adoption and enforcement of the mitigation measures identified in the respective Chapters.

9.1.5 The available mitigation for the operational phase includes:

- o installation and adoption of the mitigation measures identified in the respective Chapters;
- o adoption of appropriate land use layouts;
- o use of low impact materials (such as low noise road surfacing);
- o promotion and enforcement of vehicle emission controls.

9.1.6 Noise impacts will be the dominant environmental impacts in most cases and they will therefore be the determining land use constraint.

9.2 NOISE IMPACTS

9.2.1 There will be significant potential noise impacts associated with both the construction and operation of the WKE. Noise impacts are anticipated as being the most significant environmental impact and the greatest constraint on land use within the WKR arising from the WKE.

Construction Phase

9.2.2 Noise producing construction activities will include:

- o piling;
- o pile cap construction;
- o pier construction;
- o superstructure construction;
- o roadworks;
- o works area activities.

9.2.3 The recommended day time noise limits should be achievable at all sensitive receiver locations with minimal efforts. However, noise control measures would be required for the contractors to comply with the ANL at night.

9.2.4 Night time working on the WKE is likely and will include 24 hour working for deck construction in the works area near Mei Foo Sun Chuen. Mitigation will be required for the Northern Works Area and deck construction at Wong Tai Street and Fat Tseung Street if works are to continue into the night. In addition, significant noise impacts could occur at all receivers in the Northern Section if general construction work proceeds through the evening and the night. Maximum construction noise levels are likely to exceed 10-15 dB(A) of the ANL in the nightime over a substantial period of the construction phase.

9.2.5 Construction traffic is unlikely to contribute much to the noise levels produced by other site activities except at locations close to haul routes (Mei Foo Sun Chuen and Man Cheong Street).

9.2.6 Percussive piling may be required for the Cherry Street Flyover and a construction noise permit would be required for this activity.

9.2.7 Options for mitigating construction noise have been suggested. The most effective single noise control measure is to include noise control limits and the requirements for noise monitoring in the tender and contract documents. The recommended day time noise limits should be achievable at all sensitive receiver locations with minimal efforts. However, noise control measures would be required for the contractors to comply with the ANL at night.

Operational Phase

9.2.8 Future road traffic noise could impose severe constraints on noise sensitive development on the WKR. Even with quiet type road surface, road traffic noise is likely to render some 250-500m of the reclaimed land on either side of the WKE incompatible with noise sensitive development if no mitigation treatment is incorporated. Mitigation measures which have been investigated include the use of noise barriers, noise louvres and enclosure of roadways.

9.2.9 Mei Foo Sun Chuen and the residential buildings in Ferry Street and Man Cheong Street are unlikely to be adversely affected by future traffic noise because of the setback distance. However, Nam Cheong Estate and the residential buildings in Wong Tai Street and Hoi King Street are likely to be adversely affected and the use of noise barriers is proposed.

9.2.10 For the section between the Yau Ma Tei Interchange and Cherry Street which is identified for residential development, full enclosure of the WKE and the P1 southbound together with overhead development atop the proposed Tai Kok Tsui Station would substantially reduce incompatibility. Similar noise benefit could be obtained with louvres covering the WKE and P1 (S/B) instead of enclosing the roads but would place some constraints on adjacent development.

9.3 AIR QUALITY IMPACTS

9.3.1 The potential air pollutants will be limited to dust from construction related activities and particulates and gaseous emissions from vehicles during the operation of the Expressway.

Construction Phase

9.3.2 There will be numerous construction activities which will give rise to dust. These include:

- o excavation and earthworks including backfilling;
- o concrete batching;
- o aggregates stockpiling;
- o spoil heap formation;
- o truck and vehicle movements.

9.3.3 Predicted dust emission concentrations were calculated using models with information on likely emissions from various activities and typical meteorological conditions used as input data. The EPD guideline for the maximum particulates level in air as a 1 hour average is 500 ug/m^3.

9.3.4 The prevailing winds are likely to be easterlies and this will help in blowing dust away from the SRs for much of the time, however mitigation measures will be required for concrete batching and truck movements on unpaved haul roads. General dust sources should also be controlled/mitigated wherever reasonable as part of good site practice.

9.3.5 The dust control measures recommended for concrete batching plants are:

- o cement storage in closed silos with filters and high level alarms;
- o all movement and transfer activities covered;
- o paving of work areas;
- o wetting of work areas;
- o wheel washing.

9.3.6 The dust control measures recommended for haul road emissions are:

- o temporary hard surfacing wherever practicable;
- o frequent water spraying and cleaning of the surface;
- o restriction of vehicle speeds;
- o wheel washing at site exits;
- o use of damping and dust covers on potentially dusty loads.

9.3.7 A greater than 90% dust control efficiency will be required to reduce worst-case situations to acceptable levels. The incorporation of dust control and mitigation measures into construction contracts is essential.

Operational Phase

9.3.8 The main air pollutants in the vehicle emissions will include carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons, lead and particulates. For some of these maximum acceptable concentrations in air are included in the AQOs.

9.3.9 Ambient pollutant concentrations for the study area have been obtained from EPD's Sham Shui Po and Central Western monitoring stations as well as a short baseline study for CO.

9.3.10 Realistic worst-case situations including vehicle emission factors and meteorological conditions have been assumed and used in a model to predict potential impacts for the air quality in the vicinity of the WKE.

9.3.11 It is anticipated that the recent introduction of lead free petrol and the introduction of a requirement for catalytic converters to be fitted to all new cars (Starting 1 January 1992) will significantly reduce the lead, CO NOx and hydrocarbon emissions by the time the WKE is operational.

9.3.12 Identified locations for potential air quality impacts include the neighbourhood of the Yau Ma Tei Interchange and near the section between the Prince Edward Road Roundabout and Yen Chow Street extension.

9.3.13 Future vehicle emissions are unlikely to result in major impact on the air quality of the WKR. In view of the dominating effect of noise, it is unlikely that air quality will impose a constraint on land use development on WKR. It has been noted that certain wind conditions (low directional variability) could render about 130m of the land westward of the section between Cherry Street and Yen Chow Street extension unsuitable for sensitive land use development.

9.4 WATER QUALITY IMPACTS

9.4.1 There is potential for significant water quality impacts to occur during the construction phase of the WKE. However it is not considered that the operational phase will give rise to any significant water quality impacts.

9.4.2 The main potential source of impacts during the construction phase will be contamination of run-off and drainage water by spillage and washout etc. of construction chemicals, cement, fuel, oil and general soil and silt. Of particular note is the anticipated need for a concrete precasting site which is proposed to be located at a sensitive location (See Figure 2.1) in terms of proximity to what will be an enclosed water body between Stonecutters Island and Lai Chi Kok and the reprovisioned MTR water intake at Lai Chi Kok.

9.4.3 The significance of any impacts will be dependant on the water quality of the receiving waters of North West Kowloon at the time of construction. This will itself depend on a number of factors including the implementation of Sewage Master Plan improvements and possible achievement of WQOs and also the potential adverse affects of the WKR.

9.4.4 It is understood that site run-off will not be subject to discharge consents. The main mitigation measures will be enforcement of good site practice including the provision of interceptor channels and settlement tanks.

9.4.5 It is considered that strict monitoring of the mitigation measures will be required and suitable control clauses should be included in contract documentation. The monitoring requirements are discussed below in Section 9.7.

9.5 LAND USE IMPACTS

9.5.1 The WKE will be a major constraint to the development of the WKR. It is inevitable that a road proposal of this scale will have significant land use impacts. These will include not only direct effects such as disruption, land take and severance, but also constraints imposed on future land use and urban design due to noise, air and visual impacts in particular. In general, impacts during construction should be fairly limited, as few land uses will be in place at that time but impacts during operation may be more severe.

Construction Phase

9.5.2 Land use impacts during construction will generally be concentrated at a limited number of points within the existing hinterland, where established land uses may be affected by:

- o construction activities at nearby works areas and sites;
- o construction traffic, generating noise, dust and general nuisance;
- o temporary land take and severance.

9.5.3 The main sensitive receivers will be on the existing waterfront, where there are a number of densely populated residential areas.

9.5.4 At Yau Ma Tei the waterfront has a mixture of commercial and residential uses. The main sensitive receiver is the prominent, 16 storey residential development at Man Cheong Street, which protrudes physically and visually into the reclamation area.

9.5.5 Tai Kok Tsui, similarly, protrudes into the reclamation area. Although there is commercial use at its southern end, and industrial use to the north, it is largely residential. A school and college are also found on Cherry Street. Further north, at Sham Shui Po, are Tung Chau Street Park and public housing at Nam Cheong Estate. Building height at both Tai Kok Tsui and Nam Cheong Estate is around 15 storeys. On Fat Tseung Street, Sham Shui Po, there is a temporary housing area.

9.5.6 Mei Foo Sun Chuen, a private housing estate of 20 storey blocks, is the most important sensitive receiver in the Lai Chi Kok vicinity. In addition to housing, a school and waterfront walkway will be affected.

9.5.7 The scope for mitigation of land use impacts during construction is often limited. The best mitigation is to avoid siting construction activities close to sensitive receivers, and this principle has been applied in choice of construction sites and accesses. Additional mitigation measures are largely confined to controls over noise and dust emissions, and enclosure or screening of works and haul routes.

Operational Phase

9.5.8 The main direct sources of land use impact are noise, air quality and visual impacts, which in turn create impacts in terms of development potential, land values, land take and severance. Although there will be some impacts upon existing land uses that will be retained in future (especially at Man Cheong Street, Tai Kok Tsui, Nam Cheong Estate and Mei Foo Sun Chuen), the most important sensitive receivers will be the future planned land uses of the reclamation.

9.5.9 Given that the WKE's horizontal and vertical alignments were largely fixed prior to the start of the study, the ability to prevent or mitigate land use impacts through design of the Expressway is limited. In addition, as the WKE and its distributors are essential to the future transport network of the reclamation, many of its land use impacts are inevitable. Nonetheless, there is some scope to mitigate land use impacts through good road design - particularly through integral noise mitigation and landscape measures.

9.5.10 As the land use pattern for the reclamation is not yet finalised, there is also scope to adjust the layout of land uses to help mitigate the impacts of the WKE. It should be noted that this type of mitigation, although very effective, is beyond the remit of the Highways Department, and will require the agreement and cooperation of other departments if it is to be implemented. Cooperation of the Planning Department and Urban Services Department will be especially important in respect of suggested changes in land use zoning and the future adoption and maintenance of adjacent open spaces and buffers.

9.5.11 In addition, there will be significant potential during the detailed design of developments next to the Expressway to further mitigate land use impacts, for example through noise shielding and acoustic insulation. This will require action by developers and their architects and engineers.

9.5.12 The main conclusion of the assessment is that the Expressway does significantly constrain development potential within the WKR. The overriding constraint is noise, which places fairly severe limitations upon land availability of residential and other noise-sensitive development.

9.5.13 The area of greatest impact is north-east of Yau Ma Tei Interchange. However, problems can largely be overcome through enclosure, commerical development above Tai Kok Tsui Station, and development of a non-sensitive commercial shield close to the interchange.

9.5.14 A second area of major potential impact is the land to the west of the Expressway between Cherry Street and Prince Edward Road, which is now proposed for public housing in the short term. As development proposals stand at present, housing would need to be set back from the Expressway by around 400m, with a significant loss of potential housing land. Further noise assessment and land use planning work to address this problem should form part of the WKRS.

9.6 VISUAL IMPACTS

9.6.1 Significant impacts will occur during both the construction and operational phases. The construction related impacts will be of a temporary nature albeit in many cases for quite lengthy periods and will extend beyond the route corridor. Operational impacts will be confined to the more immediate alignment.

9.6.2 It needs to be understood that while guidelines exist there are no rules or regulations regarding visual impact assessment and although it may be obvious when a development will be visually significant it is often more difficult to decide if it will be significantly detrimental to the amenity and aesthetics of the general environment and the identified impact receivers. This is particularly the case in Hong Kong.

9.6.3 Sensitive receivers are taken to include residential areas, public open space and institutions such as schools and hospitals.

Construction Phase

9.6.4 Principal sources of impact will be from works areas, construction accesses and the general activities along the route corridor. Particularly significant items will be the proposed northern works area, the Yau Ma Tei Interchange and the accesses at Man Cheong Street, Tonkin Street extension and Po Lun Street extension.

Southern Section

9.6.5 The magnitude of the interchange development, both in terms of height of structure and area under construction, will have the most impact upon immediate receivers. The most severe impact will be experienced by the housing area at Man Cheong, partly due to the construction of the interchange but also as a result of the proximity of the P1 distributor and the Jordan Road extension. The impact will be reinforced by the construction traffic entering the reclamation area along the northern end of Man Cheong.

Northern Section

9.6.6 The level of impact associated with the construction of the elevated structure will be relatively uniform with areas of concentrated activity at proposed interchanges. (Prince Edward Road, Tonkin Street and the interchange with Route 16). In addition Tonkin and Po Lun Streets will form access routes for construction traffic reinforcing impacts in these areas. A major works area will be located south of Mei Foo Fun Chuen and south-west of the Expressway.

9.6.7 The most sensitive receivers in this area are the residential developments at the northern end of Tai Kok Tsui, Nam Cheong and Mei Foo Sun Chuen. A buffer of open space, 150m wide will exist between the alignment and housing at Nam Cheong and Mei Foo Sun Chuen. The impact on Mei Foo Sun Chuen will be reinforced by the location of the works area to the south and by the scale of activity associated with the Route 16 interchange. A further concern is the impacts on these areas at night if 24 hour operations are necessary, requiring extensive lighting in both the works area and construction zone.

9.6.8 Possible mitigation measures include:

- o careful attention to site layout
- o advance planting
- o temporary screen planting
- o ground modelling

Operational Phase

9.6.9 The visual envelope will initially be the existing waterfront but will change as development proceeds. The proximity of the alignment to receivers and the vertical alignment (and its form) will be the determining factors for impacts.

9.6.10 Particularly significant elements of the WKE causing impact include:

- o the at-grade or slightly depressed Southern Section where mitigation options include enclosed structure and noise barriers;

- o the elevated Northern Section which will create a distinct visual barrier;
- o interchanges and roundabouts which are elevated and will form dominant visual features;
- o noise barriers which may be required at Tai Kok Tsui, Nam Cheong and Mei Foo and will significantly add to the depth, and therefore impact, of the elevated structure.

9.6.11 The landscape strategy aims to mitigate visual impacts; however, given the scale of the likely development on the WKE it will be unlikely to provide more than a partial screen and principally to low level receivers.

9.6.12 The proposed extensive use of embankments thoughout the Yau Ma Tei Interchange will provide visual interest and reduce visual impact as will many of the landscape proposals such as screen planting and earthmounding.

9.6.13 As development of land use on the reclamation proceeds, the impact of the WKE on existing receivers will gradually diminish at lower levels but in the Southern Section there will remain severe at upper levels of residential areas at Man Cheong and Ferry Street and on proposed housing in the reclamation. In the Northern Section planting and earthmounding in open space buffers will create an effective screen to lower levels sensitive receivers. Areas where industrial areas are proposed are not considered to be visually sensitive.

9.6.14 Design features which reduce the apparent mass of the elevated concrete structure should be investigated in the detailed design stage. Of the three forms proposed in situ and precast concrete decks are prefered to U beam construction because of the reduced sectional detail.

Table 9.1 SUMMARY OF IMPACTS - CONSTRUCTION PHASE

Impact Category	Location	Impact	Mitigation Measures or Control	Net Impact
Noise (Day works)	Wong Tai Street Hoi King Street Ferry Street	***	Section 4.2.37	*
Noise (Percussive Piling)	Southern Section	***	Construction Noise Permit	**
Noise (Night works)	Mei Foo Sun Chuen Fat Tseung Street THA Wong Tai Street	***	Construction Noise Permit & Section 4.2.37	**
Noise (Construction Traffic)	Mei Foo Sun Chuen Man Cheong Street	***	Section 4.2.37	*
Air Quality (Dust from Concrete Batching)	Mei Foo Sun Chuen Ferry Street Man Cheong Street	**	Air Pollution Control (Specified Processes) Regulations & Section 5.2.21	*
Air Quality (Dust from Unpaved Haul Road)	Mei Foo Sun Chuen Fat Tseung Street Nam Cheong Estate Wong Tai Street Hong King Street Cherry Street Ferry Street Man Cheong Estate	***	Section 5.2.22	*
Water Quality	The whole Water Zone	**	Section 6.2.15	*
Landuse	Mei Foo Sun Chuen Nam Cheong Estate Tung Chau Street Park Cherry Street Yau Ma Tei Residential Area Man Cheong Street	***	Avoid Site construction activities close to SRs	*
Visual	Residential area at Mei Foo Sun Chuen Nam Cheong Estate Tai Kok Tsui & Man Cheong Street (particularly around Interchanges, Roundabouts & Flyovers)	**	Section 8.3.16	*

Key: * Slight Impact
** Moderate Impact
*** Severe Impact

Net Impact column assumes mitigation measure adopted.

Table 9.2 SUMMARY OF IMPACTS - OPERATIONAL PHASE

Impact Category	Location	Impact	Mitigation Measures	Net Impact
Noise	Whole route	***	Quiet type road surface	**
Noise	Mei Foo Sun Chuen	***	Double 3m Noise Barriers	*
Noise	Nam Cheong Estate & Tai Kok Tsui	***	Double 3m Noise Barriers for Expressway, 3m Noise Barrier for P1 (S/B)	*
Noise	Section between Cherry Street & Yau Ma Tei Interchange	***	High-rise Commercial Development over the Tai Kok Tsui Station, 230m of full Enclosure of Expressway and P1 (S/B), non-sensitive Development around the south-western corner	*
Air Quality (NO_2)	Road sides and YMTI	***	Non sensitive landuse	*
Landuse	North-east of YMTI	***	Enclosure and Commercial Development above Tai Kok Tsui	*
Landuse (Residential development)	West of WKE at Tai Kok Tsui	***	150m setback for housing development	*
Visual	Northern Section (Elevated Structures)	***	Embankment, Ground Modelling, Screen Planting, Buffer Zone	**
Visual	Northern Section (Roundabouts/Interchanges at Prince Edward Road, Tonkin Street and Route 16 accommodating the slip roads to P1)	***	Embankment, Ground Modelling, Screen Planting, Extensive Woodland Planting, Buffer Zone	**
Visual	Tai Kok Tsui & Nam Cheong Estate (where noise barriers are proposed)	***	Separation	**
Visual	Southern Section (particularly around YMTI)	***	Depressed Section of Road, Embankment, Extensive Woodland Planting, Screen Planting	**

Key: * Slight Impact
** Moderate Impact
*** Severe Impact
YMTI = Yau Ma Tei Interchange

9.7 MITIGATION COSTS

9.7.1 It is important to quantify the proposed mitigation measures in terms of costs. This is possible for the noise mitigation measures and estimates have been provided in Section 10.4 of Volume 1 of the Preliminary Report.

9.7.2 The key noise mitigation measures which are proposed in order to achieve the limits set by the HKPSG for the WKE and P1 and their estimated associated costs are summarised in Table 9.3 Noise Mitigation Costs. These estimated costs are at June 1991 prices and do not allow for the associated noise and air modelling work which would be required for the covered/enclosed sections. For each location the preferred mitiation option, from a combination of environmental and cost considerations, is given first, except for Yau Ma Tei. Here the second and more costly option is the preferred environmental option as the higher load bearing capacity will permit much greater landscaping and visual mitigation measures to be provided.

9.8 ENVIRONMENTAL MONITORING AND AUDIT

9.8.1 It is customary to determine the significance of potential environmental impacts by relating them to the existing environmental baseline conditions prevailing prior to the commencement of the proposed development. As the WKE will be constructed into new reclamation it has not been appropriate to carry out any baseline monitoring at this stage for use in the EA. Some baseline monitoring could be carried out prior to the commencement of the construction phase.

General Monitoring and Checking Requirements

9.8.2 In order to check that the construction and operational impacts are kept to acceptable levels and to ensure that the various control and mitigation measures are effective, environmental monitoring will be required. This involves monitoring for noise levels, air quality, water quality, checking on good site practice and compliance with the various control and mitigation measures identified in this report on a frequent and regular basis as part of a monitoring programme.

9.8.3 The monitoring requirements for each aspect are different and it is not possible to suggest a single monitoring programme which is applicable to all aspects. Therefore the monitoring requirements have been discussed individually for each environmental impact category in the respective chapters of this report. The monitoring requirements for both the construction phase and the operational phase are briefly discussed below and are summarised in Table 9.1 Environmental Monitoring Summary - Construction Phase and Table 9.2 Environmental Monitoring Summary - Operational Phase.

9.8.4 The project is currently at the outline design stage and definitive decisions have not yet been made regarding a number of aspects including construction methods and location of work compounds and activities etc. The monitoring programme reflects this by being more general in certain instances and will need to be developed and confirmed at the detailed design stage.

9.8.5 It is understood that it is proposed to entrust the environmental compliance monitoring to the construction contractors i.e. self monitoring. This will only be a credible approach if there is strict provision for environmental monitoring contained within the construction contracts and a checking/audit role clearly given to the Resident Site Engineer or an appropriate independant organisation.

Table 9.3 Noise Mitigation Costs

Location	Noise Level at Design Year (1) dB(A) L_{10}/hour 2001	2011	Mitigation Option	Estimated Cost ($million)
Mei Foo Sun Chuen	73.1	73.3	1 3m high* concrete noise barrier on both carriageways of Expressway viaduct (1660m)	3.6
			2 3m high* Plexiglass noise barrier on both carriageways of Expressway viaduct	17.1
Nam Cheong Estate	73.1	74.0	1 3m high* concrete noise barrier on both carriageways of Expressway viaduct (1380m) and concrete noise barrier 3m high on P1 southbound (435m)	4.5
			2 3m high* Plexiglass noise barrier on both carriageways of Expressway viaduct (1380m) and 3m high Barrier on P1 southbound, with 2m of Plexglass (435m)	20.3
Tai Kok Tsui	73.5	74.2	1 Corrugated steel cover on Expressway viaduct southbound (220m) including ventilation and lighting and 3m high concrete barrier on P1 southbound (200m)	16.2
			2 Plexiglass cover on Expressway viaduct southbound (220m) including ventilation and lighting and 3m high concrete barrier on P1 southbound, with with 2m of Plexiglass (200m)	40.5
			3 Provision of insulated single glazed windows and air conditioning including running and maintenance costs for air conditioning (per annum) (refer Volume 1 10.4.2.6)	8.9
Yau Ma Tei	N/A	76.0	1 Noise cover including ventilation and lighting (5kPa loading); or	116.0
			2 Noise cover including ventilation and lighting (12kPa loading)	137.0

* Taking into account the profile barrier, additional height of barrier is about 2.2m.

(1) Noise levels in this Table are the maximum predicted noise levels at various locations along existing or assumed facades for both 2001 and 2011. The use of low noise open textured surfacing on both WKE and P1 has been taken into account.

During Construction

9.8.6 The anticipated environmental impacts associated with the construction of the WKE which will require monitoring and/or checking of control and mitigation measures will be noise, air quality (dust and fumes) and water pollution aspects. Monitoring should be carried out by the contractor and/or the Resident Site Engineer in accordance with the monitoring programme. For each construction site works area a check list should be prepared relating to each of the environmental issues identified in the EA, together with clauses in the contract documentation related to environmental issues. This check list will form the basis of a pro-forma for Environmental Monitoring.

Noise

9.8.7 Noise monitoring will be required and should be carried out to check for compliance with the noise control standards in force in the contract and the requirements of any Construction Noise Permit. It is noted that monitoring will not be required during restricted hours under the NCO. Measurements should be made at the facade of the worst affected receivers and also at the noise source where appropriate.

Dust

9.8.8 Regular checking that dust suppression/control measures are being carried out will be required.

9.8.9 Monitoring for airborne dust (as TSP or RSP) should be carried out at nearest SRs using high volume sampling over 24 hour periods.

Fumes

9.8.10 The checking of GSP and in particular careful location of and regular maintenance/servicing of diesel plant will be required.

Water Quality

9.8.11 Regular checking of settlement tanks, interceptors and other water sediment control measures will be required as will frequent checking of the pH of discharged waters from locations near to concrete/cement preparation areas.

During Operation

9.8.12 The anticipated environmental impacts associated with the operation of the WKE are linked to noise, air (fumes) and water pollution aspects. Monitoring should be carried out by the operators to meet the requirements specified in the Environmental Monitoring Summary Table 9.2. This monitoring should ensure that any unforseen environmental impacts wil be detected and timely action can be taken to rectify any problems.

Noise

9.8.13 It would be anticipated that some intensive monitoring would be required during the early operational lifetime of the WKE in order to characterise and confirm the noise environment. After this, regular (perhaps every 3 years) noise monitoring assessments would be appropriate.

Air (Fumes)

9.8.14 The data from the existing air monitoring stations should be supplemented by a short term monitoring programme which would be agreed with EPD. It is likely that this would consist of some initial monitoring after the opening of the WKE and at regular but infrequent intervals thereafter.

Table 9.4 Environmental Monitoring Summary - Construction Phase

Parameter/Item	Monitoring Location	Frequency/Details
Noise	NSRs	Weekly, during noisy activities and as requested by RSE Leq (5 mins)
	At or near noise source	As appropriate
Air Dust	SRs on the alignment including Mei Foo Sun Chuen, Fat Tseung St. THA and residential areas in Ferry St. and Man Cheong St.	Weekly (more in event of complaints) High Volume sampling for TSP and RSP measured over 24 hr period
Fumes	At diesel plant etc.	As part of GSP checking
Water		
Settlement tanks and Lagoons	Within site area as appropriate	Weekly
Oil interceptors	Within site area as appropriate	Weekly
Cement related discharges	Discharge point or tank prior to discharge	Daily
GSP	Within the site as appropriate	Daily

Key NSR - Noise Sensitive Receiver
GSP - Good Site Practise
RSE - Resident Site Engineer
TSP - Total Suspended Particulates
RSP - Respirable Suspended Particulates

Table 9.5 Environmental Monitoring Summary - Operational Phase

Parameter/Item	Monitoring Location	Frequency/Details
Noise	NSRs	Programme to be agreed.* At peak traffic hours L10 (1-hr) Leq (1-hr) Leq (24-hr) Leq (1-hr)
Air NOx O_3 CO	SRs	Programme to be agreed.
Water		
Routine inspection of Sediment Traps	At appropriate drainage points	Monthly (or as per normal maintenance period)

Key : NSR - Noise Sensitive Receiver

* An initial monitoring exercise and approximately every 3 years thereafter is recommended.

Environmental Audit

9.8.15 The environmental monitoring results, records of any exceedance of regulatory requirement levels, reports of any public complaints and details of control and or mitigatory action taken to reduce any unacceptable environmental impacts should be kept by the Resident Site Engineer during the construction phase and the agreed Government Department during the operational phase. These can be forwarded to EPD at an agreed frequency as required.

9.8.16 It is considered that a review of the monitoring results should be carried out in order to identify any areas of concern which can be characterised and used to improve future monitoring programmes.

9.8.17 A review will also provide a mechanism for the WKE's monitoring results to be assessed in the longer term and for any unanticipated impacts to be addressed and as a check on the various assumptions and programmed events which have been used in this assessment.

9.9 FURTHER STUDIES

9.9.1 The proposed development of the WKR includes a number of significant projects (such as the AR and the completion of the Reclamation itself) which are scheduled at least in part for concurrent construction/development. These developments will contribute impacts to the overall environment and may well significantly add to the impacts predicted for the WKE. The assessment of the significance of these cumulative impacts is beyond the scope of this EA.

9.9.2 In that respect, it should be noted that the EA presented in this Volume is considered to fulfill the requirements of the current Brief. However, there are a number of further environmental studies which are essential. The requirement for some of these has been raised by Government Departments. These can most appropriately by carried out during the detailed design stage of the WKE when definitive decisions are being formulated and land use plans will be more advanced. These environmental studies may well result in overall cost savings on mitigation as they would consider the cost effectiveness of

the actual mitigation measures which are to be implemented. There is therefore a general requirement for environmental involvement in the further design process and apart from this, other outstanding areas for further study include the following:

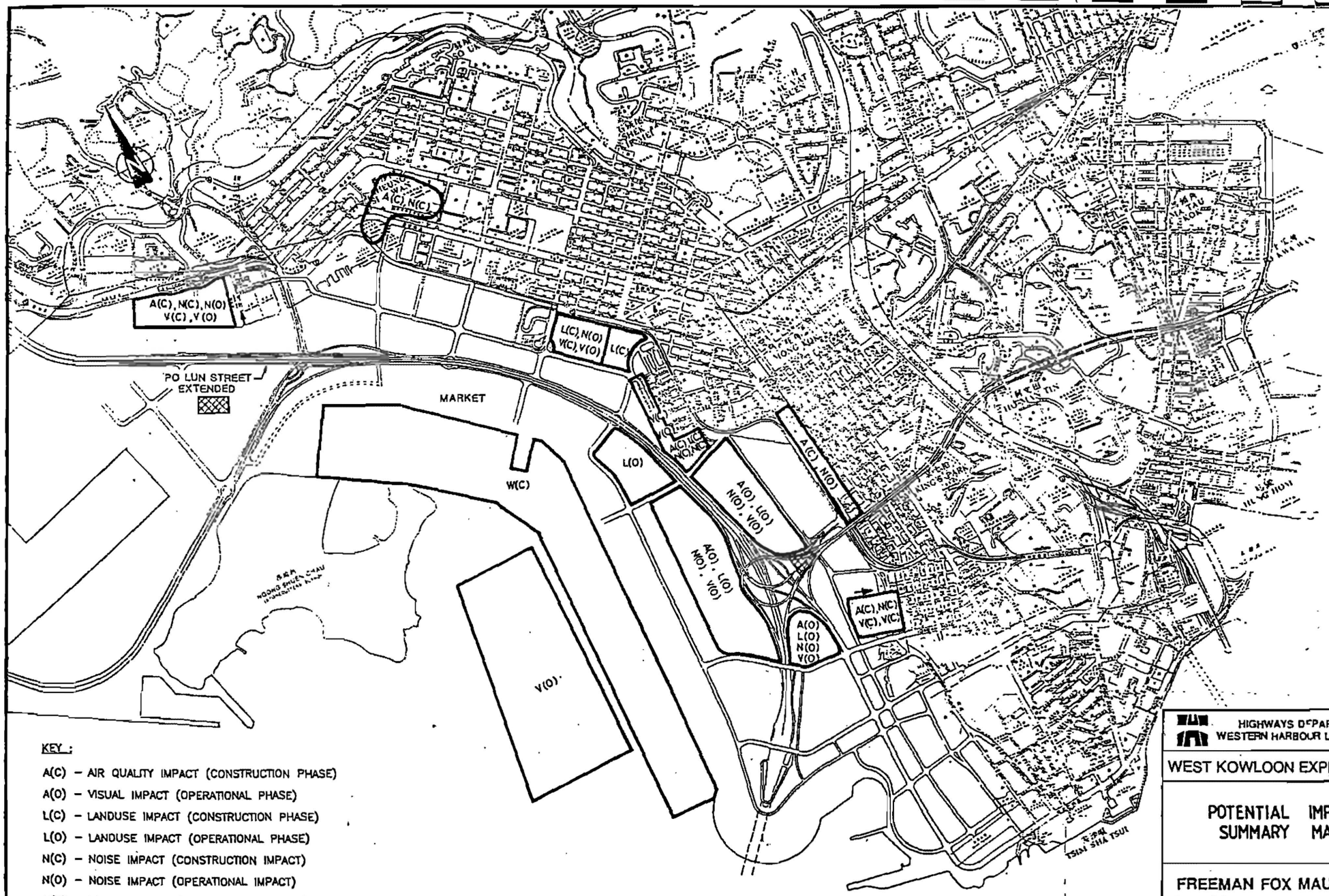
- As pointed out by EPD in their comments on the EA Working Paper the proposal for decking-over of sections of the Expressway as a mitigation measure will require detailed noise study of the reflection characteristics inside the enclosure. This will logically be carried out during the detailed design stage as the study will help to formulate the design and consider the best internal surface material.

- The air quality within the enclosed section will need to be assessed/predicted. This will help to decide if any mechanical ventilation will be required.

- Environmental protection/pollution control conditions will need to be produced for inclusion in Contract Documentation. This would include consideration of the existing 'standard' contract conditions for relevance and adequacy and also formulation of conditions which are specific to this project.

- Definitive mitigation proposals - especially for noise - cannot be made until clear decisions are taken on future land use. The actual 'fine tuning' of the mitigation proposals can only be carried out when the Draft Outline Development Plan for the WKR becomes available. It is recommended that more detailed noise assessment work be undertaken as soon as the Plan is ready so that the necessary mitigation can be built into the detailed design of the WKE.

- The proposals for monitoring requirements will need to be updated and refined as more information becomes available and decisions are made during the detailed design stage. This requirement was identified in para 9.7.4 of this report. This work would be carried out in conjunction with the formulation of contract conditions.



HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE

WEST KOWLOON EXPRESSWAY

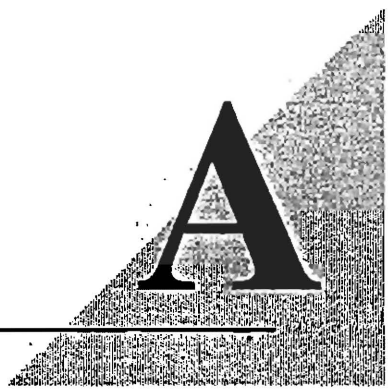
POTENTIAL IMPACT SUMMARY MAP

FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental

FIGURE 9.1

Date JAN. 1991 | Scale 1 : 20 000

Detailed Construction Programme



APPENDIX A

DETAILED CONSTRUCTION PROGRAMME

WKE - NORTHERN SECTION

Activity I.D. : 1. Elevated Expressway

(A) Piling

Description	:	Piling will be carried out in the north to south direction with all piling rigs working in close proximity at any one time, piles assumed to be machine bored piles 1.8m in diameter.
Working Period	:	Sept. 93 to Sept. 95
Working Hours	:	0700 - 1900
Location	:	From CP2 roundabout to Cherry Street
Equipment	:	Pile Boring machine 4 Mobile cranes 2 Concrete pump trucks 1 Concrete trucks 2

(B) Pile Cap

Description	:	Pile Cap construction which involves excavation for the caps, fixing reinforcement, concreting and backfilling. The work will be carried out as soon as piling work is completed, and so is expected to be in close vicinity to where piling is being carried out.
Working period	:	Nov. 93 to Dec. 95
Working Hour	:	0700 - 1900
Location	:	From CP2 R/A to Cherry Street
Equipment	:	Excavators 1 Backhoe 1 Earth moving truck 2 Compressor 1 Crane 1 Concrete pump truck 3 Vibrating poker 6 Roller 1

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WEST KOWLOON EXPRESSWAY

Volume 3
Environmental Assessment

June 1991

FREEMAN FOX MAUNSELL

in association with

MVA Asia

Acer / Environmental

Clouston

(C) Pier

Description	:	Pier construction will follow pile cap construction immediately. The work will involve steel fixing, form work erection and concreting.
Working Period	:	Nov. 93 to Dec. 95
Working Hours	:	0700 - 1900
Location	:	CP2 roundabout to Cherry Street.
Equipment	:	Compressor 1 Crane 1 Concrete pump truck 1 Concrete truck 3 Vibrating poker 6
Remark	:	These are expected to be shared with those for pile cap construction. Concreting for pile cap and pier will be carried out on different days.

(D) Superstructure

Description	:	Superstructure will be erected by joining precast bridge segments, using a hydraulically operated launching girder which should be relatively quiet. Precast bridge units will be cast in the works area and transported to site by special trucks in combination with a trolley and rail system.
Working Period	:	Aug. 94 - Dec. 95
Working Hour	:	24 hours
Location	:	From CP2 R/A to Cherry Street
Equipment	:	Launching girder 1 (24 hrs) Special Truck 1 (day time only) Compressor for 1 (day time only)

Activity I.D. : 2. Works in the Works Area.

Description : Activities in the Works Area will include :

- Batching plant operation
- Precasting of concrete bridge units & other precast units like edge barriers
- movement of materials

Working Period : Aug. 93 to June 96

Working Hours : 24 hours

Equipment :

Batching Plant	1
Concrete Trucks	2
Vibrating Poker	4
Compressor	1
Crane	1

Activity I.D. : 3. Roadwork

Description : Roadwork Comprises - Earthworks
Drainage works
Road surfacing work

Working period :

Earthwork	-	Sept. 93 to Mar. 95
Drainage works	-	Nov. 93 to Nov. 95
Road surfacing	-	Jun. 94 to Mar. 96

Working Hour : 0700 to 1900

Location : Along the transport corridor. It can be assumed that the road works will be carried out in different areas from the piling, pile cap and pier works; this will most likely be adopted by the contractor as a means of relieving construction congestion.

Because of site availability problem, the roadworks construction should generally proceed from north to south in general.

Equipment : Earth Work:-

Excavator	2
Roller	2
Trucks	2

Drainage Works:-

Backhoe	2
Truck with crane	

Road Surfacing Works:-

Roller	2
Dozer	1
Paver	1
Trucks	2

Activity I.D. : 4. Access Traffic

Description	:	Most traffic is associated with delivery of material to the site for construction of the reinforced concrete and roadworks. The main access route is the Po Lun Street Extended and gaining access to the Works Area.
Working Period	:	July 1993 to May 1996
Working Hour	:	0900 to 1700
Location	:	Po Lun Street Extension
Vehicles	:	600 vehicles per day in each direction.

Activity I.D. : 5. Internal Traffic

Description	:	Traffic is generated by (i) - delivery of material from works area to works site (ii) - movement of plant between sites (iii) - labour movement
Working Period	:	July 1993 to June 1996
Working Hour	:	0900 to 1800
Location	:	Within the Works site
Vehicles	:	1400 vehicles movements per day

WKE - SOUTHERN SECTION

Activity I.D. : 1. Earthwork

Description : The main earthwork consists of

- excavation for the slightly depressed expressway
- filling of the mounds in the YMT Interchange.

Working Period : August 93 to December 95

Working Hour : 0700 to 1900

Location : Excavation within the Expressway corridor. Ground modelling in the YMT Interchange.

Equipment :

Excavator	4
Trucks	8
Dozer	2
Roller	4

Activity I.D. : 2. Drainage and Road Surfacing Work

Description : Drainage & road surfacing work will be carried out in areas where earthwork is completed. These works will be mainly along the road, with some drainage works in the open areas/verges etc.

Working Period : October 93 to February 95

Working Hours : 0700 to 1900

Location : Mainly along proposed ground level roads.

Equipment : Drainage Works:-

Backhoe	3
Truck with crane	2
Roller	2

Road Surfacing Work:-

Dozer	1
Paver	1
Trucks	2

Activity I.D. : 3. Concrete Work

Description : A batching plant is expected to be erected in the Work Area.

Some precasting work will be carried out in the works area for precast concrete barriers.

It is expected that the contractor will try to programme the concreting works in such a manner that there only one major concreting operation is carried out at any one time.

Working Period : September 93 to June 96

Working Hour : 0800 to 1900

Location : In Bridge and culvert areas.

Equipment :

Compressor	2
Crane	2
Concrete pump truck	1
Concrete truck	4
Vibrating poker	6

Activity I.D. : 4. Access Traffic

Description : Access to the site is at present envisaged to be from:-

(1) Man Cheong Street
(2) Through area d7
(3) Through area d6

Access (3) above is not preferred as it is too close to (1) and also because it is connected to the busy Ferry Street. Therefore for the purpose of the environmental assessment it could be assumed that each of access (1) and (2) will carry 50% of the total access traffic.

Working Period : July 1993 to September 1996

Working Hour : 0800 - 1700

Location : From Man Cheong Street and area d7

Equipment : 200 vehicles in each direction per day per access

Activity I.D. : 5. Internal Traffic

Description	:	Internal traffic is generated by
		(i) - delivery of material from works area to works site
		(ii) - movement of plant between site
		(iii) - personal and labour movement
Working Period	:	July 1993 to June 1996
Working Hour	:	0800 to 1800
Location	:	Within the Works site
Vehicles	:	1700 vehicles movements per day

Sample Construction Noise Calculation

APPENDIX B

C. Pier

SWL = 122.3 dB(A)

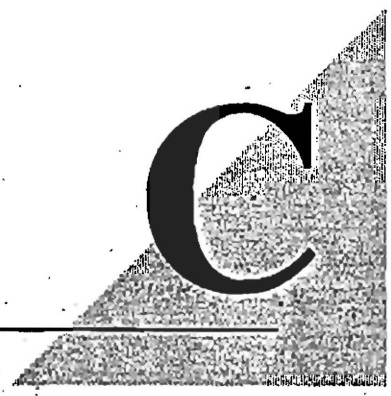
Receiver	Dist. (m)	Dist. Att. (m)	Barrier Effect (dB(A))	Facade Effect (dB(A))	Leq (dB(A))
MFSC	200	-54	0	+3	71.3
HWTI	350	-58.9	0	+3	66.4
FTS	200	-54	0	+3	71.3
NCS	200	-54	0	+3	71.3
WTS	100	-48	0	+3	77.3
HKS	240	-55.6	0	+3	69.7

D. Superstructure

SWL = 118.3 dB(A)

Receiver	Dist. (m)	Dist. Att. (m)	Barrier Effect (dB(A))	Facade Effect (dB(A))	Leq (dB(A))
MFSC	200	-54	0	+3	67.3
HWTI	350	-58.9	0	+3	58.9
FTS	200	-54	0	+3	67.3
NCE	200	-54	0	+3	67.3
WTS	100	-48	3	+3	73.3
HKS	240	-55.6	3	+3	65.7

Calculation of Emission Factors and Emission Rates



APPENDIX

APPENDIX C

CALCULATION OF EMISSION FACTORS AND EMISSION RATES

The following calculations were based on "Compilation of Air Pollutant Emission Factors" AP-42, Fourth Edition, 1985.

1. Unpaved Haul Roads

Emission factor = $K(1.7)(s/12)(s/48)(w/2.7)\ (w/4)0.5$ kg/veh-km

where

k	=	particle size multiplier	= 0.8 < 30 um = 0.36 < 10 um
s	=	silt content	= 15%
S	=	Mean vehicle speed	= 15 km/hr.
W	=	Mean vehicle weight	= 24 tonnes
w	=	Number of wheels	= 10

Substitution of the values gives

TSP (<30 um) : Emission factor = 3800 g/veh-km
RSP (<10 um) : Emission factor = 1700 g/veh-km

2. Concrete Batching

Emission factor = 0.12 kg/m3 (uncontrolled)

Assuming capacity of plant is 60 cu.m. per hour, the emission rate of TSP is 7.2 kg/hr.

3. Aggregate Stockpiling

$$\text{Emission factor} = 0.0009\ k \frac{(s/5)(U/2.2)(H/1.5)}{(M/2)\ (Y/4.6)} \text{ kg/Mg}$$

where

k = particle size multiplier = 0.73 (<30 um)
= 0.36 (<10 um)

s	= silt content	= 2% (for aggregates)
U	= mean wind speed	= 2m/s
H	= drop height	= 3m
M	= moisture content	= 2%
Y	= bucket size	= 2 cu.m.

Substitution of the values gives :

TSP emission factor = 0.00063 kg/Mg
RSP emission factor = 0.00031 kg/Mg

Assuming that the works area handles 500 tonnes of aggregate per day, the average emission rates are 35 g/hr. (TSP) and 17 g/hr. (RSP)

4. Excavation and Earthwork

Emission factor = 1.2 tons per acre of construction per month of activity

Composite Emission Factors as a Function of Vehicle Speeds

APPENDIX D

APPENDIX D

COMPOSITE EMISSION FACTORS AS A FUNCTION OF VEHICLE SPEEDS

(a) Automobile

Vehicle Speed (km/hr.)	CO (g/mi-veh.)	NOx (g/mi-veh.)
45	31.8	4.07
50	28.1	4.16
60	22.8	4.35
70	19.4	4.54

(b) Heavy Diesel

Vehicle Speed (km/hr.)	CO (g/mi-veh.)	NOx (g/mi-veh.)
45	16.9	24.7
50	14.7	25.3
60	11.5	25.3
70	9.2	27.1

Proposed Beneficial Uses and Water Quality Objectives for Victoria Harbour

APPENDIX E

APPENDIX E

PROPOSED BENEFICIAL USES (B.U.) AND WATER QUALITY OBJECTIVES FOR VICTORIA HARBOUR WATER QUALITY CONTROL ZONE

Parameter	BU	Water Quality Objective
Visible Pollution	Marine Life Domestic/Industrial Aesthetic	No objectionable odours or discolouration of the water. Tarry residues, floating wood, glass, plastic, rubber or any other substances should be absent. Mineral oil should not be visible on the surface. Surfactants should not give rise to lasting foam. There should be no recognizable sewage derived debris.
Bacteria (E. Coli)	Domestic/Industrial	Not to exceed 20,000/100 ml as the annual geometric mean 90%.
Dissolved oxygen	Marine Life	Not less than 4mg/l or 60% saturation, column average, for 90% of sampling occasions. Not less than 2mg/l or 30% saturation within 2m of bottom on 90% of occasions.
	Domestic/Industrial	Not to fall below 2mg/l at point of intake.
Ammonia	Marine Life	Not more than 0.021mg/l annual average, as un-ionised form, to protect fish.
	Domestic/Industrial	
Temperature	Marine Life	Not raised by more than 2°C by discharges.
Colour	Marine Life	Not raised by more than 10mg pt/l.
	Domestic/Industrial	As above.
Suspended Solids	Marine Life	Not raised by more than 30% by discharges.
	Domestic/Industrial	As above.
Salinity		Not changed more than 10% by discharges.
pH	Marine Life	Between 6.5 and 8.5 - change due to waste discharge not to exceed 0.2 units.
	Domestic/Industrial	Between 6.0 and 9.0 for 95% of samples - Discharges not to extend range by more than +/- 0.5 units.

Survey of Building Uses at Tai Kok Tsui Foreshore

APPENDIX F

APPENDIX F

BUILDINGS ALONG TAI KOK TSUI SEASHORE

(A) Chung Yiu House

Address	:	75, Kok Cheung Street
No. of floors (excluding ground floor)	:	14
No. of housholds on each floor	:	28
No. of housholds facing the sea on each floor	:	10
Unit Area	:	400 - 500 ft^2
Estimated no. of occupants in each unit	:	4 - 5
A/C Installation	:	most are without A/C
History	:	20 - 30 years old

(B) Chung Sing House

Address	:	63, Chung Wui Street
No. of floors (excluding ground floor)	:	14
No. of housholds on each floor	:	10
No. of housholds facing the sea on each floor	:	4 (no. 9, 10, 11, 12)
Unit Area	:	400 - 500 ft^2
Estimated no. of occupants in each unit	:	4 - 5
A/C Installation	:	most are without A/C
History	:	20 - 30 years old

(C) Tai Wah House

Address	:	62, Wong Tai Street
No. of floors (excluding ground floor)	:	13
1/F	:	Christ Baptist Church
No. of housholds on each floor	:	9
No. of housholds facing the sea on each floor	:	5 (no. 1, 2, 3, 4, 5)
Unit Area : No. 1,3,4	:	200 - 300 ft^2
No. 2,5	:	400 - 500 ft^2
Estimated no. of occupants : No. 1,3,4	:	3
No. 2,5	:	4 - 5
A/C Installation	:	most are with A/C
History	:	10 - 20 years old

(D) Tai Ying House

Address	:	48, Wong Tai Street
No. of floors	:	13 (similar to (C) & (E)
1/F	:	Snooker Centre
No. of housholds on each floor	:	16
No. of housholds facing the sea on each floor	:	8
Unit Area	:	300 - 400 ft^2
Estimated no occupants in each unit	:	3 - 4
A/C Installation	:	most are with A/C
History	:	10 - 20 years old

(E) Tai Yick House

1/F	:	St. Garwick Kindergarden
Other Characteristics	:	similar to (C) Tai Wah House

(F) Tai Lee House

Address	:	31-41, Kok Cheung Street
No. of floors (excluding ground floor)	:	9
No. of housholds on each floor :-		
1/F - 7/F	:	18
8/F	:	15
9/F	:	5
No. of housholds facing the sea on each floor	:	around 5
Estimated no. of occupants in each unit	:	4 - 5
A/C Installation	:	most are without A/C
History	:	20 - 30 years old

(G) Tai Chi Industrial Building

Address	:	25-29, Kok Cheung Street
No. of floors (excluding ground floor)	:	13
Uses	:	Industrial

(H) Tai Kok Tsui Centre

Address	:	11-15, Kok Cheung Street
No. of floors	:	13
Uses (excluding ground floor)	:	Industrial & Commercial

(I) Tai Kwan House

No. of floors (excluding ground floor)	:	13
Uses	:	1/F & 2/F Commercial, Other residential

(x) Cheong Yat House &
(y) Cheong Chit House

No. of floors : 15
(excluding ground floor)

Noise environment : Noise from material handling, aircraft and marine traffic (or from shipyard)

Remarks

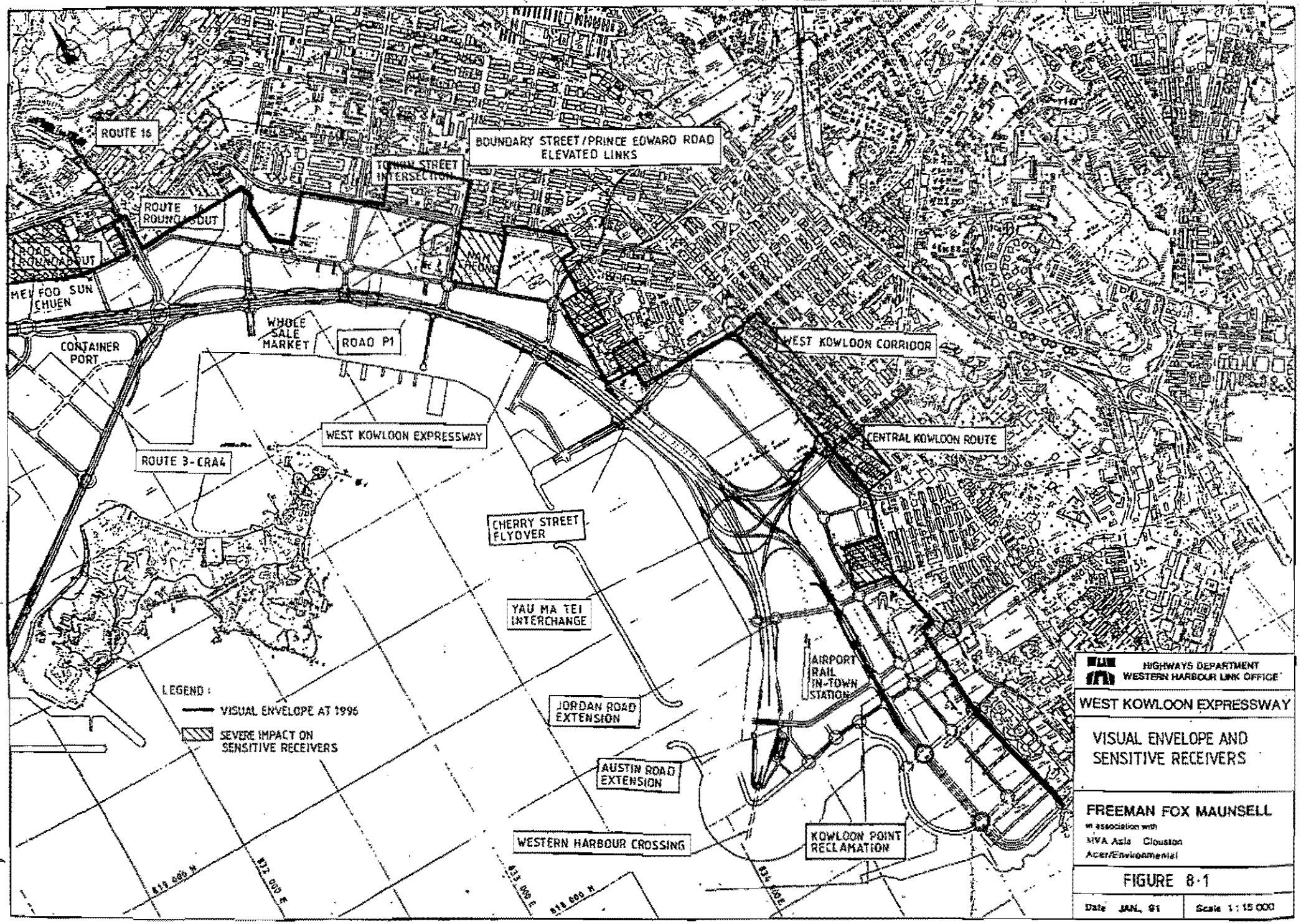
1. Ground Floor of (A) - (I) :

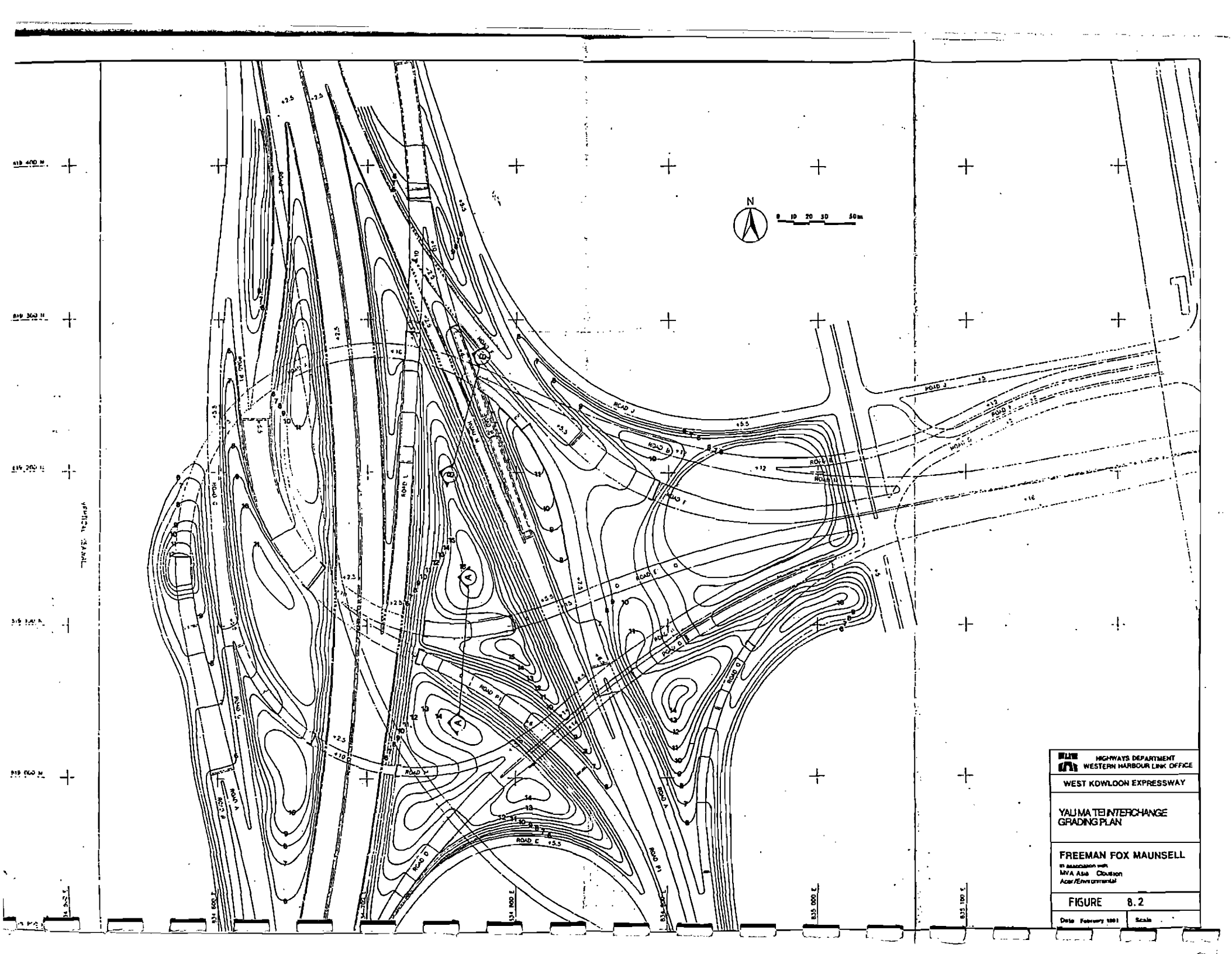
   - o Small scale machine shops, stores, printing shops etc.

2. Noise Environment :

   - o Industrial noise from (G) to (H)
   - o Occasional aircraft noise
   - o Noise from shops on ground floor
   - o Buses and vehicles noise
   - o Material handling noise
   - o Marine traffic (or from shipyard) noise

3. Estimated total no. of households facing the sea from (A) to (F) : around 500
   Estimated total no. of occupants facing the sea from (A) to (F) : around 2000


ROUTE 16
BOUNDARY STREET/PRINCE EDWARD ROAD ELEVATED LINKS
TONKIN STREET INTERSECTION
ROUTE 16 ROUNDABOUT
ROAD P2 ROUNDABOUT
MEI FOO SUN CHUEN
WHOLE SALE MARKET
ROAD P1
CONTAINER PORT
WEST KOWLOON CORRIDOR
WEST KOWLOON EXPRESSWAY
CENTRAL KOWLOON ROUTE
ROUTE 3-CRA4
CHERRY STREET FLYOVER
YAU MA TEI INTERCHANGE
AIRPORT RAIL IN-TOWN STATION
JORDAN ROAD EXTENSION
AUSTIN ROAD EXTENSION
WESTERN HARBOUR CROSSING
KOWLOON POINT RECLAMATION
LEGEND :
VISUAL ENVELOPE AT 1996
SEVERE IMPACT ON SENSITIVE RECEIVERS
819 000 N
822 000 E
833 000 E
834 000 E
819 000 N
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
VISUAL ENVELOPE AND SENSITIVE RECEIVERS
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental
FIGURE 8·1
Date JAN. 91
Scale 1 : 15 000


N
0 10 20 30 50m
ROAD A
ROAD B
ROAD C
ROAD D
ROAD E
ROAD F
ROAD G
ROAD H
ROAD J
ROAD L
ROAD P1
ROAD P2
ROAD P3
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
WEST KOWLOON EXPRESSWAY
YAU MA TEI INTERCHANGE
GRADING PLAN
FREEMAN FOX MAUNSELL
in association with
MVA Asia Clouston
Acer/Environmental
FIGURE 8.2
Date February 1991
Scale