(25) B

2/N9/22 XII

Territory Development Department
South West NT Development Office

North Lantau Development

Topic Report TR18

Environmental Impacts from Construction of the First Phase (Revised)

7th November 1991

Study Consultants:
Mott MacDonald Hong Kong Ltd.
Shankland Cox
Wilbur Smith Associates
EBC Hong Kong

Territory Development Department
South West N.T. Development Office

North Lantau Development

Topic Report TR18

Environmental Impacts from Construction of the First Phase (Revised)

7th November 1991

Study Consultants:
Mott MacDonald Hong Kong Ltd.
Shankland Cox
Wilbur Smith Associates
EBC Hong Kong

NORTH LANTAU DEVELOPMENT

TOPIC REPORT NO. 18

ENVIRONMENTAL IMPACTS FROM CONSTRUCTION OF THE FIRST PHASE

CONTENTS

		Page No.
1.	INTRODUCTION	1
2.	CONSTRUCTION ACTIVITIES	2
	2.1 Components of the First Phase	2
	2.2 Tung Chung First Phase Site Formation	2
	2.3 Tai Ho East Site Formation	4
3.	AIR QUALITY	5
	3.1 Introduction	5
	3.2 Air Sensitive Receivers	5
	3.3 Assessment Methodology	5
	3.3.1 Methodology	5
	3.3.2 Construction Programme	5
	3.3.3 Emission Factors	9
	3.3.4 Location of Sources	9
	3.3.5 Meteorological Conditions	9
	3.3.6 Evaluation Techniques	13
	3.3.7 Background Level	15
	3.4 Results	15
	3.4.1 Presentation of Results	15
	3.4.2 24 Hour TSP	16
	3.4.3 1 Hour TSP	16
	3.4.4 24 Hour RSP	16
	3.4.5 Other Pollutants	16
	3.5 Mitigation	16
	3.6 Monitoring	19
	3.7 Conclusions	21
4.	WATER QUALITY	22
	4.1 Existing Environment	22
	4.1.1 Baseline Data	22
	4.1.2 Existing Water Movements	22
	4.1.3 Existing Water Quality	23
	4.1.4 Existing Sediment Quality	23
	4.1.5 Water Courses	23
	4.1.6 Potable Water	26
	4.2 Sensitive Receivers	26
	4.3 Assessment Methodology and Criteria	26
	4.4 Impacts from Dredging and Reclamation	27
	4.4.1 Introduction	27
	4.4.2 Tai Ho East and Sui Ho Wan	27
	4.4.3 Tung Chung	28
	4.5 Impacts from Disposal of Spoil	29

			Page No.
	4.6	Impacts from the Construction Support Facility and General Work Sites	29
		4.6.1 Facilities Provided	29
		4.6.2 Water Quality Impacts	29
		4.6.3 Spillages	31
	4.7	Mitigation Measures	31
		4.7.1 Key Issues	31
		4.7.2 Dredging and Reclamation	31
		4.7.3 Construction Support Facility and General Work Sites	31
		4.7.4 Floating Refuse	32
		4.7.5 Accidental Spills	32
		4.7.6 Pollution Control	32
	4.8	Water Quality Monitoring	33
		4.8.1 General	33
		4.8.2 Baseline Conditions	33
		4.8.3 Impact Monitoring	33
		4.8.4 Monitoring of effluents	35
	4.9	Conclusions	37
5.	NOISE		38
	5.1	Introduction	38
	5.2	Assessment Methodology and Impact Criteria	38
	5.3	Impact Assessment and Evaluation	40
	5.4	Mitigation	41
	5.5	Noise Monitoring	42
	5.6	Conclusion	44
6.	THE NEXT STEPS		45

Tables

3.1 Air Sensitive Receivers in the Study Area
3.2 Air Quality Objectives
3.3 Maximum Yearly Averaged Background Air Pollutant Concentrations in the NLD Area
3.4 Maximum Level of Gaseous Pollutants at the Worst Affected Areas
3.5 Target, Trigger and Action Levels for Dust
3.6 Action Plan

4.1 Sediment Sampling Results and Assessment Criteria
4.2 Estimated Liquid Waste Discharges from the Construction Supply Facility
4.3 Target, Trigger and Action Levels for Water Quality
4.4 Action Plan

5.1 Activities which Could Not Work in the Restricted Periods
5.2 ANLs with Sound Insulation
5.3 Target, Trigger and Action Levels for Noise during Restricted Periods
5.4 Target, Trigger and Action Levels for Noise during the Daytime
5.5 Action Plan

Figures

2.1 Layout of First Phase Site Formation

3.1a Locations of Air Sensitive Receivers (Tung Chung Area)
3.1b Locations of Air Sensitive Receivers (Siu Ho Wan Area)
3.2 Key Construction Activities
3.3a Locations of Construction Activities (Tung Chung Area)
3.3b Locations of Construction Activities (Siu Ho Wan Area)
3.4 Predicted 24 hour TSP Levels
3.5 Predicted 1-hour TSP Levels
3.6 Predicted 24-hour RSP Levels

4.1 Locations of Sediment Sampling
4.2 Proposed Water Quality Monitoring Stations

5.1 Noise Neighbourhoods

NORTH LANTAU DEVELOPMENT

TOPIC REPORT NO. 18

ENVIRONMENTAL IMPACTS FROM CONSTRUCTION OF THE FIRST PHASE

1. INTRODUCTION

The original purpose of this Topic Report No 18 was to:-

(i) present the results of an environmental impact assessment of construction aspects of the development;

(ii) define environmental conditions to be included in construction contracts; and

(iii) define procedures to be followed in engineering designs and construction to minimise environmental impacts.

It has subsequently been agreed that the construction impact assessment should be presented in two parts. The first part has considered construction of the First Phase and is presented in this report. The second part will consider the remainder of the original objectives of NLDS as set out above. The second report will be issued as Topic Report TR20, "Environmental Development Manual" in November 1991.

The objectives of this report are therefore to present the results of a construction stage assessment of the First Phase and to recommend environmental conditions to be included in construction contracts. The report is being issued in advance of the original programme in view of the urgency of proceeding with the design and contract documentation for the First Phase contracts and the need to include environmental conditions in these contracts.

This report includes recommendations for the development of contract conditions. The contract conditions are being prepared by the First Phase detailed design team as a separate task.

2. CONSTRUCTION ACTIVITIES

2.1 Components of the First Phase

Civil engineering works for the first phase will comprise the following:-

(a) Tung Chung Phase I Site Formation will include reclamation, seawalls, land excavation, main drainage and construction support facilities. The construction support facilities will comprise a cargo working area, a passenger ferry pier and areas for asphalt batching, concrete precasting, workers accommodation, works areas and offices; and

(b) Tai Ho East and Siu Ho Wan Site Formation will include reclamation, main drainage, seawalls and other infrastructure for the sites for the sewage treatment works at Siu Ho Wan and the refuse transfer station and the railway depot at Tai Ho East. Land excavation for the water treatment works at Siu Ho Wan is also included. These works will be entrusted to Highways Department but their design is being carried out by the North Lantau Development (NLD) team.

Design work has commenced on both of these contracts and is well progressed. According to the present programme construction of the works in Tung Chung will start in January 1992 and the work will be completed in January 1994. Construction of the Tai Ho East site formation will start in April 1992 and will be completed in September 1994.

Work included in the present contracts comprises reclamation and drainage. Construction of facilities for the new town and the airport access corridor will start thereafter. These will include infrastructure for Tung Chung Phase I, the sewage treatment works and outfall, the refuse transfer station, the North Lantau Expressway and airport railway (NLE). The assessment of impacts from these works are not included in the present report. A construction impact assessment should be incorporated in the design brief for these works.

2.2 Tung Chung First Phase Site Formation

The layout of the First Phase site formation area is shown on Figure TR18-2.1. The first stage in forming the reclamation will be dredging of marine mud underneath sea walls, probably using grab dredgers. The seawall mounds will then be constructed by bottom dumping from barges until the water depths become too shallow and then by placing fill from derrick barges. Armouring for the seawall and seawall blocks for vertical seawalls will probably also be placed by derrick barges. The reclamation will be formed from sand fill placed hydraulically over the marine mud and vertical drains will be installed to speed up consolidation. The reclamation will also be surcharged in areas that are required early. The surcharge will be placed using loaders, dump trucks and compactors.

Drainage channels and basic infrastructure for the construction support facility will be constructed on the reclamation once settlement has finished.

There will also be some land excavation to the south west of the marine reclamation. This will be achieved using excavators loading material into dump trucks and there will be some rock blasting. The excavated material will be used elsewhere in the Tung Chung reclamation including the use of it as surcharge material.

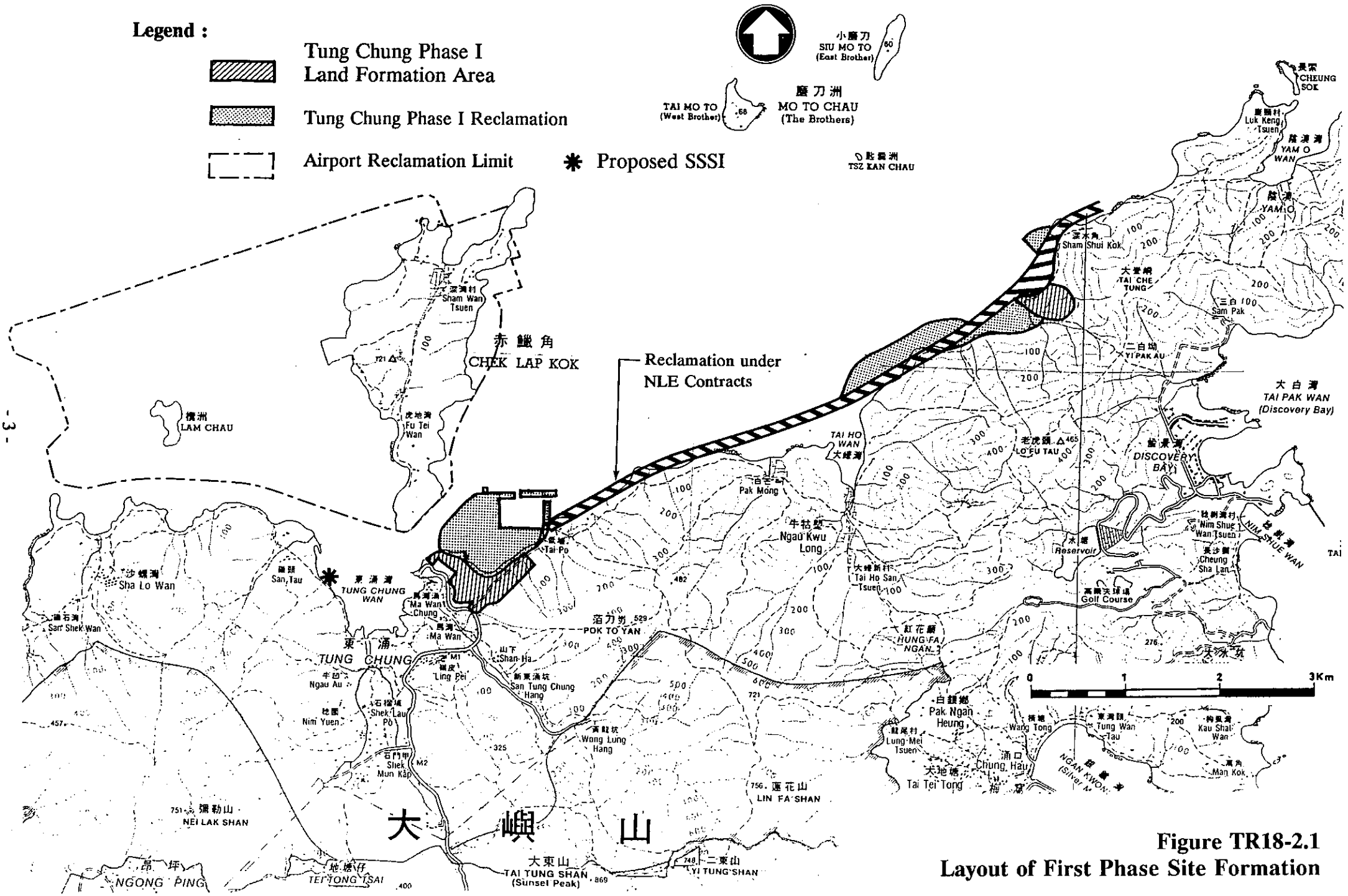


Figure TR18-2.1
Layout of First Phase Site Formation

The scale of the works in this contract may be appreciated from the following approximate quantities:-

(a)	dredging (including fairway dredging)	12 million cu m
(b)	reclamation	5.1 million cu m
(c)	land excavation (soft material)	250,000 cu m
(d)	rock blasting	3,000 cu m
(e)	temporary and permanent sea walls	2,200 lin m
(f)	temporary breakwater	480 lin m
(g)	access roads	1,500 lin m
(h)	concrete for drainage channels etc	8,000 cu m

2.3 Tai Ho East Site Formation

This contract will form land for the sewage treatment works, the refuse transfer station the water treatment works and the railway depot. The site formation will be carried out in a similar way to the reclamation at Tung Chung except that only very limited surcharging will be needed. Land excavation will be carried out for the waterworks site.

The following approximate quantities of work will be included in this contract:-

(a)	dredging	1.9 million cu m
(b)	reclamation	3.0 million cu m
(c)	land excavation (soft material)	450,000 cu m
(d)	rock blasting	850,000 cu m
(e)	temporary and permanent sea walls	2,500 lin m
(f)	access roads	1,000 lin m
(g)	concrete for drainage channels etc	8,000 cu m

3. AIR QUALITY

3.1 Introduction

This section of the report presents the results of an assessment of the air quality impacts due to construction of the First Phase. The First Phase construction has been broadly divided into two stages. The first stage includes the civil engineering works of land reclamation, land formation and sea wall construction. The second will comprise the construction of drainage channels and basic infrastructure on the formed land.

The construction activities which have been assessed are those which could generate dust impacts on air sensitive receivers (ASRs) which will remain during the First Phase construction. In addition an asphalt plant could be constructed on the site formed for the construction support facilities and this could cause impacts from Suphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO).

3.2 Air Sensitive Receivers

Total of 34 ASRs have been identified according to the definition of air sensitive uses in Hong Kong Planning Standards and Guidelines which could be affected by the construction works (Figure TR18-3.1). The co-ordinates of the ASRs as used in the modelling are shown in Appendix A. Most of the ASRs are villages but there are two recreational camps, one at Tai Po and other at Sha Tsui Tau.

Parts of Tai Po will be resumed during First Phase construction but this will not be until early 1993 and the village may be affected by the early works. The whole of Tai Po has therefore been considered as an ASR for this assessment. The Buddhist Youth Camp, although near the construction site, will not be resumed. The ASRs have been divided into nine groups in accordance with the severity of the impacts at each receiver as shown in Table 3.1. The first ASR in each group is representative of the worst affected ASR in that group.

3.3 Assessment Methodology

3.3.1 Methodology

The Industrial Source Complex Short-Term (ISCST) has been used for predicting air quality. The model uses stack, area and volume source types which are suitable for modelling the air quality impact arising from construction activities.

3.3.2 Construction Programme

The assessment has been based on the latest construction programmes. These are the best assessment of the construction that can be made at the present time. Programming of construction will be the responsibility of contractor and there is no guarantee that he will follow the same programme. Building construction has also been included to give an indication of likely dust levels during subsequent stages of the development.

Schedule of Air Sensitive Receiver	
Ref. Point	Location Name
19	Sheung Ling Pei
20	Village Resite 3
21	Ha Ling Pei
22	Tin Liu
23	Ma Wan Chung
24	Wong Lung Hang
25	Sha Tsui Tau
26	Ma Wan
27	Fui Yiu Ha (School)
28	Outdoor Recreation Camp
29	San Tung Chung Hang
30	Shek Lau Po
31	ASR (West of Youth Camp)
33	Tai Po Buddhist Youth Hostel
34	Tai Po

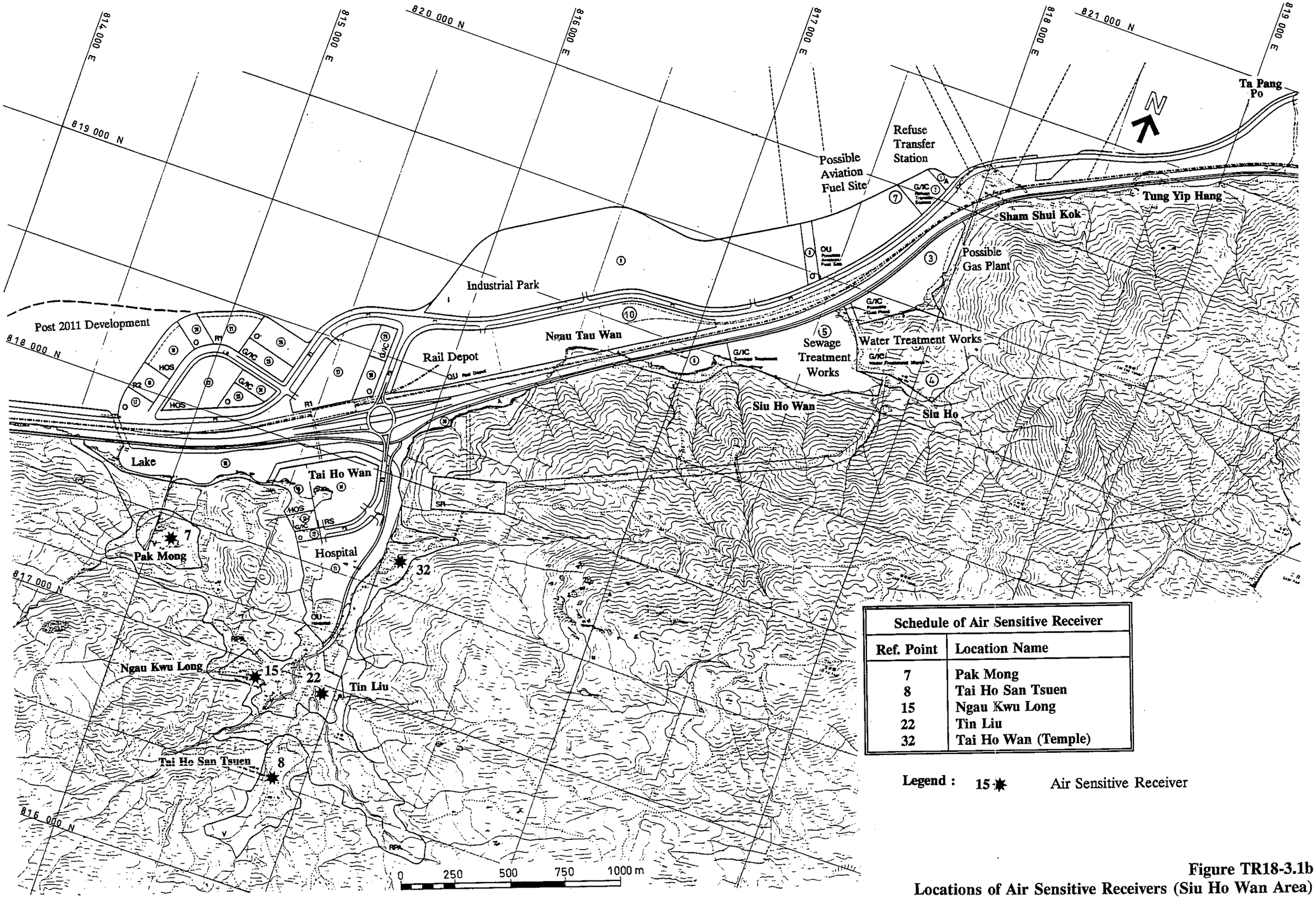
For Ref. Points 7, 8,15, 22 and 32 refer to Figure No. TR18-3.1b

Schedule of Air Sensitive Receiver	
Ref. Point	Location Name
1	Kau Liu
2	Ngau Au
3	Mok Ka
4	Shek Pik Au
5	Wong Ka Wai
6	Shan Ha
9	Tin Sam
10	Tung Hing
11	Village Resite 1
12	Shek Mun Kap
13	Lung Tseng Tau
14	San Keng
16	San Tau
17	Nim Yuen
18	Village Resite 2

Legend :

13✸ Air Sensitive Receiver

Figure TR18-3.1a
Locations of Air Sensitive Receivers (Tung Chung Area)



Schedule of Air Sensitive Receiver	
Ref. Point	**Location Name**
7	Pak Mong
8	Tai Ho San Tsuen
15	Ngau Kwu Long
22	Tin Liu
32	Tai Ho Wan (Temple)

Legend : 15 ✸ Air Sensitive Receiver

Figure TR18-3.1b
Locations of Air Sensitive Receivers (Siu Ho Wan Area)

Table 3.1 Air Sensitive Receivers in the Study Area

Group	ASR
Group 1 - Tai Ho (A)	32. Tai Ho Wan Temple
Group 2 - Tai Ho (B)	22. Tin Liu 15. Ngau Kwu Long 8. Tai Ho San Tsuen
Group 3 - Pak Mong	7. Pak Mong
Group 4 - Tai Po	33. Tai Po Buddhist Youth Camp 34. Tai Po
Group 5 - Mok Ka	3. Mok Ka 31. ASR west of the outdoor Camp 2. Ngau Au 10. Tung Hing 17. Nim Yuen 11. Village Resite 1 18. Village Resite 2 4. Shek Pik Au 29. San Tung Chung Hang 24. Wong Lung Hang
Group 6 - Shek Lau Po	30. Shek Lau Po 14. San Keng 12. Shek Mun Kap
Group 7 - Sheung Ling Pei	19. Sheung Ling Pei 20. Village Resite 3 27. Fui Yiu Ha (School) 6. Shan Ha 21. Ha Ling Pei 5. Wong Ka Wai 13. Lung Tseng Tau 25. Sha Tsui Tau 28. Outdoor Recreation Camp
Group 8 - Tin Sam	9. Tin Sam 1. Kau Liu 16. San Tau
Group 9 - Ma Wan Chung	23. Ma Wan Chung 26. Ma Wan

The programme for each activity is shown on Figure TR18-3.2 and their assumed locations are illustrated on Figure TR18-3.3.

Dust levels received at each ASR will, inter alia, depend on the distance between the ASR and the dust emission source and the strength of the dust emission source. These will change during the different stages of construction, hence the time profile of dust levels at each ASR has been considered.

3.3.3 Emission Factors

Dusts are subdivided into two categories with nominal aerodynamic diameter 0-10μm and 10-30μm. The dust particles of larger than 30μm tend to settle relatively close to the source. The dusts with diameter 0-10μm are termed as respirable suspended particulates (RSP) and total suspended particulates (TSP) is the total of the two categories.

The construction activities that will cause dust are:-

- o vehicles on haul roads;
- o drilling;
- o blasting;
- o loading and unloading;
- o rock crushing;
- o concrete batching; and
- o asphalt mixing.

Asphalt mixing will also generate SO_2, NO_2 and CO.

The emission factors used in the modelling have been based on USEPA-AP42 4th Edition, 1985. Details of the emission factors are given in Appendix A.

The Hong Kong Air Quality Objectives (AQO) for TSP and RSP are based on 24 hour or longer averaging times but the EPD recommended TSP level for construction is based on a 1 hour average. Pollution levels have therefore been calculated over 1 hour and 24 hours for TSP and 24 hours for RSP. Blasting has been assumed to be one blast per day and twelve hour working has been used as the basis for calculating 1 hour averaged dust levels.

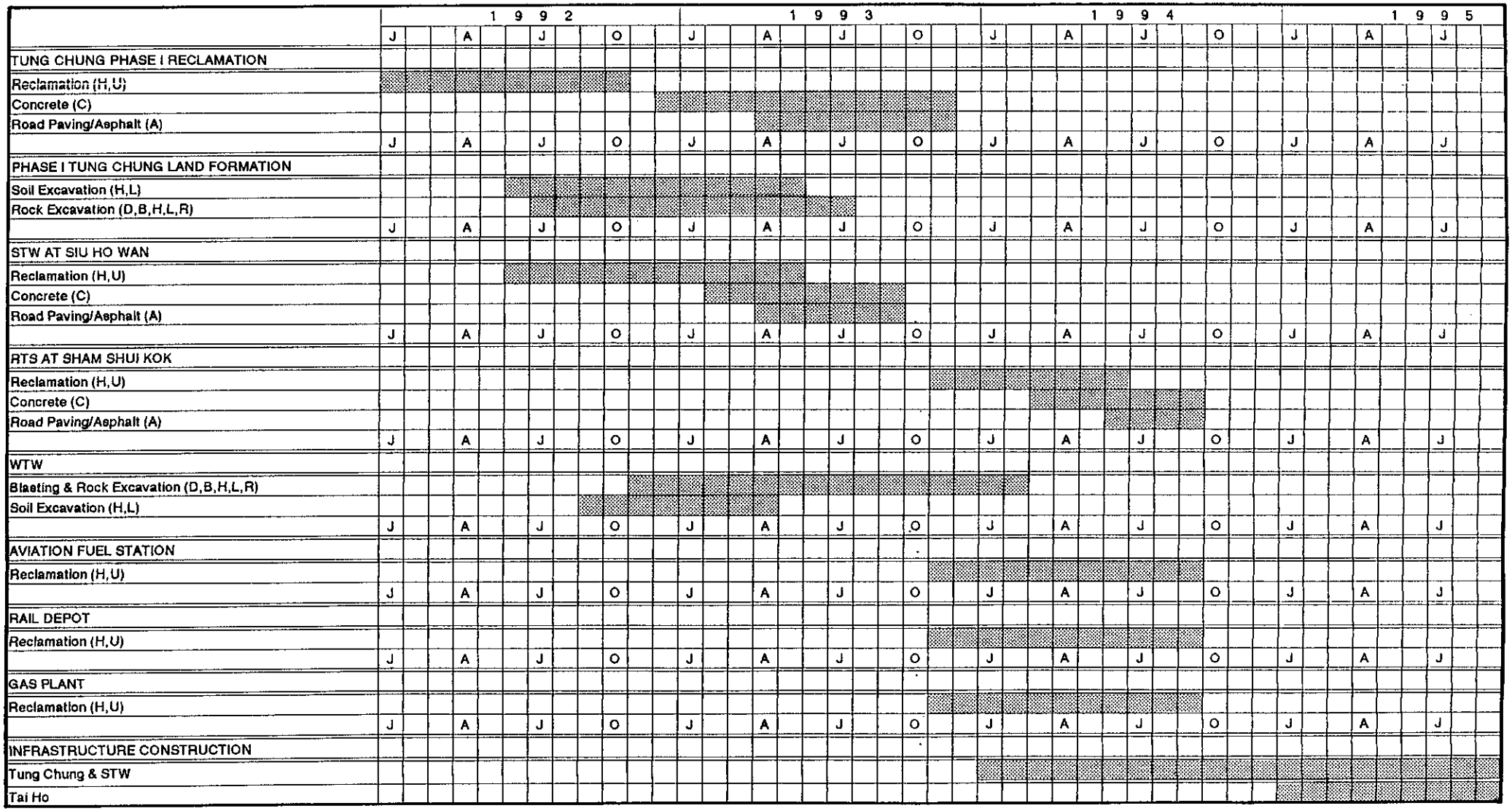
3.3.4 Location of Sources

The exact locations of the activities are unknown at this stage and the assessment has therefore used the area where the activities are likely to be carried out. The locations of each activity are presented in Appendix A. The coordinates for the area sources are the south-west corner of a square which is the assumed location of that activity. The size of the square is shown as its width.

3.3.5 Meteorological Conditions

The most important meteorological parameters governing dispersion are:-

- o wind speed;
- o wind direction;
- o stability class; and
- o mixing height.



Note : A – Asphalt Mixing, B – Blasting, C – Concreting, D – Drilling, H – Hauling
L – Loading, R – Rock Crushing, U – Unloading

Figure TR18-3.2
Key Constrution Activities

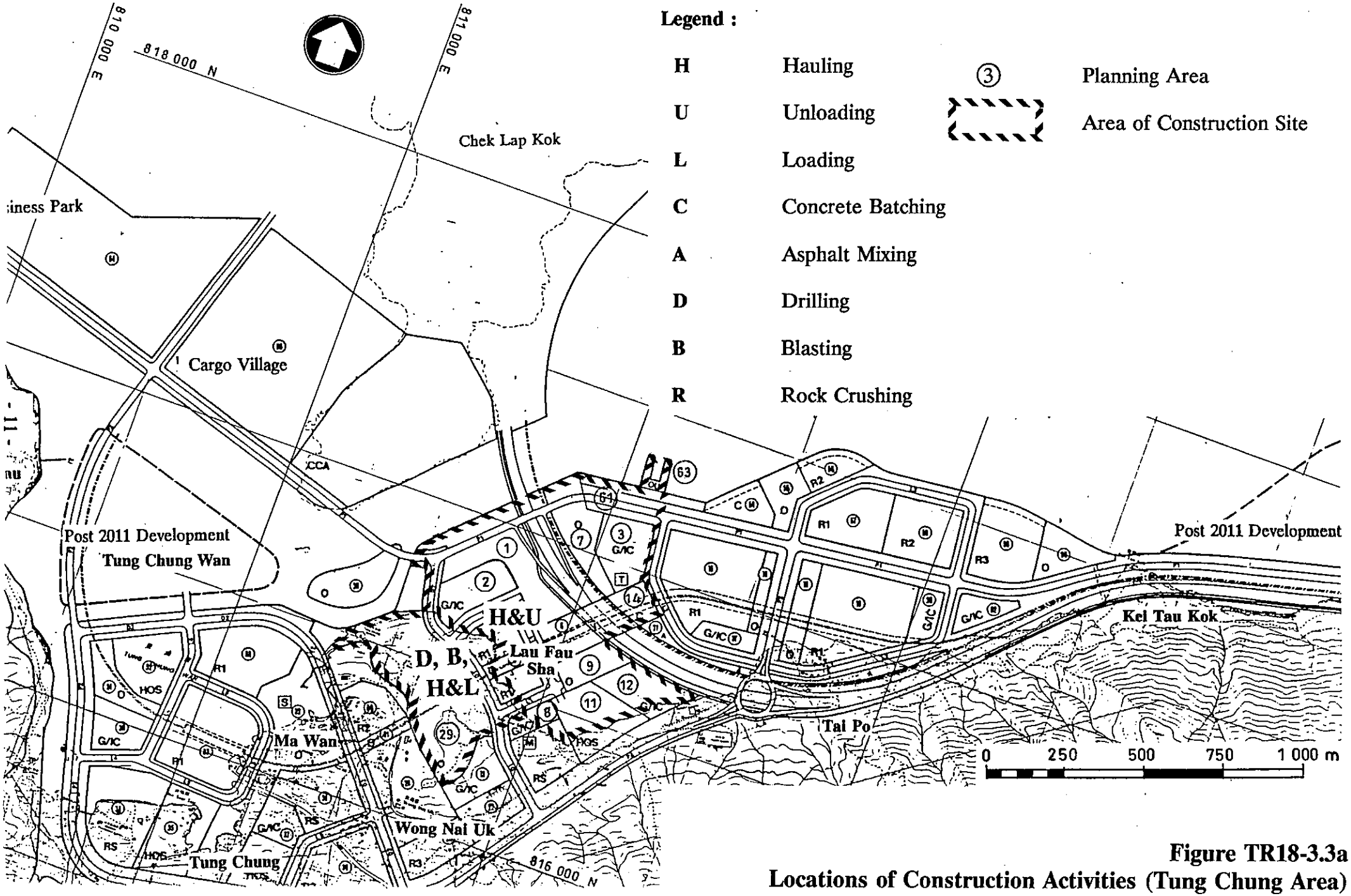
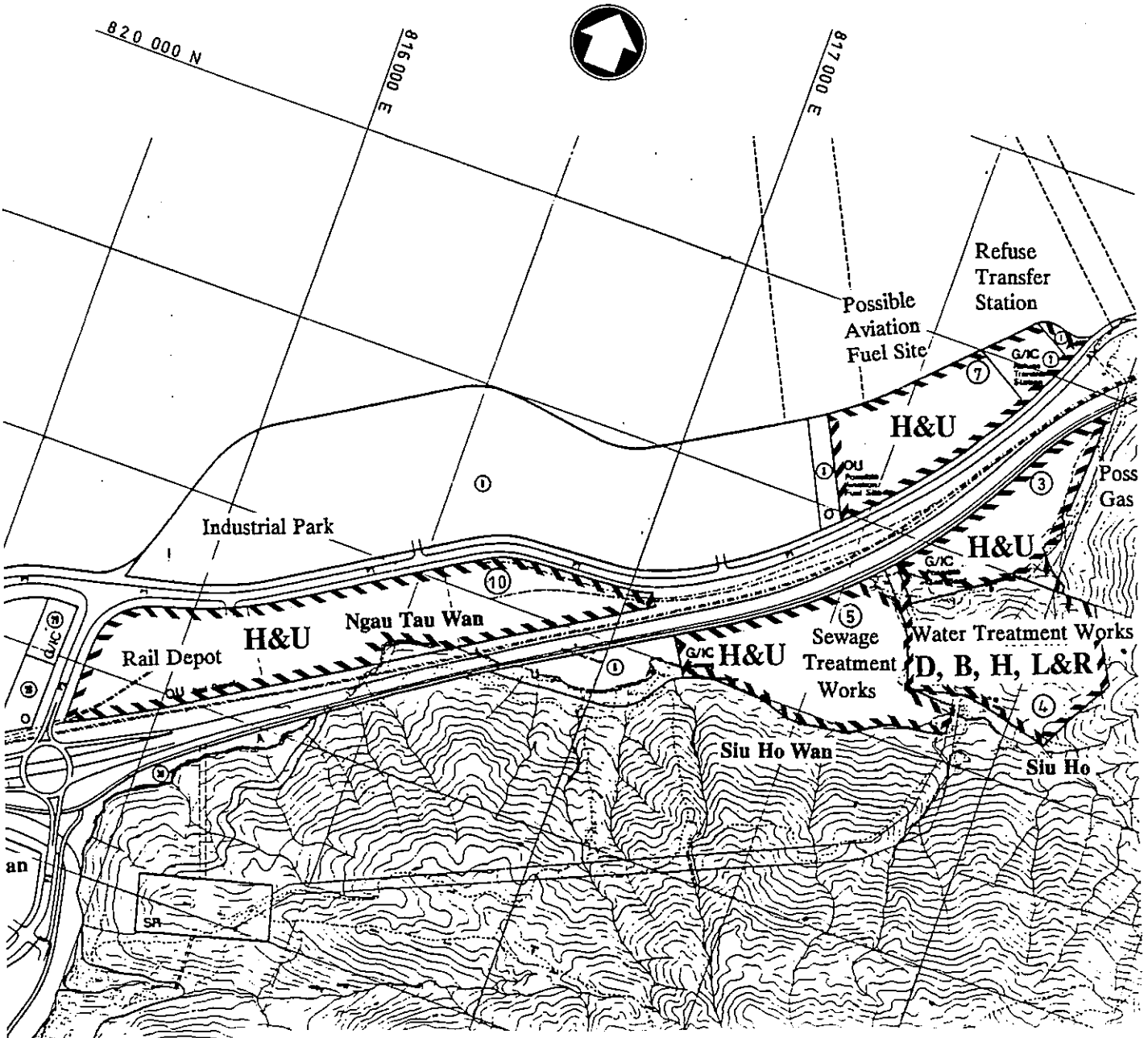


Figure TR18-3.3a
Locations of Construction Activities (Tung Chung Area)



Legend :

H	Hauling
U	Unloading
L	Loading
C	Concrete Batching
A	Asphalt Mixing
D	Drilling
B	Blasting
R	Rock Crushing

③ Planning Area

Area of Construction Site

0 250 500 750 1 000 m

Figure TR18-3.3b
Locations of Construction Activities (Siu Ho Wan Area)

Wind speed of $2ms^{-1}$ and stability class D have been chosen because at lower wind speeds the dispersion will be lower and the pollutants will concentrate relatively near to the source. At higher wind speeds dispersion will be higher and the pollutant levels at ASRs will be lower. Stability Class D is the most stable day-time weather condition. These parameters are considered to represent the worst-case meteorological criteria for air quality assessment.

3.3.6 Evaluation Techniques

Thirty-six wind angles have been tested to evaluate the impacts. This large number of wind angles was needed because of the complicated construction programme, scattered receptors and the extent of the Study Area. The results generated for the 36 wind directions have been compared and the highest values have been chosen for each receptor to estimate the worst 1-hour averaging time concentrations.

The method of assessment allows for the variability of local winds since it is most unlikely that winds will blow from a constant direction over short distances in areas of complex topography such as North Lantau, particularly at the low wind speeds used for the assessment. The 24-hour dust levels have been calculated by summing up the dust levels at each of the 36 wind directions multipled by the percentage frequency of that wind direction based on annual wind data provided by the Royal Observatory measured at Chek Lap Kok in 1989. It is possible that the use of annual statistics may slightly underestimate the extreme worst case 24 hour concentrations but it is considered that this method of assessment gives more representative 24 hour values. The annual figures employed have taken account of the prevailing winds and these were given a relatively high weighting in the multiplication. Also the project will last for many years, and hence the annual figure is the best practicable means available for the construction assessment.

The extent of air quality changes has then been compared the appropriate with AQOs and the EPD recommended 1-hour TSP level. These are shown in Table 3.2.

Table 3.2 Air Quality Objectives

Pollutant	Concentration in micrograms per cubic metre (i) (Parts per million (ppm) in brackets)				
	1 Hour (ii)	8 Hour (iii)	24 hours (iii)	3 Months (iv)	1 Year (iv)
Sulphur Dioxide	800 (0.30)		350 (0.13)		80 (0.03)
Total Suspended Particulates	(vii)		260		80
Respirable Suspended Particulates (v)			180		55
Carbon Monoxide	30,000 (26.20)	10,000 (8.73)			
Nitrogen Dioxide	300 (0.16)		150 (0.08)		80 (0.04)
Photochemical Oxidants (as ozone) (vi)	240				
Lead				1.5	

Notes: (i) Measured at 298K (25°C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Yearly and three monthly figures calculated as arithmetic means.
(v) Respirable suspended particulates means suspended particles in air with nominal aerodynamic diameter of 10 micrometres and smaller.
(vi) Photochemical oxidants are determined by measurement of ozone only.
(vii) Suggested short term averaging level for 1 hour is 500 $\mu g/m^3$.

3.3.7 Background Level

Background levels of air pollution in the Study Area were estimated in NLDS TR10. The maximum background concentrations are summarized in Table 3.3.

Table 3.3 Maximum Yearly Averaged Background Air Pollutant Concentrations in the NLD Area (Averaging time : 1 hour)

Pollutant	Tung Chung ($\mu g/m^3$)	Tai Ho Wan ($\mu g/m^3$)
Sulphur dioxide	50	60
Nitrogen dioxide	80	80
Carbon monoxide	25-135	30-150
Non-RSP particulates > 10 μm	< 1	< 1
Respirable suspended particulates < 10 μm	15	20
Total suspended particulates	15	20

3.4 Results

3.4.1 Presentation of Results

The results of the construction dust modelling have been presented in the form of histogram plots showing the impacts from the main activities which will cause dust and the combined impacts. The histograms show the impacts with time so that the duration of the worst impacts can be assessed. These are shown in Appendix A. The dust concentrations shown on all of these figures assume that no mitigation of dust at source is applied. The histograms show that the main impact in the Tung Chung area will be from the start of the construction works at the beginning of 1992 and lasting for up to about 12 months to the end of 1992. Impacts at the worse affected areas will last for a further 6 months to mid-1993. The largest impact in the area affected in the Tai Ho area will last for about 12 months from late 1993. The histograms in Appendix A also show an indication of dust levels from construction of buildings and infrastructure on the First Phase for comparison.

Figures TR18-3.4 to 6 show the maximum predicted dust levels for 24 hour and 1 hour TSP and for 24 hour RSP for the two cases firstly where there is no mitigation and secondly where there is comprehensive mitigation at source. The mitigation assumed is as follows:-

(a) concrete batching - enclosures and filters;

(b) rock crushing - filters and wet spray systems;

(c) haul road - speed reduction and the alternative of watering (mitigation method A) and surface chemical treatment mitigation method B; and

(d) loading and unloading - the alternative of watering and chemical wetting agents.

3.4.2 24 Hour TSP

The AQO for 24 hour TSP is 260 $\mu g/m^3$. This will be exceeded at all receivers except Pak Mong unless mitigation at source is applied. The largest contribution to the exceedance will be the dust caused by vehicles on haul roads and the contribution from blasting, rock crushing and other activities will be relatively small. Figure TR18-3.4 shows that there will be no exceedance of the 24 hour TSP objective except at Ma Wan Chung if the assumed mitigation method B is applied.

3.4.3 1 Hour TSP

There is no AQO for 1 hour TSP but a level of 500 $\mu g/m^3$ is recommended by EPD. This level is not statutory and has not been included in other Airport Core Projects but has been used in this assessment to give an indication of the short term impacts. The level of 500 $\mu g/m^3$ will be exceeded at all the ASRs whenever reclamation or land formation is proceeding on nearby works sites. The activity which contributes most to the 1 hour TSP levels is blasting. There is little that can be done to limit the dust from blasting except to use the minimum practical charge. The impact from blasting, however, tends to be very short term and only lasts for a short period after the blast. One blast per day is likely for these works.

3.4.4 24 Hour RSP

The 24 hour AQO for RSP is 180 $\mu g/m^3$. This will be exceeded for much of the period of construction unless mitigation measures are applied. The mitigation measures would be the same as those used to reduce TSP. Figure TR18-3.6 shows the maximum predicted levels assuming that these mitigation measures are applied and this indicates that there should be no exceedance of this AQO except at Ma Wan Chung for mitigation methods A or B.

3.4.5 Other Pollutants

The impacts from pollutants other than dust are shown in Table 3.4. These have been calculated assuming an asphalt production plant could be at Tung Chung or Tai Ho East. None of these are likely to be significant.

3.5 Mitigation

Mitigation methods tested in the assessment are listed in Section 3.4 above. Mitigation of dust, particularly from vehicles on haul roads, will be needed to reduce the impact on the ASRs. The methods of achievement of dust standards should be left to the contractor as methods of working will be his responsibility but the contract should include clauses specifying that strict dust control should be employed. The Engineer should be empowered to direct the contractor to take appropriate measures if dust levels become excessive. The option of mitigating the dust by increasing the contract period is not practical as this contract is on the critical path leading to opening of the new airport.

Table 3.4 Maximum level ($\mu g/m^3$) of Gaseous Pollutants at the Worst Affected ASR

	Tung Chung Phase 1 Reclamation						STW at Siu Ho Wan						RTS at Sham Shui Kok					
	24-Hour			1-Hour			24-Hour			1-Hour			24-Hour			1-Hour		
	SO_2	NO_2	CO	SO_2	NO_2	CO	SO_2	NO_2	CO	SO_2	NO_2	CO	SO_2	NO_2	CO	SO_2	NO_2	CO
Maximum Level	0.10	0.03	0.03	0.21	0.05	0.05	0.03	0.01	0.01	0.05	0.01	0.01	0.04	0.01	0.01	0.09	0.02	0.02
Worst ASR	San Keng						Pak Mong						Pak Mong					
Background Level	50	80	25-135	50	80	25-135	60	80	30-150	60	80	30-150	60	80	30-150	60	80	30-150
AQO	350	150	-	800	300	30,000	350	150	-	800	300	30,000	350	150	-	800	300	30,000

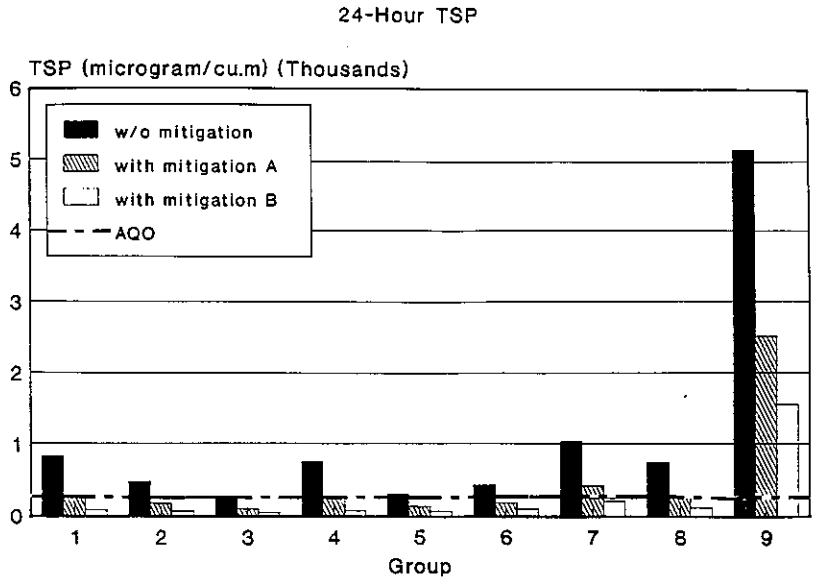


Figure TR18-3.4
Maximum Predicted 24 Hour TSP

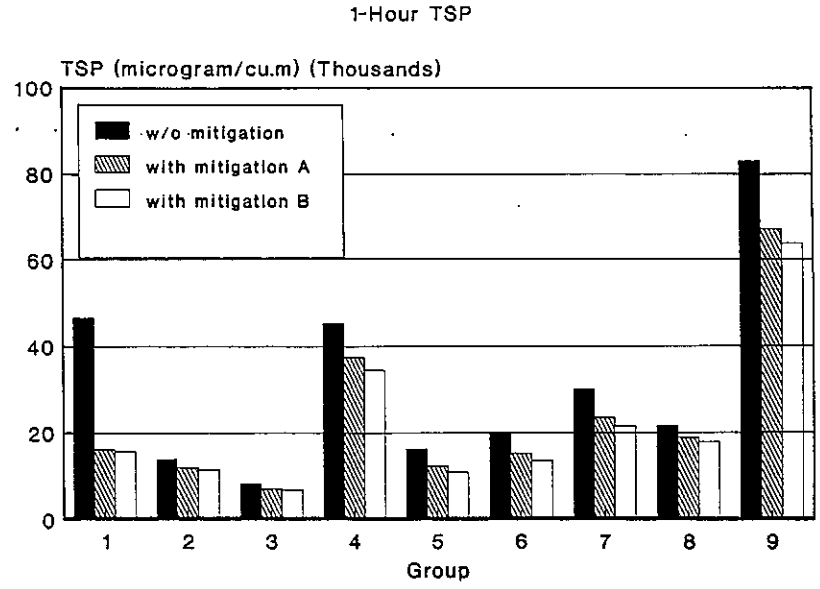


Figure TR18-3.5
Maximum Predicted 1 Hour TSP

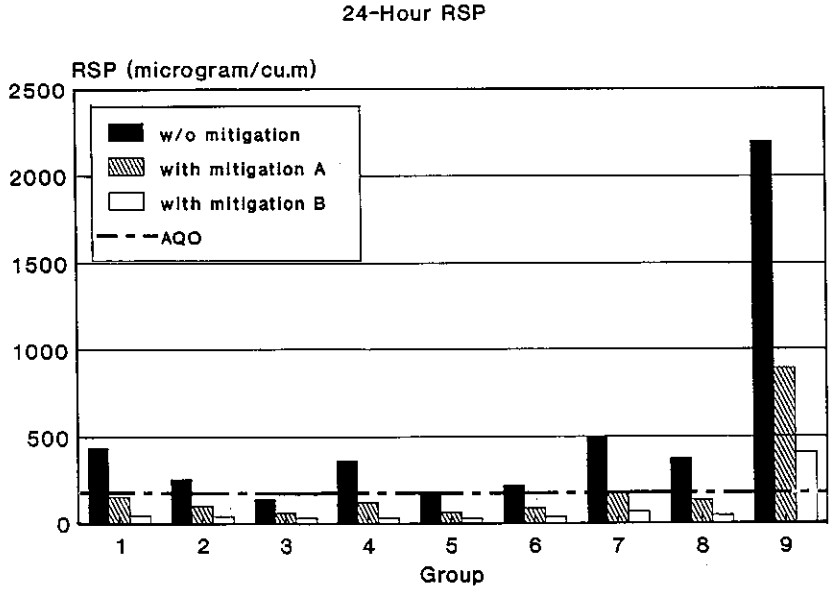


Figure TR18-3.6
Maximum Predicted 24 Hour RSP

3.6 Monitoring and Audit

Impact monitoring of 1 hour and 24 hour TSP levels should be carried out at all sensitive receivers and at the site boundary whenever works generating dust are being carried out. The monitoring schedule should be determined by the Engineer depending on the contractor's method of working but as a guide should be about 3 days per week at all sensitive receivers that are likely to be affected and at selected points around the site boundary. A 1 hour and a 24 hour sample should be collected on each day with the 1 hour sample being representative of high impacts (for example during blasting). More frequent impact monitoring will be necessary if dust levels increase. Baseline monitoring should be carried out prior to the start of the construction works with measurements being taken at each monitoring station daily for two weeks.

All monitoring should be reported on daily record sheets recording:-

(a) sampling point;
(b) sampling time;
(c) monitored level;
(d) equipment used;
(e) weather conditions; and
(f) activities being carried out on site.

Monthly reports of all monitoring data should be prepared and copied to the Contractor and EPD.

Where the impact monitoring shows that the recorded dust (TSP) level is significantly greater than the levels established in the baseline survey or that TSP levels are increasing as a result of the contractor's activities, the Contractor should be directed to take effective remedial measures including, but not limited to, reviewing dust sources and modifying working procedures. The contract documents should include methods of dust suppression to be adopted by the contractor.

The Contractor should be instructed to inform the Engineer of all steps taken. Written reports and proposals for action should be passed to the Engineer by the Contractor whenever air quality monitoring shows that the recorded dust level is significantly greater than the levels established in the baseline survey or that dust levels are increasing.

It is not appropriate to specify compliance limits for this contract since dust levels will be affected by factors outside the control of the Engineer and the Contractor, notably the dust from the New Airport site formation contract which is likely to be very much higher than dust from the First Phase works. However the AQO dust levels for TSP and the predictions of dust levels made in this report may be used as a guide to acceptable levels.

Table 3.5 shows target, trigger and action levels proposed for construction dust which would be reasonable based on the assessment carried out for this report. This does not take any account of dust from the New Airport construction and the levels in Table 3.5 should be reviewed continuously on site in the light of the impact monitoring results. The action level at Ma Wan and Ma Wan Chung is very high but has been set at this level in view of the high predicted levels at these receivers. Lower action levels could preclude certain construction activities and affect the progress of the works. It is recommended that this level in particular is kept under review and reduced if possible.

Table 3.5 Target, Trigger and Action Levels for Dust

Location	24 hour TSP Level in $\mu g/m^3$		
	Target	Trigger	Action
Ma Wan Chung and Ma Wan	180	300	2000
Other receivers	180	300	400

Table 3.6 summarises action to be taken in the event that the target, trigger and action levels proposed in Table 3.5, or revised during the contract, are exceeded.

Table 3.6 Action Plan

Event	Action	
	Engineer	Contractor
Exceedance of target level for one sample	Repeat measurement as soon as possible	-
Exceedance of target level for more than one consecutive sample	Repeat measurements Notify contractor	-
Exceedance of trigger level for one sample	Repeat measurement as soon as possible Notify contractor	-
Exceedance of trigger level for more than one consecutive sample	Increase frequency of monitoring to daily Notify contractor Require contractor to make proposals to reduce dust	Review plant and methods Submit proposals for reducing dust to Engineer Implement remedial actions
Exceedance of action level for one sample	Repeat measurement as soon as possible Notify contractor	-
Exceedance of action level for more than one sample	Increase frequency of monitoring to at least daily Notify contractor Notify EPD Require contractor to implement immediate steps to reduce dust	Review plant and methods Implement measures to reduce dust immediately Notify Engineer of action taken

3.7 Conclusions

The assessment has considered the impact of dust and other pollutants from construction operations. Significant impacts from dust are expected and strict control of dust at source should be applied. The recommended 1 hour dust level of 500 $\mu g/m^3$ is likely to be exceeded due to blasting but only for short durations.

Monitoring of dust levels should be carried out throughout the contract and the Engineer should be empowered to instruct the contractor to take additional mitigation measures if dust levels become excessive. AQOs at Ma Wan Chung are likely to be exceeded even with mitigation of dust at source.

Dust levels from building construction are not likely to cause significant impacts.

4. WATER QUALITY

4.1 Existing Environment

4.1.1 Baseline Data

Water Movement Data

A survey has been commissioned to establish the existing water movements in the channel between Chek Lap Kok and Lantau. These data are needed to confirm the design for the sea channel and ensure that flows into East Tung Chung Bay are maintained at their present level. This survey will be started early in September 1991 but the complete data set will not be available until October 1992. None of these data have therefore been available for this assessment.

Water Quality Data

It was recommended in NLDS Topic Report TR 2, Environmental Studies that water quality sampling should be carried out to establish the baseline conditions in the Study Area. This work has recently been commissioned and the sampling will continue until August 1991. Some initial data will be available late in September 1991 and the data set will gradually be built up over the next year. None of these data are available at present and this assessment therefore relies on the previous assessment reported in NLDS Topic Report TR10 (Revised), "Environmental Assessment".

4.1.2 Existing Water Movements

The water body to the north of Lantau Island forms part of the proposed North Western Water Control Zone. This is scheduled to come into force in August 1992.

The North Western Waters form a complex water body where oceanic and estuarine waters mix. During the wet summer months the massive influx of fresh/brackish water from the Pearl River influences water quality, evident in the strong salinity gradients in parts of the water body. Conversely during the dry winter months, the water column is well mixed reflecting the dominant influence of oceanic water moving in a north easterly direction.

More specifically, to the north of Chek Lap Kok on the ebb tide the flows divide and part moves towards the Western Harbour via the Ma Wan Channel, while the remainder flows southwards round Lantau Island.

The easterly moving waters form a fast moving tidal stream which passes through a channel some 20m deep in places and peak current velocities are in excess of 1m/s. However close to the North Lantau shoreline the velocities are much reduced and peak velocities may be as low as 0.1-0.2 m/s in East Tung Chung Bay.

Part of the ebb tide flows down the west side of Chek Lap Kok and through the channel between Chek Lap Kok and Lantau. It is believed that there is some local strengthening of the tidal stream here.

The flood tide flows in the reverse direction from east to west and probably also strengthens in the channel between Chek Lap Kok and Lantau.

4.1.3 Existing Water Quality

The existing water quality data were discussed in NLDS TR10 data. The data indicate that the North Western Waters are well oxygenated in both surface and bottom layers. In the Urmston Road the mean values of dissolved oxygen are reported to be 87% and 81% in the surface and bottom layers respectively. By comparison the reported values for North Lantau are 92% (surface) and 80% (bottom) respectively.

Biochemical oxygen demand in the North Western Waters ranged between 0 and 1.6 mg/l with a mean of 0.6 mg/l.

Seasonal influences are evident in the oxidised nitrogen values. The wet season values are two to three times greater than those of the dry season, due to the influx of material conveyed by the freshwater runoff from the Pearl Estuary, and from the flushing of dry stream beds and nullahs. Chlorophyll-a concentrations also increase during the wet season with high dissolved oxygen levels, suggesting daytime blooming of algae.

While major steps are being taken to improve Hong Kong's marine water quality, it is worth noting that the North Western Waters are influenced by the quality of water conveyed by the Pearl River. This could be a major source of pollution during the next twenty years. It is not possible to speculate what, if any, legislative controls will be effected by the People's Republic of China relating to water quality.

4.1.4 Existing Sediment Quality

The existing sources of sediment data have been reviewed together with data collected as part of the baseline studies. Data collection was coordinated with the North Lantau Expressway Study to avoid any overlap, and to maximise the data set.

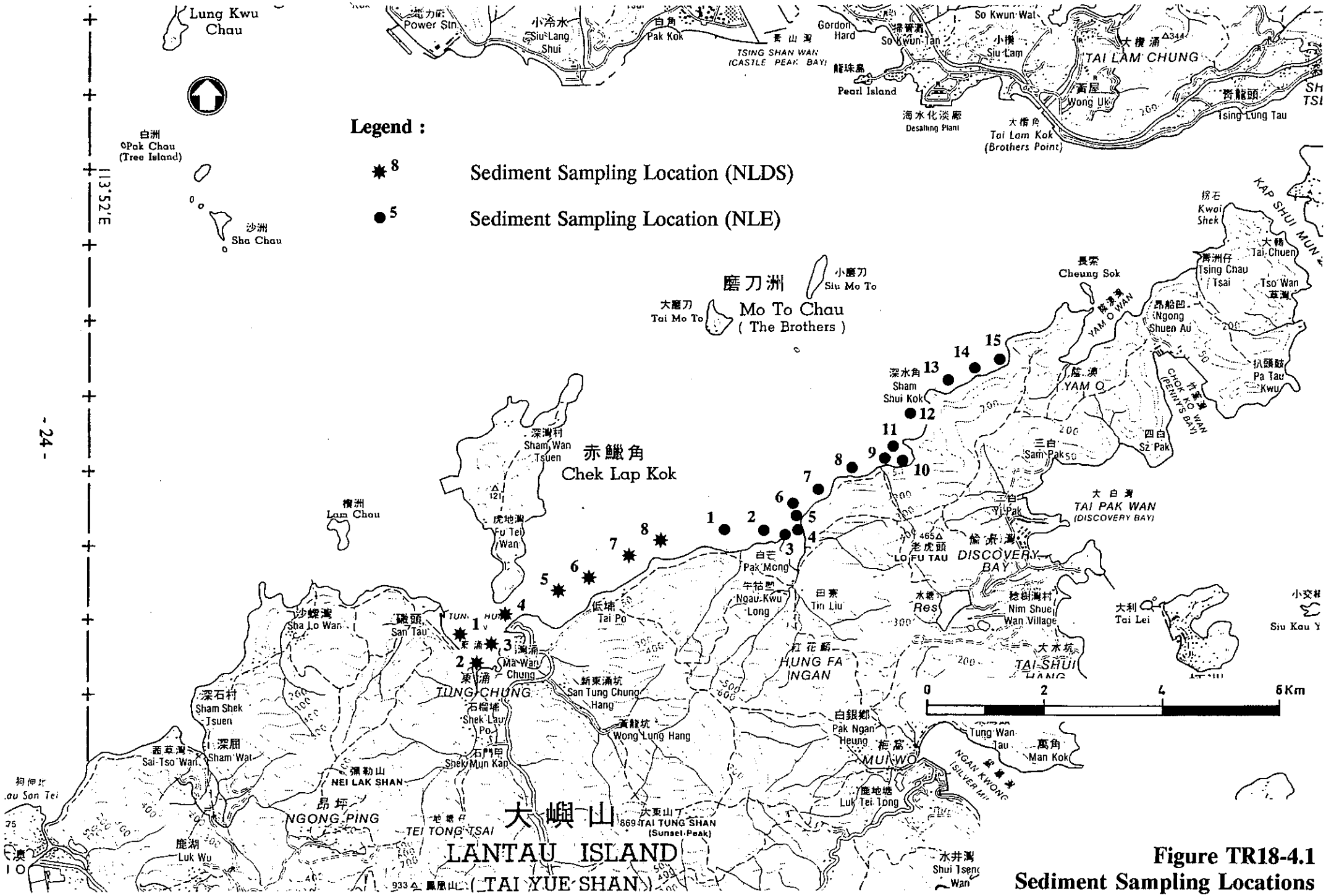
Sediment samples were collected from the locations shown on Figure TR18-4.1. Table 4.1 shows the results of the sediment sampling together with the criteria used for assessing the level of contamination (see section 4.5 below).

Levels of contamination are within the standards proposed in the Contaminated Spoil Management Study except for two samples of Cadmium where levels of 2.2 mg/kg and 1.1 mg/kg were recorded. The former of these, at NLDS Station 4, is higher than the action levels recommended under the Contaminated Spoil Management Study. The area of apparent contamination is isolated and may well be a result of sampling error. It is therefore recommended that additional samples be taken in the same area to prove the results of the previous sampling.

4.1.5 Water Courses

The principal catchments in the Study Area drain Tung Chung, Tai Ho Wan, Siu Ho Wan, Pak Mong and San Tau. In general the water courses are steep in the upland stretch, widening into an alluvial fan in the lower reaches.

Water quality, particularly in the upland sections, is good as there are few sources of pollution. Many of the dwellings in the Study Area are connected to septic tanks. Assuming these are well maintained only grey water should be discharged into any adjacent streams.



- 24 -

Figure TR18-4.1
Sediment Sampling Locations

Table 4.1 Sediment Sample Results and Assessment Criteria

	Pollutant concentration (mg/kg)										
	Zn	Cu	Ni	Pb	Cd	Cr	Hg	TKN	TP	COD	Organic Matter (%)
Sample No (a)											
SS1	25	4	4	11	0.2	5	<0.01	160	2	3300	1.3
SS2	22	4	3	10	0.2	3	<0.01	110	4	1700	1.1
SS3	24	3	3	10	0.3	2	0.05	130	5	2400	1.5
SS4	42	8	15	35	2.2	6	0.17	280	9	5300	2.5
SS5	89	15	16	34	0.8	10	0.16	670	18	19000	3.8
SS6	120	29	21	49	0.6	18	0.32	890	29	20000	4.2
SS7	120	29	22	44	0.8	18	0.27	920	28	17000	4.1
SS8	130	31	21	48	0.6	18	0.27	860	41	17000	4.2
SS9	100	30	17	41	0.6	15	0.14	1300	23	31000	3.6
SS10	96	21	18	34	0.8	13	0.16	670	8	27000	3.5
SS11	110	25	19	41	0.6	17	0.23	900	9	25000	4.0
SS12	110	8	19	36	0.6	18	0.19	830	32	28000	3.3
ES1	43	20	16	41	0.9	18	0.10	640	6	14000	2.9
ES2	70	28	24	58	0.9	23	0.10	1100	3	21000	2.9
ES3	69	28	19	47	0.8	19	0.14	850	4	22000	3.0
ES4	78	34	22	52	0.7	23	0.14	680	3	30000	2.9
ES5	69	35	23	55	0.8	25	0.11	840	10	21000	3.3
ES6	72	37	25	56	0.8	26	0.11	1100	5	22000	3.2
ES7	78	41	25	61	0.8	28	0.12	1100	9	21000	2.9
ES8	71	34	25	55	1.0	28	0.14	650	12	18000	4.0
ES9	79	39	25	60	0.8	26	0.13	1100	8	19000	3.4
ES10	10	8	4	16	0.2	5	0.17	190	18	3900	1.1
ES11	79	31	22	56	0.9	25	0.18	830	7	19000	3.1
ES12	70	22	23	50	1.0	23	0.10	930	7	17000	2.6
ES13	60	17	19	38	1.1	20	0.05	570	7	18000	3.1
ES14	68	48	24	53	0.7	28	0.10	940	4	26000	3.0
ES15	20	8	5	24	0.2	7	0.03	110	5	1400	1.3
Study Area Mean Value	71	24	18	41	0.7	17	0.14	720	12	17400	3.0
Assessment Criteria (b)											
Trigger Levels	150	55	35	65	1.0	50	0.8				
Action Levels	200	65	40	75	1.5	80	1.0				

Note: a) Samples collected for the North Lantau Development Study are labelled SS
Samples collected for the North Lantau Expressway are labelled ES

b) Proposed Trigger and Action Levels for Hong Kong Sediments, Contaminated Spoil Management Study, Technical Note 1 (1991)

4.1.6 Potable Water

The potable water supply for Tung Chung is presently fed by a series of small reservoirs. There are plans to supply sixteen small villages by 1993. It is unlikely any new water wells will be sunk in the area as the Water Supplies Department is providing a water treatment works east of Siu Ho Wan to meet the increased demand for potable water on North Lantau.

The existing reservoirs are fed from stream courses but extraction points are upstream from the construction works and outside the contractor's works areas. It is therefore unlikely that there will be any impact on potable water supplies.

4.2 Sensitive Receivers

Sensitive receivers which could be affected by the construction works include:

(a) fishing grounds between Castle Peak and North Lantau. This is a favoured nursery area because of the warm shallow inlets and abundant food supply;

(b) shell fisheries at Tai Ho Wan, Tung Chung and Sham Wat;

(c) bathing beaches. There are a number of small beaches along the North Lantau coastline and while these are not gazetted they are popular recreational areas; and

(d) stream courses; and

(e) the marine waters in East Chung Bay, the sea channel and Tung Chung Bay.

It is important to note that the airport reclamation will be proceeding at the same time as the Tung Chung reclamation. One of the first activities in the airport reclamation will be to construct a 10m high berm along the southern boundary opposite San Tau. This is mainly to reduce the noise impact but it will also form the northern edge of the sea channel and partly shelter Tung Chung from sediment impacts from the airport works. Tung Chung Bay will become almost fully enclosed as a result of this and its sensitivity to water quality impacts will increase. The sensitivity will reduce over the years as the Tung Chung new town develops and sections of the bay are reclaimed.

4.3 Assessment Methodology and Criteria

Water quality may be affected by dredging, reclamation, disposal of spoil or construction wastes from work sites. The criteria used for assessment of impacts are the Water Quality Objectives proposed by the Sewage Strategy Study for the North Western Water Control Zone, which is now scheduled to be gazetted in 1993.

Once the Water Control Zone is gazetted, water quality in North Western Waters will be required to comply with the Water Quality Objectives and any discharges (including those from construction works) will have to comply with the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (Water Pollution Control Ordinance, Cap. 358, S.21).

The criteria used in considering dredging methods and disposal of spoil are the action and trigger levels for Hong Kong sediments proposed under the recently completed Contaminated Mud Study. These are given in Table 4.1.

4.4 Impacts from Dredging and Reclamation

4.4.1 Introduction

Water quality impacts from dredging may include:-

(a) longer term impacts from changes in bathymetry causing changes to both water movements and water quality;

(b) suspension of solids in the water column during the dredging. A consequence of this can be reductions in dissolved oxygen levels;

(c) disturbance and suspension in the water column of previously dissolved organic and inorganic materials such as ammonia, sulphides and heavy metals. Release of nutrients into the water column is a specific concern as these may provide a food source for phytoplankton in the water column reflected by an increase in algal blooms. Contamination of the water column could occur either at the dredging site or the dumping site; and

(d) contamination from oil spills and the like from dredging plant.

4.4.2 Tai Ho East and Siu Ho Wan

Water Movement and Water Quality

The removal of seabed deposits and reclamation of land at Tai Ho East and Siu Ho Wan will have no significant impact on water movements or water quality during the construction phase.

Marine access will be required for the Refuse Transfer Station (RTS) site at the eastern end of the reclamation. It is unlikely that any changes in water movements would affect vessel handling.

Suspended Sediments

Land required for the sewage treatment and water treatment works will be formed in Siu Ho Wan by the end of the third quarter of 1993; about 77,000 cu m of marine deposits will be removed over a six month period prior to filling. Assuming a six day working week, this is equivalent to just under 500 cu m per day. Given the relatively small volume and the fact that inshore velocities are small, the impact on the receiving waters will be minor.

Dredging will also be required prior to land formation seaward of the NLE for the refuse transfer station (RTS). Dredging works for the RTS are programmed to follow on from the sewage treatment works for a period of nine months. Assuming a six day working week, the average daily dredging rate for this reclamation is approximately 1,500 cu m. The loss of material at the dredging face would be approximately 1 to 2 cu m per hour assuming that grab dredgers are used.

Land reclamation will follow the dredging and a total of about 3 million cu m of marine sand will be placed. Sea walls will probably be constructed first to retain the fill. It is possible that a rehandling basin will be constructed close to the shore. Fill would be dumped into this basin and redredged and placed by a cutter suction dredger. Tailwaters from the marine fill will contain some suspended sediments but most of the sediment load will be deposited close to the reclamation.

There will clearly be some impact on the fish fry and benthic biota local to the site and the white dolphins which are occasionally seen in these waters but this is not likely to be significant unless an extremely large proportion of fines are released at the dredging work face or in marine fill tailwaters. The fish culture zones at Ma Wan are about 7.5 kilometres from Siu Ho Wan and are unlikely to suffer any impact as any sediment in the water column will be dispersed by the strong water currents in the approaches to the Kap Shui Mun channel.

4.4.3 Tung Chung

Water Movement and Water Quality

Dredging and reclamation for the works at Tung Chung is programmed to commence at the beginning of 1992 and to take about ten months. The seawall formation is scheduled to commence six months after the start of the dredging.

A temporary breakwater will be built at Tai Po to give shelter to contractors' boats and a public dumping area. Water movements in the embayment formed by the breakwater will be very small and there will be poor flushing. Floating rubbish and other pollutants will therefore tend to accumulate behind the breakwater. This is not likely to be a long term problem as the area will be filled in Phase 2.

The temporary pier at the mouth of the sea channel will need to be taken into account in the design of the sea channel as it will tend to disturb the water flow as it leaves the channel. This would not be a good location for a permanent pier but it is acceptable for a temporary facility.

Suspended Sediments

Nearly 12 million cu m of marine mud will be dredged for the seawalls, culverts and other structures and some 5 million cu m of marine sand will be used in the reclamation. The construction method will probably be similar to that for Tai Ho East.

Peak current velocities in most of the reclamation area are low and are probably no more than about 0.1 - 0.2 m/s. Water quality will be poor locally during the construction of the reclamation with increased levels of suspended solids. The impact of this will not, however, be significant as there are no sensitive receivers locally. The contribution of this reclamation to the sediment load in the North Western Waters will be small in comparison with the new airport reclamation

Ecology

During field trips as part of the ecological studies, sea grass (*Zostera Nana*) was found near to the pier west of Tung Chung Wan (see Figure TR18-2.1). It is understood that the World Wide Fund for Nature are particularly interested in this and have made an application to have this designated a Site of Special Scientific Interest.

EPD water quality data taken offshore from Tung Chung show variations in suspended sediments from 0.5 mg/l to 40 mg/l. The range of suspended sediments inshore is likely to be at least as great. The sea grass is therefore currently thriving in a brackish environment with dramatic natural fluctuations in suspended solids concentrations in the water body and it is unlikely that construction activities associated with the First Phase (which is over 1.5km away) will affect its survival chances unless there are massive loads of suspended sediments over a long period of time.

4.5 Impacts from Disposal of Spoil

Contamination levels in the sediments that will be dredged are below the target levels proposed in the Contaminated Mud Management Study except for the two samples described in Section 4.1.4 above. It has been recommended that the level of contamination be checked by additional sampling and it has been assumed that the additional sampling will show that contamination levels are within the standards and therefore no special dredging or disposal methods will be needed. If this proves to be not the case then further consideration of action to dispose of the contaminated sediments will be needed. Quantities of spoil will not be large as one of the objectives in the design of the reclamations has been to minimise dredging. Spoil should therefore be dumped at the gazetted dumping grounds subject to the necessary licences being obtained from Director of Environmental Protection.

4.6 Impacts from the Construction Support Facility and General Work Sites

4.6.1 Facilities Provided

It is proposed that a central construction site will be located at Tung Chung to provide construction support facilities for all projects on North Lantau. Smaller facilities may also be provided at Tai Ho Wan and Siu Ho Wan.

The central facilities will probably include approximately 3 hectares of low density residential accommodation. Other facilities have not yet been finalised but will probably include:

(a) up to three concrete batching plants;

(b) an asphalt production plant;

(c) a precast concrete yard occupying about 1 ha;

(d) site offices for the construction of the NLE and NLD;

(e) workshops and offices; and

(f) a temporary ferry pier with cargo handling facilities.

The site for the construction support facility will be handed over to Government on completion of the Phase 1 contract works. The method of allocation of the construction support areas and the method of operating the facilities has yet to be decided.

4.6.2 Water Quality Impacts

Liquid and solid wastes from these facilities could have an impact on water quality in the sea channel, Tung Chung Bay and East Tung Chung Bay. Estimates of population are still unclear but it is expected that the maximum residential population will be 5,000. In calculating impacts it has been assumed that the non-residential population will be similar.

It is important that proper collection systems are installed and operated to ensure that liquid and solid wastes do not enter the water bodies.

Domestic Liquid Wastes

Table 4.2 shows an estimate of the daily flow and load from the combined residential and non-residential population based on the factors adopted in the Sewage Strategy Study Working Paper No 5 'Future Flows and Loads'. The standard is based on Table 10a of the Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters' assuming a flow of 1,500 to 2,000 cu m per day. Table 10a has been used as it refers to waters less than 6m deep at low tide or within 200m of the low water mark. Higher standards would apply if the discharge is into deeper water but this would mean that a long outfall would have to be constructed.

The standards in the Technical Memorandum will not be mandatory until the North Western Water Control Zone is gazetted but it is recommended that they should be applied to any discharges in this area in view of the sensitivity of the receiving waters.

It is clear that the discharges will not meet the standards without treatment.

Table 4.2 Estimated Liquid Waste Discharges from the Construction Support Facility

Pollutant	Total load mg/l	Standard mg/l
Suspended Solids	330	30
Biochemical Oxygen Demand	330	20
Chemical Oxygen Demand	700	80
Total Toxic Metals	0.65	0.4

Non-Domestic Liquid Wastes

There will be non-domestic chemical and oily wastes from the construction and these must not be allowed to enter water courses or the sea. The construction site is remote from normal disposal facilities and the contractor will need to make special disposal arrangements.

Solid Wastes

Daily domestic solid waste arisings will be of the order of 5 tonnes per day for the maximum population. In addition there will be large quantities of construction wastes. Some of these wastes may be suitable for disposal in the public dump or other parts of the reclamation but the remainder will need to collected at a refuse collection point for onward transfer, by barge to WENT, or another suitable landfill site.

4.6.3 Spillages

Spillages could be from:-

(a) use of marine craft and transfer of materials from barges at the temporary jetty;

(b) handling of raw materials on site;

(c) discharge of washout waters from asphalt or concrete batching plants; and

(d) uncontrolled runoff or other discharges from work sites.

Spillages are normally accidental and the nature and extent of the spillage cannot be determined in advance. Impacts of spillages could be severe and care must be taken that adequate equipment is held on site for cleaning up all but the worst spills where Marine Department assistance may be needed.

4.7 Mitigation Measures

4.7.1 Key Issues

The following sections summarise the key issues that have been identified in the assessment of impacts from the First Phase construction. Mitigation measures are proposed for each key issue.

4.7.2 Dredging and Reclamation

No specific mitigation measures are considered necessary for dredging and reclamation but clauses should be included in the contract setting out action to be taken in the event of levels of suspended sediments becoming unacceptable. Construction contracts frequently include conditions specifying standards for suspended sediments, either in the form of maximum levels or percentage increases above background or baseline levels. This approach is not considered appropriate for these works because of difficulties in enforcement and because increased levels of suspended sediments are not expected to have a big impact. Impact monitoring of sediments should be carried out in Tung Chung Bay, the sea channel and East Tung Chung Bay during construction of the Tung Chung reclamation

4.7.3 Construction Support Facility and General Work Sites

Sewage treatment and disposal will be required from the start of construction but the extent of the system required will depend upon the size of the work force, both resident and non-resident and the extent of other facilities built on the construction works area. These cannot be determined at the present time and it is therefore recommended that contractors proposals are subjected to an environmental review to check that they are acceptable. Contracts should state the standards that will have to be achieved; these will be those in the Technical Memorandum.

Any oily or bituminous wastes arising on site will require to be either cleaned and recycled or disposed of at Tseung Kwan O or WENT landfill sites, or the proposed Chemical Waste Treatment Facility at Tsing Yi.

4.7.4 Floating Refuse

The whole area inside the breakwater is likely to be heavily polluted by floating refuse unless strict control is exercised. The floating refuse will collect in corners of the breakwater and will eventually spill out of the breakwater and pollute the sea channel and coastal waters. This can be prevented by the use of floating refuse booms and these should be specified in the contract.

4.7.5 Accidental Spills

It is possible that accidental spills will occur during the construction and contingency plans need to be set up to deal with these. The site is remote from the central Government stores of materials and equipment for cleaning up spills and stores must therefore be kept on site.

Spillages may be classified as either minor, moderate or severe. The approach adopted to clean up operations depends upon the nature of the spillage. Spillages are most likely to occur when handling materials, material transfer from barge to land, at batching plants (concrete and bitumen) or at vehicle maintenance facilities.

Minor spillages include small quantities of material which will biodegrade naturally. Due to their degradable nature it may not be essential to clean up such materials, unless they pose a threat to other activities.

Moderate impact spillages include those materials which may be biodegradable, albeit perhaps slowly, but in so doing exert a significant oxygen demand on the receiving waters. These include small quantities of oil based materials. Others in this category include inert materials which require collection, such as cement.

Materials with the potential to create a severe impact on the water body include oils and petroleum based materials. Clean up operations will be determined by the nature and extent of the spillage but may involve either dispersion and dilution of the material or containment and collection.

A spill action plan should be submitted by the contractor for the civil engineering works and by any contractor who is operating facilities in the construction works area.

Basic pollution control equipment should include containment booms, skimmers to remove oil from the surface of the water, adsorbent material to collect oil, surfactants to break up and disperse oil slicks, a work boat and protective clothing for the operatives. Staff should be trained to operate the equipment.

4.7.6 Pollution Control

There will be a large number of contractors working in the Tung Chung area and there is potential for water pollution from all of these contracts. The level of pollution control will no doubt vary from contract to contract as some contractors will be more diligent than others. It is probably inevitable that there will be some build up of refuse both floating and on the beaches and shoreline. It will be very difficult to determine responsibility for this pollution and therefore very difficult to ensure that is cleaned up using normal contractual arrangements.

It is therefore proposed that a provision for a cleaning team be included in at least one of the contracts. The team should comprise a sampan together with labour and equipment for collecting floating refuse and refuse deposited on beaches and shorelines. The cleaning team would be mobilised on instruction by the Engineer and would be paid on a dayworks basis. All contractors would remain responsible for cleaning their own sites and the cleaning team would be used where no one contractor has responsibility. Some liaison between supervisory staff on the various contracts would be necessary to ensure the efficient operation of the cleaning team.

It is recommended that provision for the cleaning team be included in the Phase 1 contract.

4.8 Water Quality Monitoring

4.8.1 General

Water quality monitoring will be carried out by the Engineer using equipment supplied by the contractor. The monitoring will be used to determine baseline conditions and then for impact monitoring. It will also provide a data base for use in subsequent project audit.

4.8.2 Baseline Conditions

Baseline water quality monitoring for the North Lantau Development Study has commenced as discussed in Section 4.1. However the monitoring stations (except for Station 1) are remote from the location of the First Phase works and these data are not intended to be used for contract specific monitoring. Monitoring stations proposed for the Phase 1 works are shown on Figure TR18-4.2. This figure also shows monitoring stations for works to be entrusted to Highways Department.

Baseline conditions should first be established at these stations by taking measurements on 4 sampling days per week, at mid-flood and mid-ebb, for 4 consecutive weeks within six weeks of the start of the marine works. Measurements should be at 2 depths, 1m below the water surface and 1m above the sea bed unless the water is less than 3m deep in which case the measurement should be at the mid-depth only. In-situ measurements of turbidity, temperature, salinity and dissolved oxygen should be taken and samples recovered for laboratory determination of suspended solids.

4.8.3 Impact Monitoring

Impact monitoring should be carried out throughout the contract whenever marine works are in progress and should continue until the adjacent water body has returned to normal conditions. The monitoring programme will depend on the contractors activities but as a guide a data set (comprising all the parameters collected for baseline monitoring) should normally be collected up to three days per week. It may be possible to delete the suspended sediment test if an adequate calibration between turbidity and suspended sediments can be determined. Monitoring should be more frequent if there are indications that water quality is deteriorating.

Should the impact monitoring record levels of turbidity, suspended solids, or dissolved oxygen which are indicative of a deteriorating situation such that closer monitoring is reasonably indicated, then the Engineer should undertake daily impact monitoring until the recorded depth averaged values of these parameters indicate an improving and acceptable level of water quality.

Where impact monitoring shows a deteriorating water quality, the Contractor should be directed to take all necessary steps to ensure that the works being carried out by the Contractor are not contributing to the deterioration. These steps should include the following:-

(a) checking of all marine plant and equipment;

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

(c) review of all working methods.

The Contractor should inform the Engineer of all steps taken. Written reports and proposals for action should be passed to the Engineer by the Contractor whenever water quality monitoring shows deteriorating water quality.

It is not appropriate to specify criteria for water quality standards for this contract as water quality will be affected by other construction works in the area, notably the works for the site formation contract for the New Airport. However the impact monitoring should allow the Engineer to identify trends in water quality and the impact of the Contractors works on the trend.

Table 4.3 shows target, trigger and action levels for water quality which would be reasonable based on the assessment carried out for this report. This does not take any account of impacts on water quality from the New Airport construction and should be reviewed continuously on site in the light of the impact monitoring results.

Table 4.3 Target, Trigger and Action Levels for Water Quality

Parameter	Target	Trigger	Action
Suspended solids	30 percent increase above the baseline level	30 per cent increase above the running mean of sampling data for the previous month	30 per cent increase above the maximum level recorded upstream of the works on that sampling day
Dissolved oxygen	As for suspended solids but 30 per cent decrease	As for suspended solids but 30 percent decrease	As for suspended solids but 30 percent decrease

Note (1) all levels should be depth averaged.

Table 4.4 summarises action to be taken in the event that the target, trigger and action levels proposed in Table 4.3, or revised during the contract, are exceeded.

Table 4.4 Action Plan

Event	Action	
	Engineer	**Contractor**
Exceedance of target level for one sample	Repeat measurement as soon as possible	-
Exceedance of target level for more than one consecutive sample	Repeat measurements Notify contractor	-
Exceedance of trigger level for one sample	Repeat measurement as soon as possible Notify contractor	-
Exceedance of trigger level for more than one consecutive sample	Increase frequency of monitoring to at least daily Notify contractor Require contractor to make proposals to reduce dust	Review plant and methods Submit proposals for improving water quality to Engineer Implements remedial actions
Exceedance of action level for one sample	Repeat measurement as soon as possible Notify contractor	-
Exceedance of action level for more than one sample	Increase frequency of monitoring to at least daily Notify contractor Notify EPD Require contractor to implement immediate steps to improve water quality	Review plant and methods Submit proposals to improve water quality to the Engineer Implement measures to improve water quality immediately Notify Engineer of action taken

4.8.4 Monitoring of effluents

It is unlikely that monitoring of effluents from works sites will be necessary but monitoring of pollutants from the construction support facilities will probably be needed. This should be considered further during the environmental review of operator's proposals.

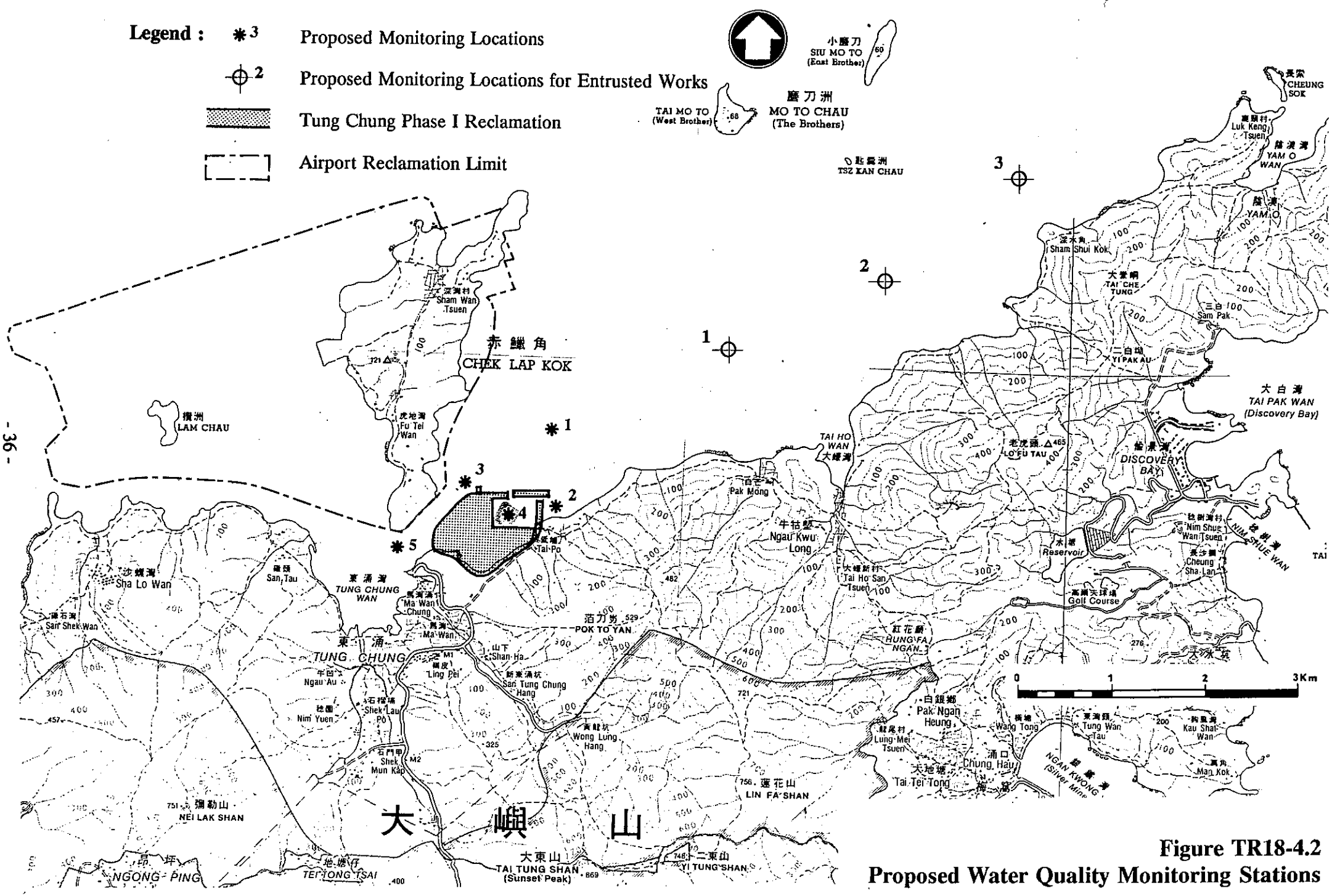


Figure TR18-4.2
Proposed Water Quality Monitoring Stations

4.9 Conclusions

The following potential water movement, sedimentation and water quality impacts and mitigation measures have been identified:-

(a) impacts from dredging and reclamation works at Tai Ho East, Sui Ho Wan and Tung Chung are not likely to be significant unless there are excessive levels of suspended sediments in tailwaters from marine fill or at dredging faces. This is unlikely to happen but clauses should be included in the construction contracts empowering the Engineer to take action if necessary;

(b) pollution from the construction support facility and general work sites could be significant. Effluents should be controlled through contract clauses and contractors should be advised in their contracts that Table 10a of the Technical Memorandum "Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters" will be used as a standard firstly to approve their proposals and secondly for monitoring;

(c) contractors should maintain proper equipment and trained staff to clean up accidental spillages and should submit a spill action plan for approval prior to start of the works or construction of any facilities;

(d) floating refuse booms should be used to contain floating debris form dumping activities inside the breakwater;

(e) a cleaning team should be set up to be used on the Engineer's instructions to clean up floating debris or rubbish on beaches and shorelines that cannot be attributed to any one contractor;

(f) facilities proposed by operators for the construction support facility should be subject to environmental review and provisions for effluent control and monitoring should be included in lease conditions; and

(g) baseline and impact monitoring should be carried out by the Engineer for turbidity, temperature, salinity, dissolved oxygen and suspended solids. Additional data should be collected to monitor pollution levels in effluents from the construction support facilities and possibly works sites.

5. NOISE

5.1 Introduction

This chapter addresses the issue of construction noise impact arising from the First Phase development. The objective has been to determine whether the construction activities as detailed below would comply with the requirements of the Noise Control Ordinance (NCO) if working in the restricted hours is needed and what, if any, mitigation measures are required. It should be noted at the outset that not all activities will need 24-hour working throughout the contract. However, there may be times when prolonged working may be necessary to make up for the loss of time due to bad weather, shortage of labour and materials, change of construction programme or other unforeseeable reasons.

5.2 Assessment Methodology and Impact Criteria

The assessment has been made by predicting the noise levels at the facade of the identified noise sensitive receivers in the Study Area and comparing the noise levels with the acceptable noise criteria stipulated in the NCO.

A number of major construction activities have been identified based on the construction method described in Chapter 2 and these are shown in Appendix B. The highest anticipated noise levels arising from individual activities have been predicted by assuming a set of powered mechanical equipment working at specified locations or notional source positions for stationary activities or working along specific paths for mobile activities. The method of prediction has followed that prescribed in the Technical Memorandum on Noise from Construction Work Other Than Percussive Piling (TM1) and the Technical Memorandum on Noise from Percussive Piling (TM2).

The types and numbers of items of powered mechanical equipment to be used for the activities have been estimated based on the construction method and these are shown in Appendix B. The nominal sound power levels of these equipment items are also shown in Appendix B.

Eleven noise neighbourhoods which cover all noise sensitive receivers likely to be affected by the construction in the Study Area have been identified. They include all the existing village settlements in Tung Chung and Siu Ho Wan. Appendix B lists the affected villages within each neighbourhood. The locations of these noise neighbourhoods are shown in Figure TR18-5.1.

In accordance with TM1, the Area Sensitivity Rating (ASR) of the area containing the noise neighbourhoods should be classified as "A" for which the ANL should be:-

(a) 60 dB(A) in Period 1 - all days during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the day-time and evening (0700 to 2300 hours); and

(b) 45 dB(A) in Period 2 - all days during the night-time (2300 to 0700 hours).

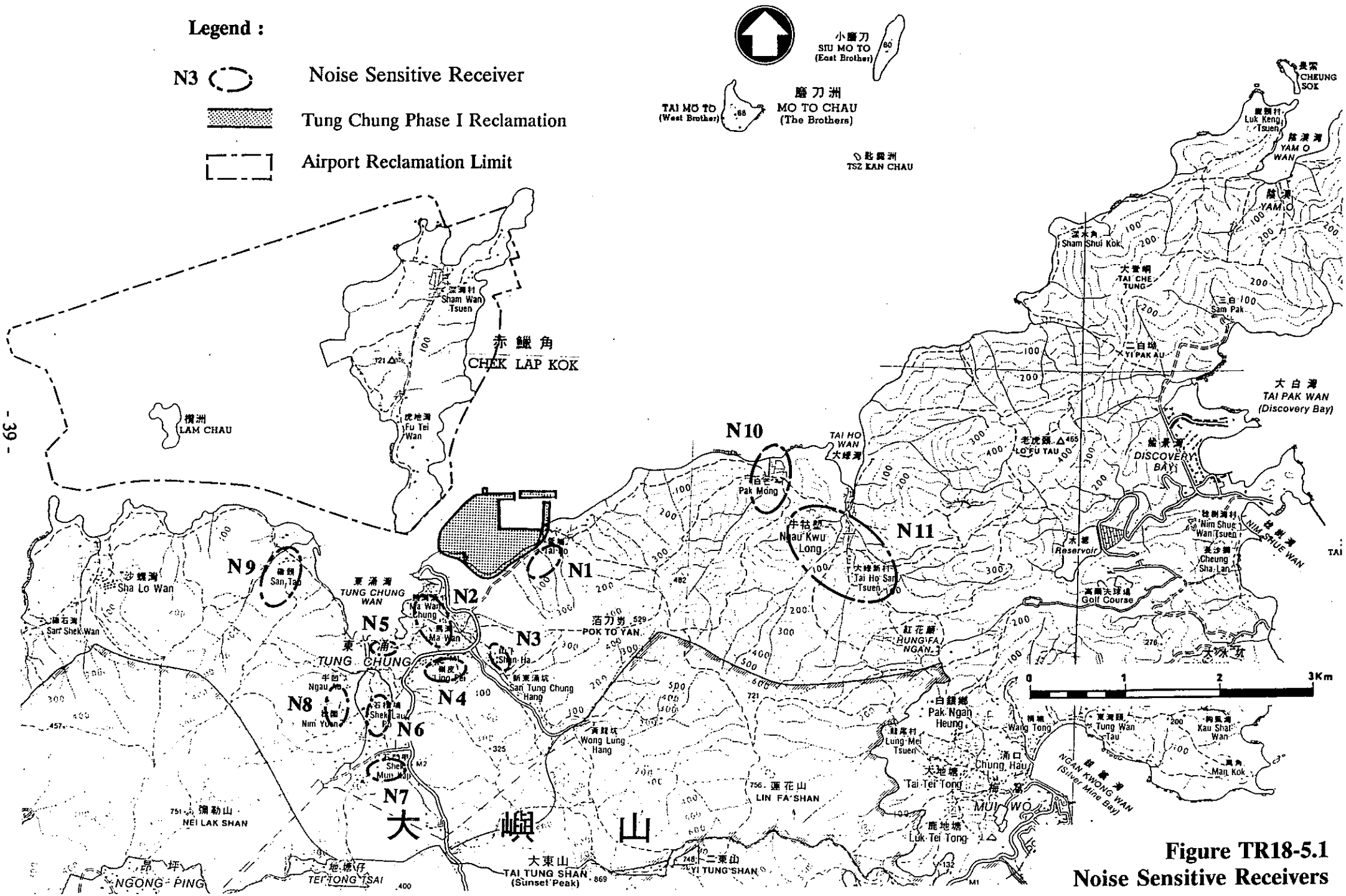


Figure TR18-5.1
Noise Sensitive Receivers

A Construction Noise Permit (CNP) must be acquired from the Control Authority for any works to be carried out in the above periods and the relevant noise criteria must be strictly observed for the issuance of permits. A Construction Noise Permit will be required for percussive piling in the daytime according to TM2. Percussive piling in the restricted hours is prohibited.

5.3 Impact Assessment and Evaluation

As there is considerable uncertainty over the construction programme to be adopted by the contractor, noise levels have been predicted for single activities only. Appendix B summarizes the predicted noise levels at all neighbourhoods. Noise levels from infrastructure and building works have been assessed even though they will not be included in the present contract.

The highest noise level of 83 dB(A) is predicted to occur at N1 during Activity A.2.1 which is rock excavation for Tung Chung Land Formation and the noisiest equipment items are the 10 pneumatic drills. However, this activity may not be a critical activity and therefore may not need to work more than 12 hours a day. High noise levels are also predicted to occur at N1 during Activity A.1.2.1 which is site formation in Tung Chung and the noisiest items would be the 20 trucks on site. This activity, again, may not be critical and therefore may not normally need to operate in the restricted hours.

Activities A.1.2.2 and A.1.7 which are dredging and reclamation using marine plant in Tung Chung will require 24-hour working. The predicted noise levels are 66 dB(A) at N1 but no higher than 50 dB(A) at other locations. A number of other activities will cause noise levels greater than 50 dB(A) at N1.

Other noise sensitive areas are not predicted to be exposed to high noise levels partly because of distance effects and partly due to screening by the local topography.

Under normal circumstances the only activity which will require 24 hour working will be the dredging and reclamation. However the construction programme for the First Phase is tight and contractors may need to work for 24 hours on many activities to meet unforseen delays. Any delay to completion of these works would delay construction of other critical components of the Airport Core Projects and would therefore be unacceptable.

Percussive piling has been predicted to produce no higher than 85 dB(A) at the noise neighbourhoods. According to TM2, daytime piling will be permitted.

Activities which could not work in the restricted periods are shown in Table 5.1.

Table 5.1 Activities Which Could Not Work in the Restricted Periods

Activity		Period 1	Period 2
Code	Description		
	Tung Chung		
A.1.1	Seawalls	*	*
A.1.2.1	Site Formation	*	*
A.1.2.2	Reclamation	*	*
A.1.3	Concrete placing	*	*
A.1.6	Piling	*	*
A.1.7	Dredging	*	*
A.2.1	Rock Excavation	*	*
A.3.1	Piling	*	*
A.3.2	Concrete placing (ferry pier)		*
	Tai Ho East/Siu Ho Wan		
B.3.1	Seawalls		*
B.3.2	Reclamation		*
B.4.2	Rock Excavation		*

5.4 Mitigation

The contractor should have the flexibility to work 24 hours on the critical activities and some form of mitigation will therefore be necessary. Mitigation at source is difficult for these activities. The reclamation works will be carried out initially in open water and the site formation will use mobile plant which is difficult to screen or silence. Nevertheless the contractor should be encouraged to silence all equipment items on site by enclosures, baffles, mufflers or silencers, particularly if night works are required. Also quiet equipment should be employed for the construction work as far as practical.

The above assessment has shown that the proposed construction activities are unlikely to cause significant noise impacts on the existing villages in North Lantau except at Tai Po and the neighbouring Youth Camp which could be exposed to higher noise levels because of their close proximity to the works sites. Other villages are further from the works sites or are well screened by the local topography and therefore would not experience high noise levels.

Most activities should not require 24-hour working and normally would only work for 12 hours a day, 6 days a week. The reclamation works in Tung Chung and Tai Ho East/Siu Ho Wan will require 24-hour working and other activities may require 24 hour working.

Mitigation at receivers must therefore be considered. This would comprise insulation of the receivers firstly by installing and operating airconditioners and secondly by adding window insulation. Airconditioners allow windows to be closed at night so that the sound proofing effect of the windows can be used. Insulation of windows provides further sound insulation. Table 5.2 shows the noise levels that would be acceptable with sound insulation.

Table 5.2 ANLS with Sound Insulation

Method of Insulation	Maximum Allowable Noise Levels (dB(A))	
	Period 1	Period 2
Airconditioners	65	60
Airconditioners and Window Insulation	75	70

The two activities which are most likely to need 24 hour working are reclamation and site formation in Tung Chung (A.1.2.2 and A.1.2.1). The maximum noise levels from these activities will exceed those in Table 5.2 as follows:-

(a) site formation will cause noise of 80 dB(A) at Tai Po and 83 dB(A) at the Youth Camp.

(b) reclamation will cause noise of 64 dB(A) at Tai Po and 68 dB(A) at the Youth Camp.

Reclamation and site formation could last from the start of the works in early 1992 to late 1993.

Sound insulation comprising airconditioners and window insulation will be needed at Tai Po and the Youth Camp to allow these activities to proceed at night and it is recommended that these are installed. Approximately 19 properties in Tai Po would qualify. Of these 10 are permanently occupied and the remainder are occupied at weekends and holidays. The total cost would be of the order of $600,000 for installation and operation of airconditioners plus $200,000 for window insulation. A detailed site survey is needed to confirm these cost figures. The contractor would then be able to work to a noise levels of 70 dB(A) and 75 dB(A). These are less than the predicted levels but it is considered that a reduction to this level could be effected by additional mitigation at source. This could include working away from sensitive receivers or using fewer plant items during the restricted periods.

These properties are due to be relocated in 1993, little more than a year after the start of construction. The NAMP Consultants have also recommended sound insulation but their works will not start until after the First Phase. The sound insulation therefore needs to be carried out for the First Phase construction if restrictions on the contractor are to be avoided. Early relocation of these properties is not possible due to statutory notice periods and the lack of suitable relocation sites.

5.5 Noise Monitoring

Noise monitoring should be carried out at Tai Po, the Youth Camp and at Ma Wan Chung. Measurement should be at least two per day, one in each of the restricted periods, unless complaints are received in which case more frequent measurements will be needed. Measurements will also be needed during the daytime at up to 3 days per week or more frequency if noise levels become high. The Contractor should be instructed to take action to reduce noise levels whenever any level is measured in excess of those defined in the Construction Noise Permit.

Target, trigger and action levels for noise are shown in Tables 5.3 and 5.4. These include daytime noise levels which are recommended but will not be mandatory under the contract.

Table 5.3 Target, Trigger and Action Levels for Noise during Restricted Periods

Location	Noise Level dB(A)					
	Target		Trigger		Action	
	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
Tai Po and Youth Camp	60	45	70	65	75	70
Other Receivers	60	45	60	45	60	45

Table 5.4 Target, Trigger and Action Levels for Noise During the Daytime

Location	Noise dB(A)		
	Target	Trigger	Action
Tai Po and Youth Camp	75	75	83
Other Receivers	75	75	78

Table 5.5 shows action that should be taken of noise levels are exceeded.

Table 5.5 Action Plan

Event	Action	
	Engineer	**Contractor**
Exceedance of Period 1 or 2 target levels Exceedance of daytime target or trigger level	Notify Contractor	-
Exceedance of Period 1 or 2 trigger levels Exceedance of daytime action level	Notify Contractor Require Contractor to propose measures to reduce noise Increase monitoring frequency to at least two measurements per daytime/Period 1/Period 2 as appropriate	Submits noise mitigation proposals to the Engineer Implements noise mitigation proposals
Exceedance of Period 1 or 2 action level	Notify Contractor Notify EPD Require contractor to implement mitigation measures Increase monitoring frequency to hourly	Implement mitigation measures Advise Engineer of measures applied

5.6 Conclusion

Most activities connected with the construction of the First Phase will not cause excessive noise and may be carried out within the constraints of the Noise Control Ordinance.

However dredging and reclamation, which must be 24 hour operations and site formation, which may need to be a 24 hour operation, will need mitigation. Sound insulation of the properties at Tai Po and the Youth Camps comprising airconditioners and sound insulation is recommended. Assuming that this is installed then an application under Clause 3.3 of the Noise Control Ordinance may be made to the Secretary for Planning Environment and Lands that higher noise levels may be applied to this project. The noise levels that are recommended are 75 dB(A) in Period 1 and 70 dB(A) in Period 2. These levels should be stated in the tender documents and tenderers should be encouraged to apply for a CNP during the tender period to confirm that their method of working will be acceptable.

6. THE NEXT STEPS

This report has presented an assessment of the environmental impacts of the construction of the First Phase together with suitable mitigation measures.

Contract documents are presently being prepared for these works and the mitigation measures will be incorporated. The report has concluded that environmental impacts for noise and water quality during construction will generally be within current standards if these mitigation measures are applied. The exception to this is that dust may exceed the EPD guideline for 1 hour levels of TSP and the AQO for 24 hour TSP at times.

Control of noise from the construction will be under the Noise Control Ordinance and the report has assessed the noise levels that are likely to be generated by construction plant. The need for special procedures to allow working in periods restricted under the Noise Control Ordinance are being considered by the engineering design team.

Construction of subsequent phases of the development will be considered in Topic Report No 20, Environmental Development Manual.

Appendix A

Air Quality

Appendix A1 Coordinates of Sensitive Receivers

		Easting	Northing	Level (mPD)
1.	Kau Liu	809770	816760	11
2.	Ngau Au	810540	815310	20
3.	Mok Ka	810700	814650	20
4.	Shek Pik Au	810710	814260	60
5.	Wong Ka Wai	811300	815450	15
6.	Shan Ha	812170	815540	20
7.	Pak Mong	815080	817400	20
8.	Tai Ho San Tsuen	815870	816520	50
9.	Tin Sam	809900	816800	5
10.	Tung Hing	810590	815190	20
11.	Village Resite 1	810620	814470	40
12.	Shek Mun Kap	811050	814480	30
13.	Lung Tseng Tau	811250	815400	15
14.	San Keng	810930	814360	40
15.	Ngau Kwu Long	815640	816930	50
16.	San Tau	809950	816570	13
17.	Nim Yuen	810530	814870	20
18.	Village Resite 2	810590	814370	50
19.	Sheung Ling Pei	811600	815480	15
20.	Village Resite 3	812050	815340	40
21.	Ha Ling Pei	811400	815480	15
22.	Tin Liu	815950	816960	20
23.	Ma Wan Chung	811430	816315	5
24.	Wong Lung Hang	813030	814890	74
25.	Sha Tsui Tau	811100	815800	5
26.	Ma Wan	811580	815950	7
27.	Fui Yiu Ha (School)	811820	815560	20
28.	Outdoor Recreation Camp	810840	815670	5
29.	San Tung Chung Hang	812520	815030	15
30.	Shek Lau Po	810890	815030	15

Appendix A1 Coordinates of Sensitive Receivers (Cont'd)

		Easting	Northing	Level (mPD)
31.	ASR (West of Outdoor Camp)	810550	815740	5
32.	Tai Ho Wan (Temple)	816080	817650	8
33.	Tai Po Buddhist Youth Hostel	812550	816570	25
34.	Tai Po	812800	816900	10

Appendix A2 - Emission Factors

Emission Rates of Stationary Sources

1. Blasting

Mass Fraction : 0 - 10 μm = 20%
10 - 30 μm = 80%

Emission Factor for TSP $E_{TSP} = \frac{344\ (A)^{0.8}}{D^{1.8}\ M^{1.9}}$ kg/blast

where A = area blasted m^2
D = hole depth m
M = % moisture content (assumed 1.5%)

Emission Factor for RSP $E_{RSP} = 0.2 \times E_{TSP}$

Location (code nos refer to Appendix A3)	Area m^2	Depth m	Volume/day m^3	Emission Factor $g/s/m^2$		
				24-hr Avg		1-hr Avg
				< 30 μm	< 10μm	< 30 μm
Tung Chung						
15.	62500	5	3782	3.269×10^{-4}	6.538×10^{-5}	7.846×10^{-3}
16.	62500	5	3782	3.269×10^{-4}	6.538×10^{-5}	7.846×10^{-3}
Tai Ho						
21.	40000	5	5288	6.79×10^{-4}	1.336×10^{-4}	1.600×10^{-2}
22.	40000	5	5288	6.79×10^{-4}	1.336×10^{-4}	1.600×10^{-2}

2. Drilling

Mass Fraction : 0 - 10 μm = 10%
10 - 30 μm = 90%

Emission Factors : E_{TSP} = 0.4 g/Mg
E_{RSP} = 0.04 g/Mg

Location (code nos refer to Appendix A3)	Area m^2	Volume/day m^3	Volume/hr m^3	Emission Factor g/s/m^2		
				24-hr Avg		1-hr Avg
				< 30 μm	< 10μm	< 30 μm
Tung Chung						
13.	62500	3782	315	6.992×10^{-7}	7.000×10^{-8}	1.680×10^{-6}
14.	62500	3782	315	6.992×10^{-7}	7.000×10^{-8}	1.680×10^{-6}
Tai Ho						
19.	40000	5288	441	1.530×10^{-6}	1.530×10^{-7}	3.060×10^{-6}
20.	40000	5288	441	1.530×10^{-6}	1.530×10^{-7}	3.060×10^{-6}

3. Concrete Batching

Assume the emission factor for uncontrolled batching is 0.12 kg/m^3

Location (code nos refer to Appendix A3)	Area m^2	Volume/day m^3	Volume/hr m^3	Emission Factor g/s/m^2	
				24-hr Avg	1-hr Avg
				< 30 μm	< 30 μm
Tung Chung					
11.	300	25.6	2.13	1.185×10^{-4}	2.370×10^{-4}
Tai Ho					
7.	300	16.5	1.38	7.640×10^{-5}	1.525×10^{-4}
17.	300	55.0	4.58	2.550×10^{-4}	5.092×10^{-4}

4. Rock Crushing

Emission Factors : $E_{TSP} = 0.14$ kg/Mg
$E_{RSP} = 0.0085$ kg/Mg

Location (code nos refer to Appendix A3)	Area m^2	Volume/day m^3	Volume/hr m^3	Emission Factor g/s/m^2		
				24-hr Avg		1-hr Avg
				< 30 μm	< 10μm	< 30 μm
Tung Chung 21.	50	3782	315	3.060×10^{-1}	1.860×10^{-2}	6.128×10^{-1}
Tai Ho 27. 28.	50 50	5288 5288	441 441	4.284×10^{-1} 4.284×10^{-1}	2.600×10^{-2} 2.600×10^{-2}	8.569×10^{-1} 8.569×10^{-1}

5. Haul Roads

Based on AP42: "Compilation of Air Pollutant Emission Factors"

$$\text{Emission Rate (kg/v-km)} = k(1.7)\left(\frac{s}{12}\right)\left(\frac{S}{48}\right)\left(\frac{W}{2.7}\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}$$

where k = particle size multiplier
s = silt content of road surface material
S = mean vehicle speed km/h
W= mean vehicle weight Mg
w= mean number of wheels

Typical values for these parameters were taken as:

s = 26% for Tung Chung Area
= 23% for Tai Ho Wan Area
S = 20km/h
W= 30 Mg (loaded), 10 Mg (unloaded)
w= 10
k = 0.36 for particulate < 10 μm
= 0.8 for particulate < 30 μm

Location (code nos refer to Appendix A3)	Area m^2	Emission Factor $g/s/m^2$		
		24 - hr Avg		1 - hr Avg
		< 30 μm	< 10 μm	< 30 μm
Tung Chung				
1	52900	8.421×10^{-4}	3.786×10^{-4}	1.684×10^{-3}
2	90000	4.950×10^{-4}	2.226×10^{-4}	9.900×10^{-4}
3	48400	9.204×10^{-4}	4.140×10^{-4}	1.841×10^{-3}
4	52900	8.421×10^{-4}	3.786×10^{-4}	1.684×10^{-3}
5	72900	6.111×10^{-4}	2.748×10^{-4}	1.222×10^{-3}
17	62500	3.352×10^{-4}	1.510×10^{-4}	6.708×10^{-4}
18	62500	3.352×10^{-4}	1.510×10^{-4}	6.708×10^{-4}
22	62500	2.050×10^{-4}	9.200×10^{-5}	4.092×10^{-4}
23	62500	2.050×10^{-4}	9.200×10^{-5}	4.092×10^{-4}
Tai Ho				
1	32400	2.840×10^{-4}	1.279×10^{-4}	5.688×10^{-4}
2	25600	3.596×10^{-4}	1.618×10^{-4}	7.186×10^{-4}
5	12100	7.280×10^{-5}	3.280×10^{-5}	1.450×10^{-4}
9	36100	3.130×10^{-4}	1.409×10^{-4}	6.270×10^{-4}
10	44100	2.564×10^{-4}	1.152×10^{-4}	5.135×10^{-4}
11	22500	5.028×10^{-4}	2.261×10^{-4}	1.005×10^{-3}
12	22500	5.028×10^{-4}	2.261×10^{-4}	1.005×10^{-3}
23	40000	5.188×10^{-4}	2.334×10^{-4}	1.038×10^{-3}
24	40000	5.188×10^{-4}	2.334×10^{-4}	1.038×10^{-3}
29	40000	1.412×10^{-4}	6.350×10^{-5}	2.825×10^{-4}
30	40000	1.412×10^{-4}	6.350×10^{-5}	2.825×10^{-4}
33	28900	5.480×10^{-4}	2.464×10^{-4}	1.093×10^{-3}
34	22500	7.040×10^{-4}	3.160×10^{-4}	1.400×10^{-3}
37	52900	8.710×10^{-4}	3.918×10^{-4}	1.736×10^{-3}
38	44100	1.045×10^{-3}	4.698×10^{-4}	2.082×10^{-3}
39	48400	9.519×10^{-4}	4.282×10^{-4}	1.897×10^{-3}
40	40000	1.152×10^{-3}	5.179×10^{-4}	2.295×10^{-3}
41	32400	1.422×10^{-3}	6.396×10^{-4}	2.834×10^{-3}
42	25600	1.800×10^{-3}	8.094×10^{-4}	3.585×10^{-3}

6. Loading/Unloading

Based on AP42: "Compilation of Air Pollutant Emission Factors"

$$\text{Emission Rate (kg/Mg)} = \frac{k\,(0.0009)\left(\frac{S}{5}\right)\left(\frac{U}{2.2}\right)\left(\frac{H}{1.5}\right)}{\left(\frac{M}{2}\right)^{2}\left(\frac{Y}{4.6}\right)^{0.33}}$$

where k = particle size multiplier
S = material silt content in %
U= mean mind speed m/s
H= drop height m
M= material moisture content in %
Y= dumping device capacity m^3

Typical values for these parameters were taken as:

S = 2%/23%/26% (depends on soil type)
U= 2m/s
H= 1m for loading
3m for unloading
M= 1.5%/16%/25% (depends on soil type)
Y= $8m^3$ for unloading
= $1.5m^3$ for loading
k = 0.73 for particulate < 30 μm
0.36 for particulate < 10 μm

Location (code nos refer to Appendix A3)	Area m^2	Volume/ day m^3	Volume/ hr m^3	Emission Factor g/s/m^2		
				24 - hr Avg		1 - hr Avg
				< 30 μm	< 10 μm	< 30 μm
Tung Chung						
6	52900	16748	1396	2.222×10^{-7}	1.094×10^{-7}	4.443×10^{-7}
7	90000	16748	1396	1.306×10^{-7}	6.432×10^{-8}	2.610×10^{-7}
8	48400	16748	1396	2.429×10^{-7}	1.196×10^{-7}	4.854×10^{-7}
9	52900	16748	1396	2.222×10^{-7}	1.094×10^{-7}	4.443×10^{-7}
10	72900	16748	1396	1.612×10^{-7}	7.941×10^{-8}	3.222×10^{-7}
19	62500	3782	315	7.176×10^{-7}	3.536×10^{-7}	1.435×10^{-6}
20	62500	3782	315	7.176×10^{-7}	3.536×10^{-7}	1.435×10^{-6}
24	62500	2308	192	5.000×10^{-8}	2.470×10^{-8}	1.000×10^{-7}
25	62500	2308	192	5.000×10^{-8}	2.470×10^{-8}	1.000×10^{-7}
Tai Ho						
3	32400	4698	392	4.063×10^{-8}	1.951×10^{-8}	8.102×10^{-8}
4	25600	4698	392	5.128×10^{-8}	2.471×10^{-8}	1.027×10^{-7}
6	12100	2033	169	2.720×10^{-8}	1.360×10^{-8}	5.434×10^{-8}
13	36100	5769	481	4.496×10^{-8}	2.214×10^{-8}	8.991×10^{-8}
14	44100	5769	481	3.693×10^{-8}	1.812×10^{-8}	7.353×10^{-8}
15	22500	5769	481	7.226×10^{-8}	3.563×10^{-8}	1.443×10^{-7}
16	22500	5769	481	7.226×10^{-8}	3.563×10^{-8}	1.443×10^{-7}
25	40000	5288	441	1.803×10^{-5}	8.875×10^{-6}	3.606×10^{-5}
26	40000	5288	441	1.803×10^{-5}	8.875×10^{-6}	3.606×10^{-5}
31	40000	1442	120	1.767×10^{-8}	8.725×10^{-9}	3.535×10^{-8}
32	40000	1442	120	1.767×10^{-8}	8.725×10^{-9}	3.535×10^{-8}
35	28900	6730	561	3.920×10^{-8}	1.890×10^{-8}	7.500×10^{-8}
36	22500	6730	561	5.020×10^{-8}	2.420×10^{-8}	9.634×10^{-8}
43	52900	12040	1003	4.914×10^{-8}	2.399×10^{-8}	9.831×10^{-8}
44	44100	12040	1003	5.897×10^{-8}	2.878×10^{-8}	1.179×10^{-7}
45	48400	12040	1003	5.372×10^{-8}	2.621×10^{-8}	1.074×10^{-7}
46	40000	12040	1003	6.500×10^{-8}	3.172×10^{-8}	1.300×10^{-7}
47	32400	12040	1003	8.024×10^{-8}	3.912×10^{-8}	1.605×10^{-7}
48	25600	12040	1003	1.016×10^{-7}	4.956×10^{-8}	2.031×10^{-7}

7. Asphalt Mixing

Assuming 0.5% sulphur in diesel fuel all oxidized to SO_2 (maximum % as defined by "Shell Products", 0.25% average). Particulate emission control by cyclone and wet scrubber.

Emission Factor:	particulates 137 g/Mg	)
	sulphur dioxide 73 g/Mg	) of asphalt
	nitrogen oxides 18 g/Mg	) produced
	carbon monoxide 19 g/Mg	)

Mass Fraction:	0 - 10 μm = 90%
	10 - 30 μm = 10%

Location (code nos refer to Appendix A3)	Production rate		Emission Factor g/s								
			24 - hr Avg					1 - hr Avg			
	t/day	t/hr	$<30\mu m$	$<10\mu m$	SO_2	NO_2	CO	$<30\mu m$	SO_2	NO_2	CO
Tung Chung 12	44	3.67	7.000×10^{-2}	6.300×10^{-2}	3.700×10^{-2}	9.170×10^{-3}	9.670×10^{-3}	1.392×10^{-1}	7.417×10^{-2}	1.833×10^{-2}	1.917×10^{-2}
Tai Ho											
8	11.54	0.9617	0.018	0.016	0.0098	0.0024	0.0025	3.667×10^{-2}	1.917×10^{-2}	4.792×10^{-3}	5.058×10^{-3}
18	19.23	1.6025	3.000×10^{-2}	2.700×10^{-2}	1.600×10^{-2}	4.000×10^{-3}	4.200×10^{-3}	5.833×10^{-2}	3.250×10^{-2}	8.000×10^{-3}	8.333×10^{-3}

8. Building Construction

Based on AP 42: "Compilation of Air Pollutant Emission Factors"

For building construction, 0.27 kg/m^2 of construction per month of activity.

Mass Fraction : 0 - 10 μm = 50%
10 - 30 μm = 50%

Location (code nos refer to Appendix A3)	Emission Factor g/s/m^2		
	24 - hr Avg		1 - hr Avg
	< 30 μm	< 10 μm	< 30 μm
Tung Chung			
26	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
27	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
28	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
29	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
30	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
31	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
32	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
33	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
Tai Ho			
49	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
50	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
51	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
52	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
53	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
54	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
55	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
56	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
57	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
58	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
59	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
60	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
61	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
62	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
63	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
64	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}
65	1.197×10^{-4}	5.987×10^{-5}	2.395×10^{-4}

Appendix A3 Coordinates of Sources

Tung Chung Area					
Activity	**Easting**	**Northing**	**Level (mPD)**	**Width (m)**	**Emission Height (m)**
A. Reclamation					
1. Hauling	811640	816860	5	230	0
2. Hauling	811870	816860	5	300	0
3. Hauling	811540	816650	5	220	0
4. Hauling	811770	816650	5	230	0
5. Hauling	812000	816450	5	270	0
6. Unloading	811640	816860	5	230	1.5
7. Unloading	811870	816860	5	300	1.5
8. Unloading	811540	816650	5	220	1.5
9. Unloading	811770	816650	5	230	1.5
10. Unloading	812000	816450	5	270	1.5
11. Concreting	811920	817070	5	17.3	3
12. Asphalt Mixing	811920	817070	5	-	16
B. Rock Excavation					
13. Drilling	811370	816350	20	250	0
14. Drilling	811630	816240	35	250	0
15. Blasting	811370	816350	20	250	0
16. Blasting	811630	816240	35	250	0
17. Hauling	811370	816350	20	250	0
18. Hauling	811630	816240	35	250	0
19. Loading	811370	816350	20	250	2
20. Loading	811630	816240	35	250	2
21. Rock Crushing	811920	817070	5	7.07	3
C. Soil Excavation					
22. Hauling	811370	816350	20	250	0
23. Hauling	811630	816240	35	250	0
24. Loading	811370	816350	20	250	2
25. Loading	811630	816240	35	250	2

Appendix A3 (Cont'd)

Tung Chung Area					
Activity	**Easting**	**Northing**	**Level (mPD)**	**Width (m)**	**Emission Height (m)**
D. Building Construction					
26. Area 3	811990	816950	5	180	0
27. Area 2	811590	816700	5	180	0
28. Area 4	811710	816600	5	170	0
29. Area 6	811920	816660	5	140	0
30. Area 10	811980	816250	5	200	0
31. Area 11	812100	816400	5	220	0
32. Area 12	812190	816560	5	200	0
33. Area 13	811800	816140	5	180	0
Tai Ho East and Siu Ho Wan					
A. Gas Plant Site - Reclamation					
1. Hauling	817750	819460	5	180	0
2. Hauling	817810	819650	5	160	0
3. Unloading	817750	819460	5	180	1.5
4. Unloading	817810	819650	5	160	1.5
B. Refuse Transfer Station Site - Reclamation					
5. Hauling	817710	819920	5	110	0
6. Unloading	817710	819920	5	110	1.5
7. Concreting	817900	819750	5	17.3	3
8. Asphalt Mixing	817900	819750	5	-	16
C. Sewage Treatment Works Site - Reclamation					
9. Hauling	817140	819000	5	190	0
10. Hauling	817340	819000	5	210	0
11. Hauling	817550	819000	5	150	0
12. Hauling	817550	819170	5	150	0
13. Unloading	817140	819000	5	190	1.5
14. Unloading	817340	819000	5	210	1.5
15. Unloading	817550	819000	5	150	1.5
16. Unloading	817550	819170	5	150	1.5

Appendix A3 (Cont'd)

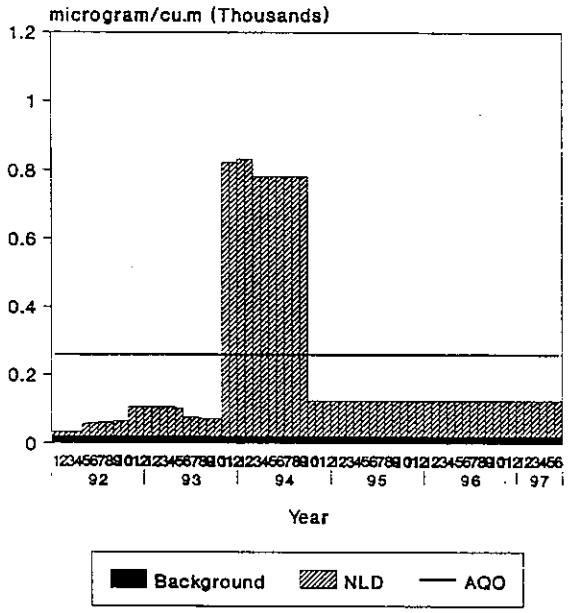
Tai Ho East and Siu Ho Wan					
Activity	**Easting**	**Northing**	**Level (mPD)**	**Width (m)**	**Emission Height (m)**
17. Concreting	817900	819750	5	17.3	3
18. Asphalt Mixing	817900	819750	5	-	16
D. Water Treatment Works - Rock Excavation					
19. Drilling	817750	819180	35	200	0
20. Drilling	817940	819170	35	200	0
21. Blasting	817750	819180	35	200	0
22. Blasting	817940	819170	35	200	0
23. Hauling	817750	819180	35	200	0
24. Hauling	817940	819170	35	200	0
25. Loading	817750	819180	35	200	2
26. Loading	817940	819170	35	200	2
27. Rock Crushing	817750	819180	35	7.1	3
28. Rock Crushing	817940	819170	35	7.1	3
E. Water Treatment Works - Soil Excavation					
29. Hauling	817750	819180	35	200	0
30. Hauling	817940	819170	35	200	0
31. Loading	817750	819180	35	200	2
32. Loading	817940	819170	35	200	2
F. Aviation Fuel Station - Reclamation					
33. Hauling	817400	819590	5	170	0
34. Hauling	817560	819770	5	150	0
35. Unloading	817400	819590	5	170	1.5
36. Unloading	817560	819770	5	150	1.5
G. Rail Depot - Reclamation					
37. Hauling	815800	818450	5	230	0
38. Hauling	816040	818560	5	210	0
39. Hauling	816250	818700	5	220	0
40. Hauling	816470	818840	5	200	0
41. Hauling	816660	818950	5	180	0

Appendix A3 (Cont'd)

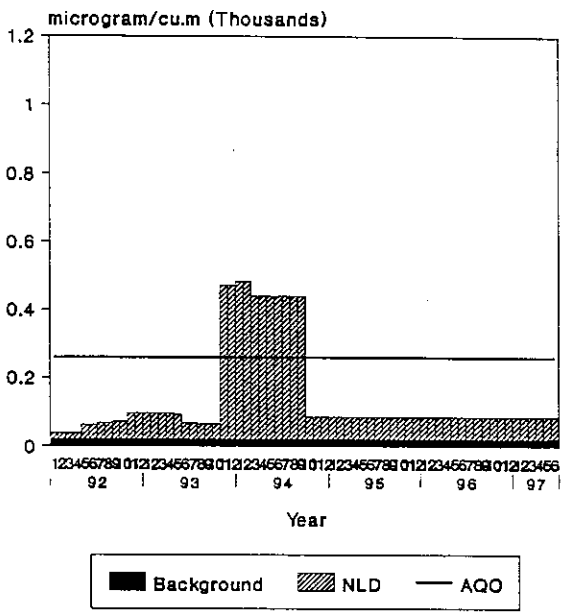
Tai Ho East and Siu Ho Wan					
Activity	**Easting**	**Northing**	**Level (mPD)**	**Width (m)**	**Emission Height (m)**
42. Hauling	816850	819000	5	160	0
43. Unloading	815800	818450	5	230	1.5
44. Unloading	816040	818560	5	210	1.5
45. Unloading	816250	818700	5	220	1.5
46. Unloading	816470	818840	5	200	1.5
47. Unloading	816660	818950	5	180	1.5
48. Unloading	816850	819000	5	160	1.5
H. Building Construction					
49. Area 2	817640	819940	5	180	0
50. Area 3	817750	819460	5	180	0
51. Area 3	817810	819650	5	160	0
52. Area 4	817750	819180	5	200	0
53. Area 4	817940	819170	5	200	0
54. Area 5	817140	819000	5	190	0
55. Area 5	817340	819000	5	210	0
56. Area 5	817550	819000	5	150	0
57. Area 5	817550	819170	5	150	0
58. Area 7	817400	819590	5	170	0
59. Area 7	817560	819770	5	150	0
60. Area 10	815800	818450	5	230	0
61. Area 10	816040	818560	5	210	0
62. Area 10	816250	818700	5	220	0
63. Area 10	816470	818840	5	200	0
64. Area 10	816660	818950	5	180	0
65. Area 10	816850	819000	5	160	0

Appendix A4

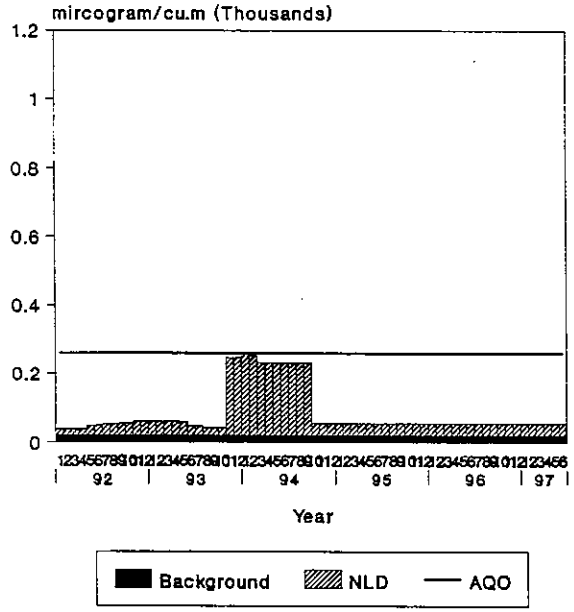
24 Hour TSP
Group 1 - Tai Ho (A)



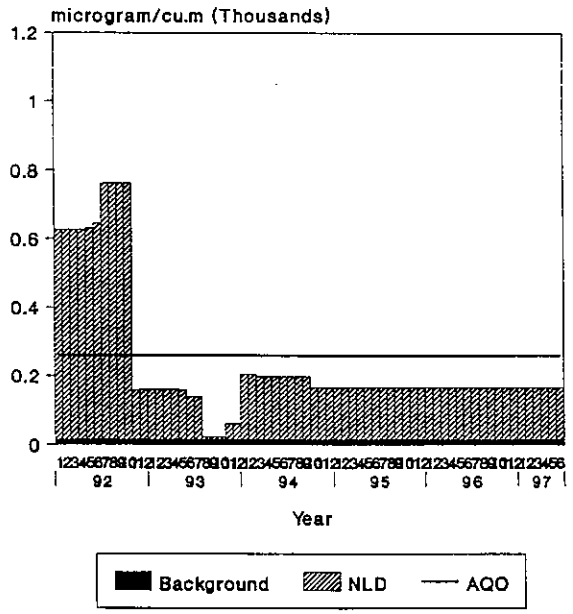
24 Hour TSP
Group 2 - Tai Ho (B)



24 Hour TSP
Group 3 - Pak Mong

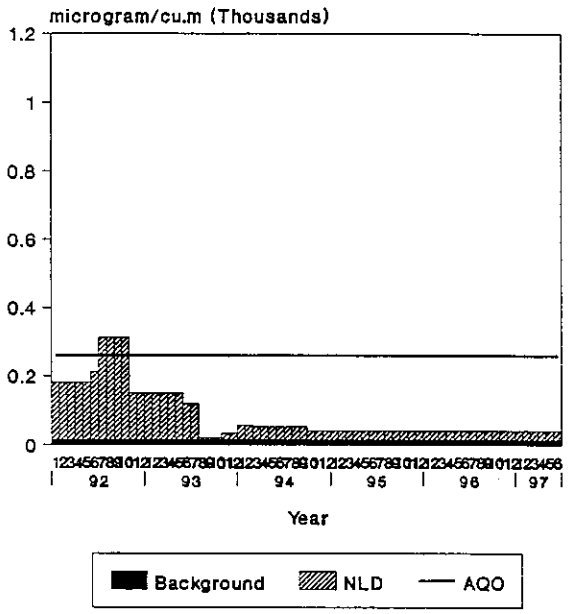


24 Hour TSP
Group 4 - Tai Po

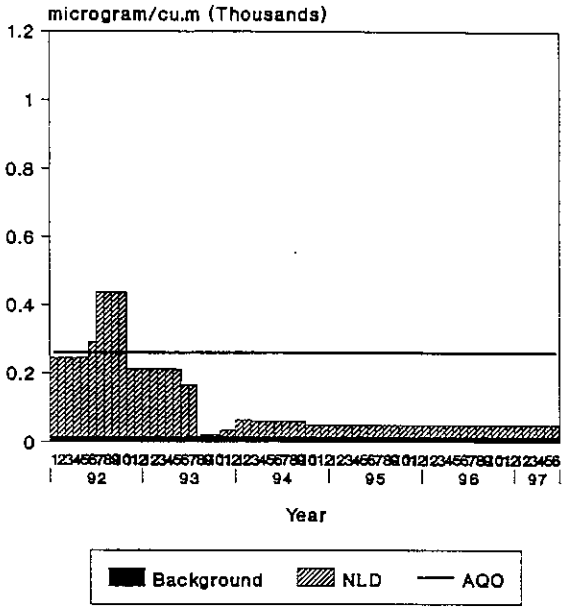


Appendix A4 (Continued)

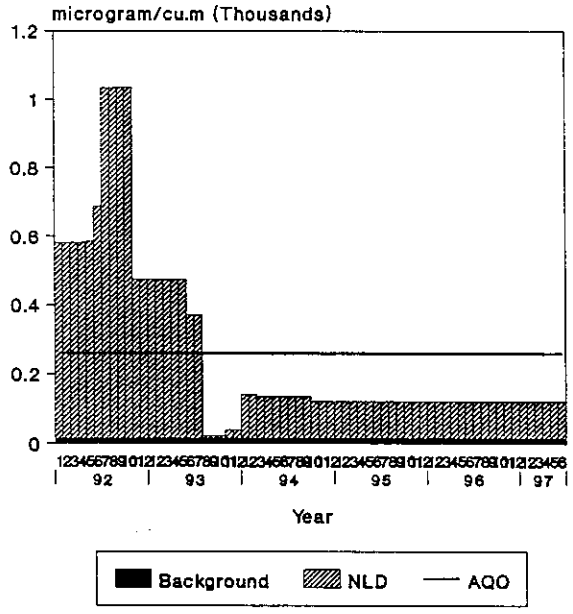
24 Hour TSP
Group 5 - Mok Ka



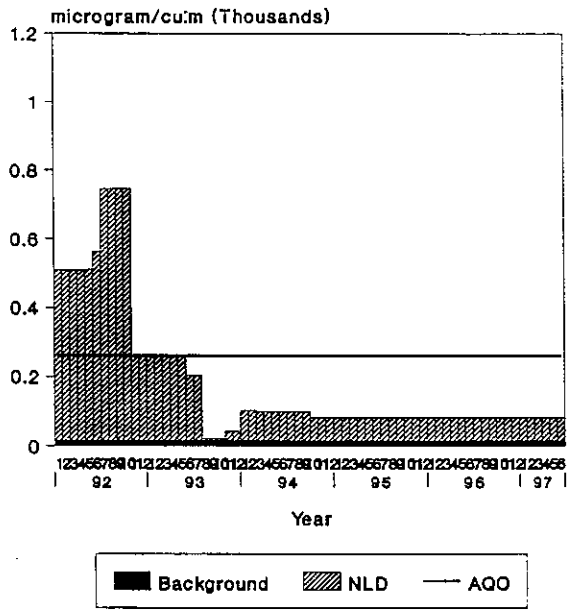
24 Hour TSP
Group 6 - Shek Lau Po



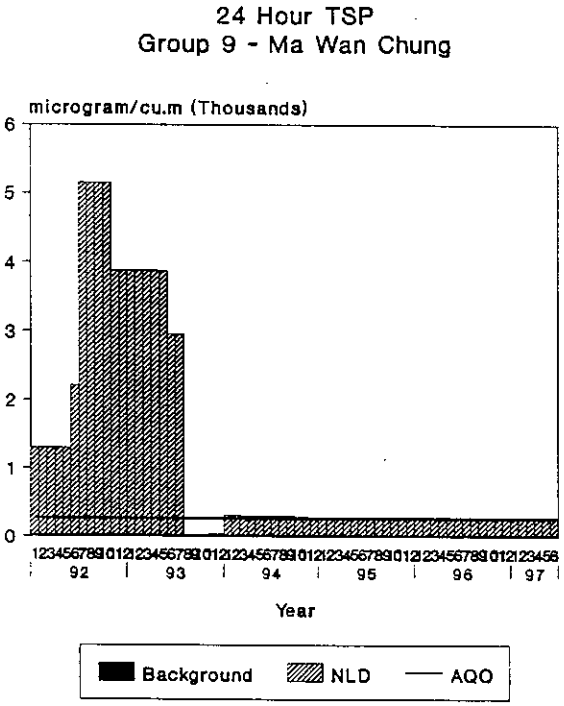
24 Hour TSP
Group 7 - Sheung Ling Pei



24 Hour TSP
Group 8 -Tin Sam

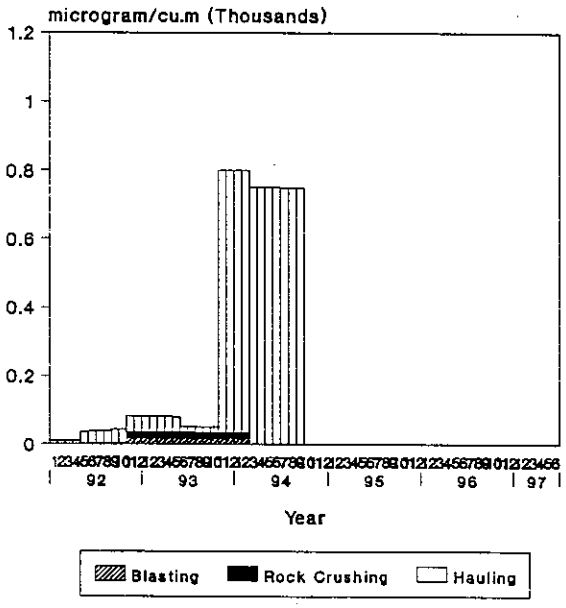


Appendix A4 (Continued)

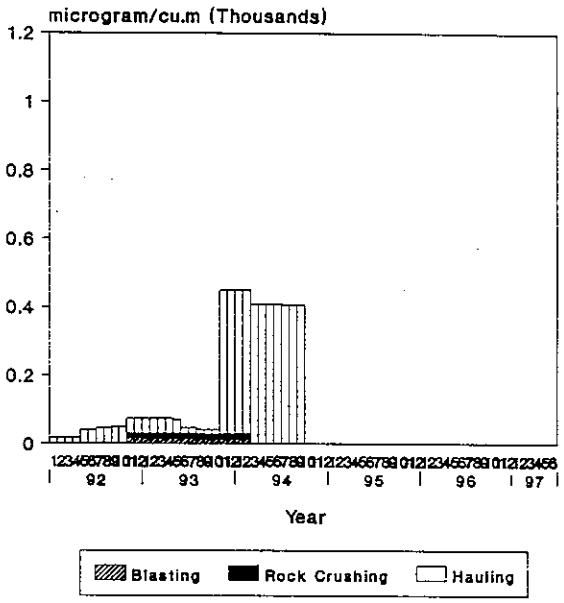


Appendix A4 (Continued)

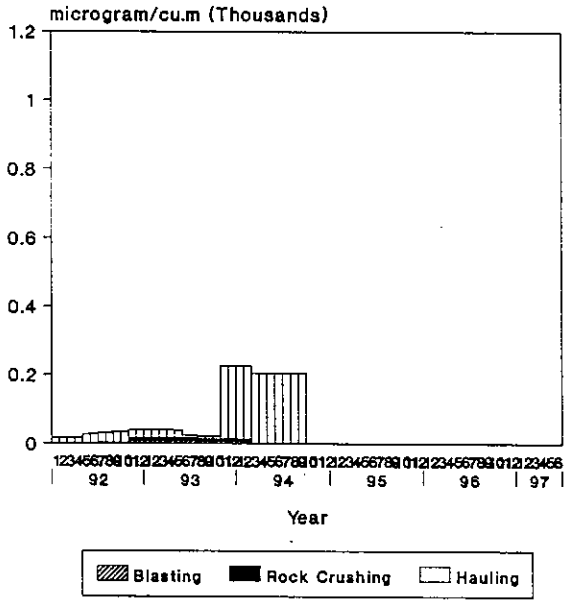
24 Hour TSP
Group 1 - Tai Ho (A)



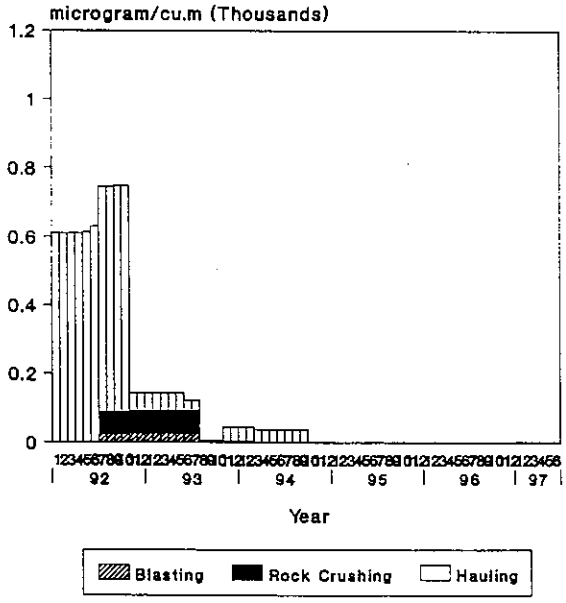
24 Hour TSP
Group 2 - Tai Ho (B)



24 Hour TSP
Group 3 - Pak Mong

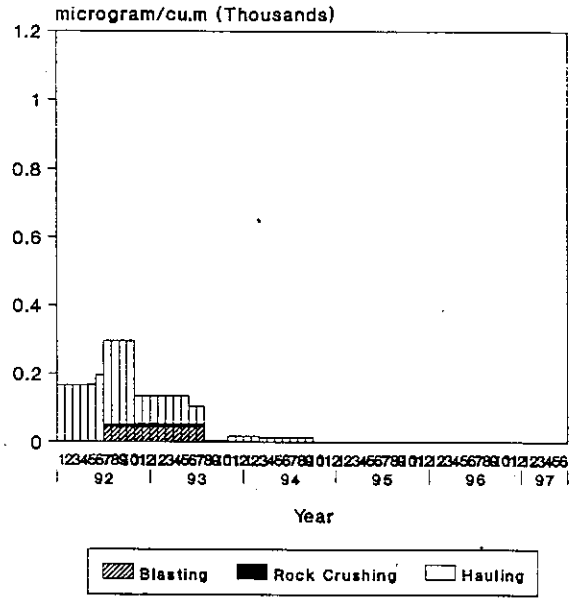


24 Hour TSP
Group 4 - Tai Po

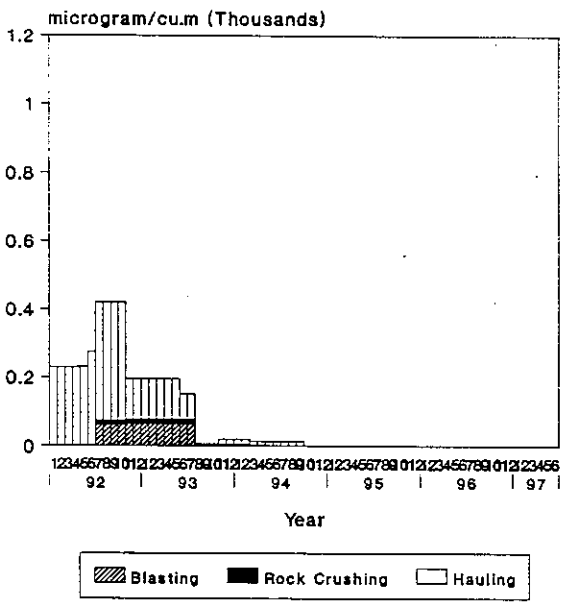


Appendix A4 (Continued)

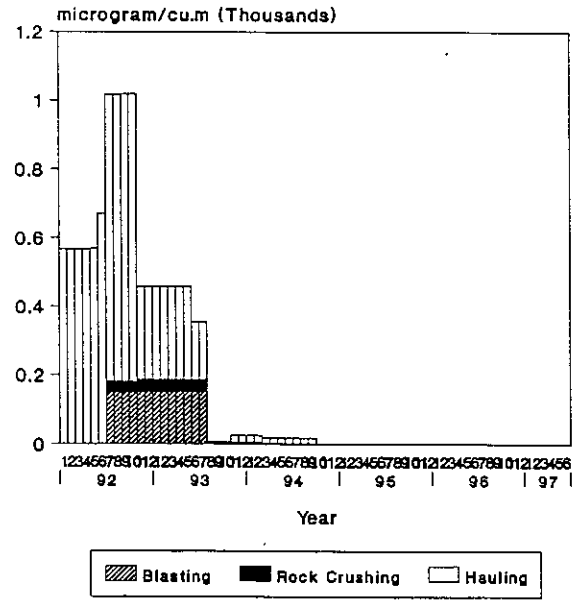
24 Hour TSP
Group 5 - Mok Ka



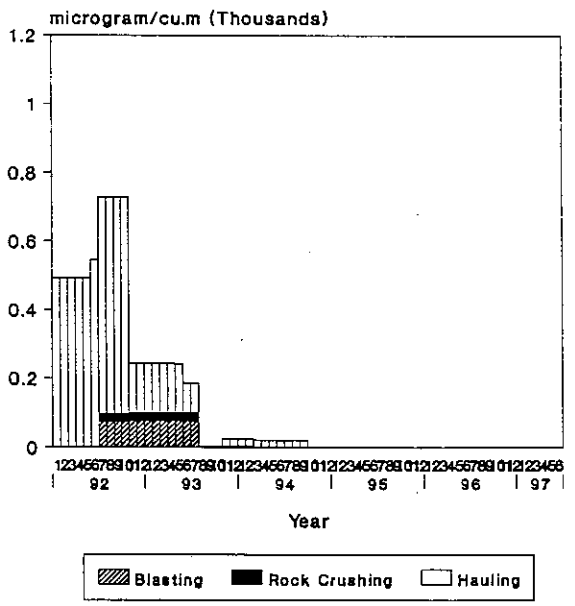
24 Hour TSP
Group 6 - Shek Lau Po



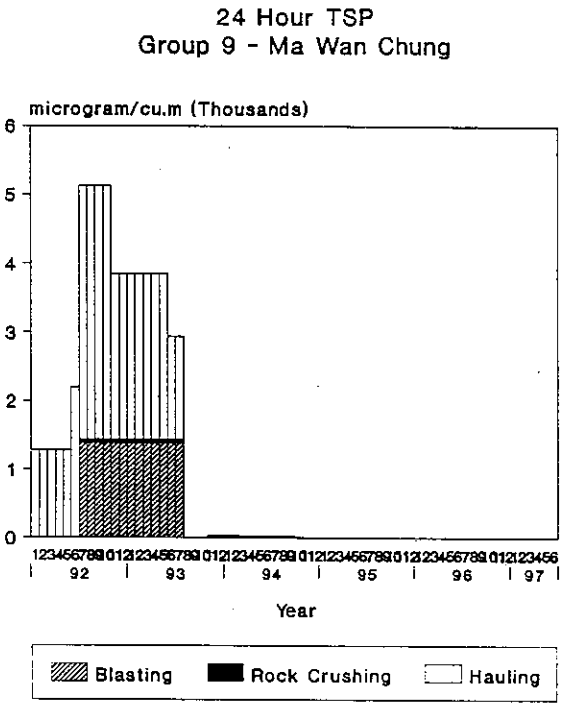
24 Hour TSP
Group 7 - Sheung Ling Pei



24 Hour TSP
Group 8 - Tin Sam

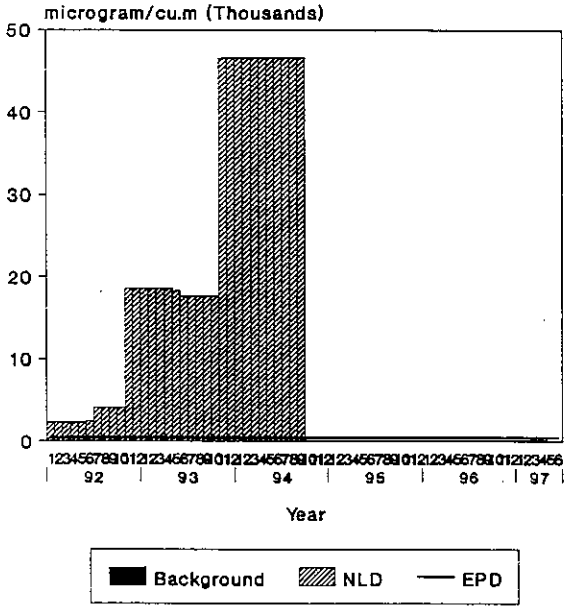


Appendix A4 (Continued)

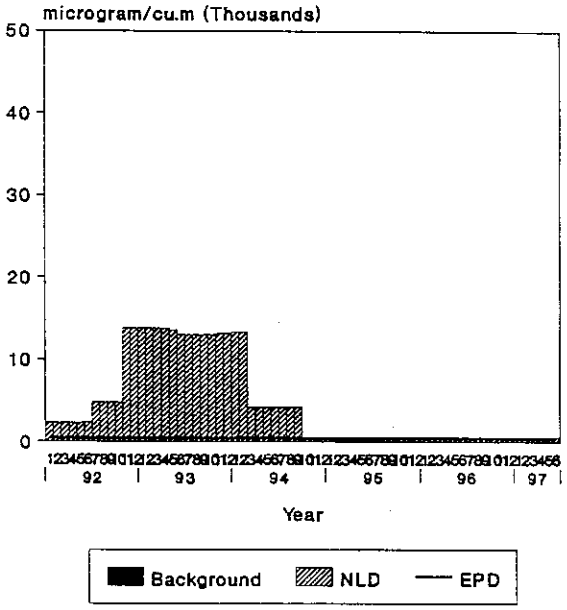


Appendix A4 (Continued)

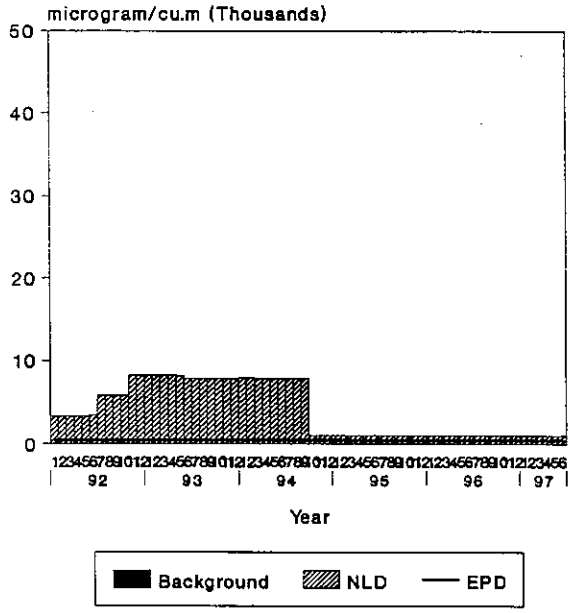
1 Hour TSP
Group 1 - Tai Ho (A)



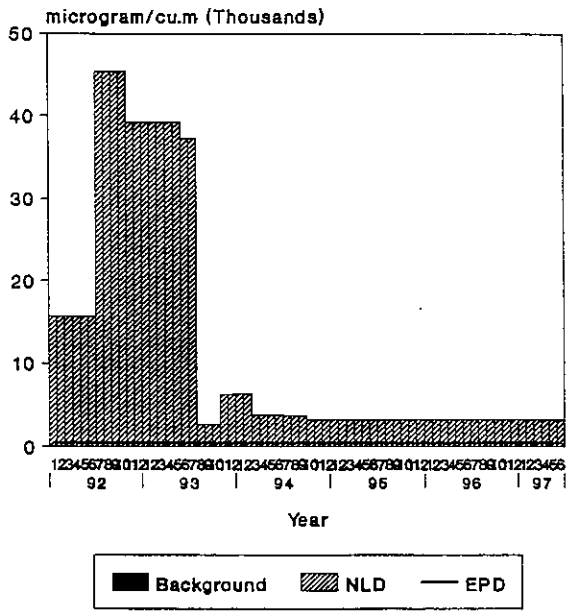
1 Hour TSP
Group 2 - Tai Ho (B)



1 Hour TSP
Group 3 - Pak Mong

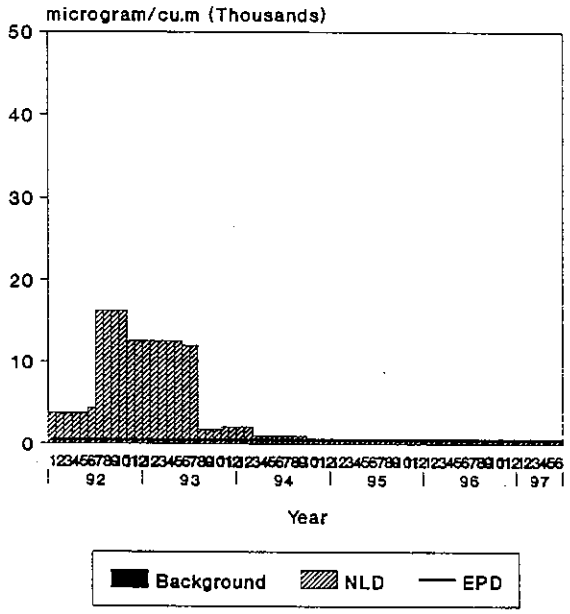


1 Hour TSP
Group 4 - Tai Po

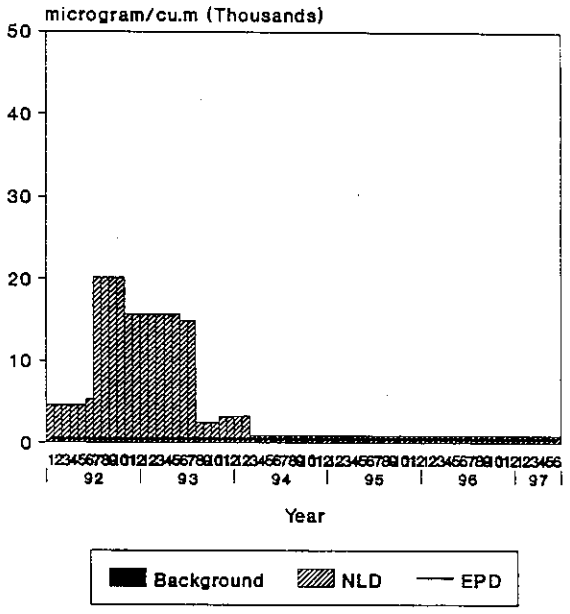


Appendix A4 (Continued)

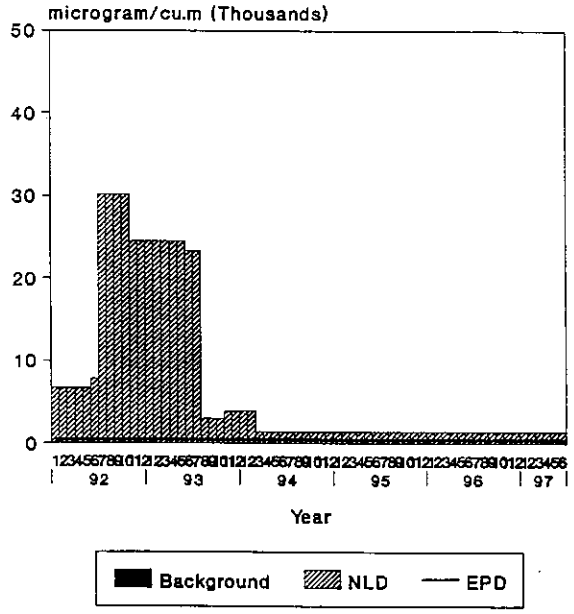
1 Hour TSP
Group 5 - Mok Ka



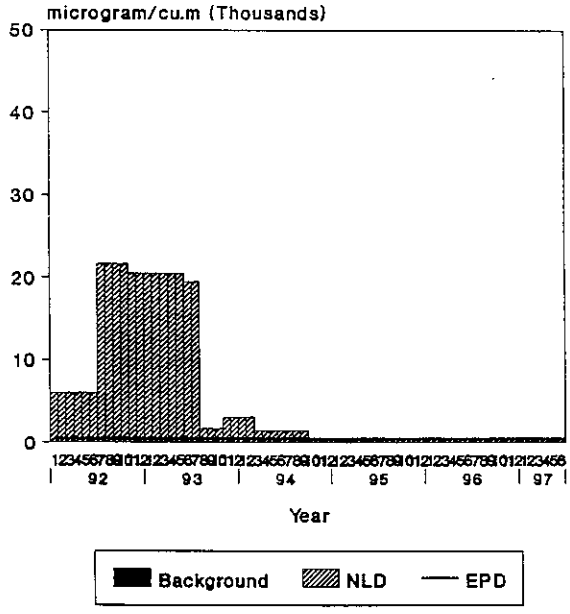
1 Hour TSP
Group 6 - Shek Lau Po



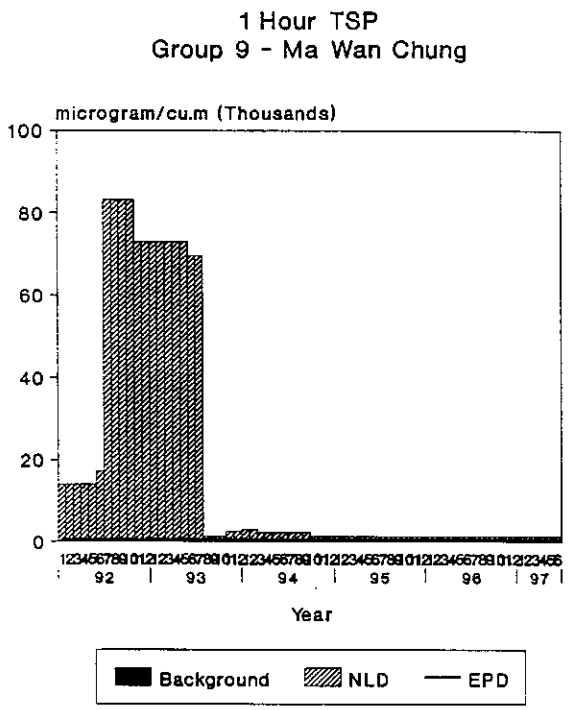
1 Hour TSP
Group 7 - Sheung Ling Pei



1 Hour TSP
Group 8 - Tin Sam

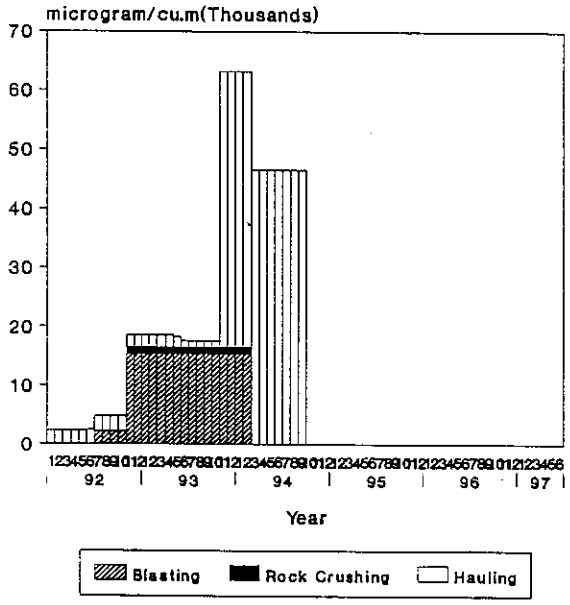


Appendix A4 (Continued)

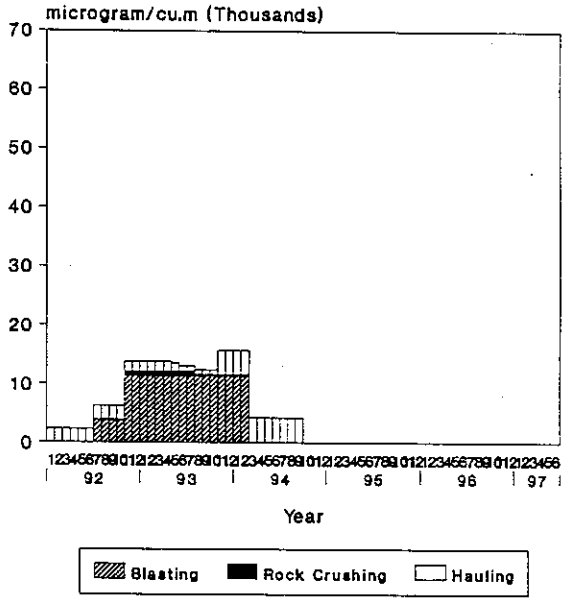


Appendix A4 (Continued)

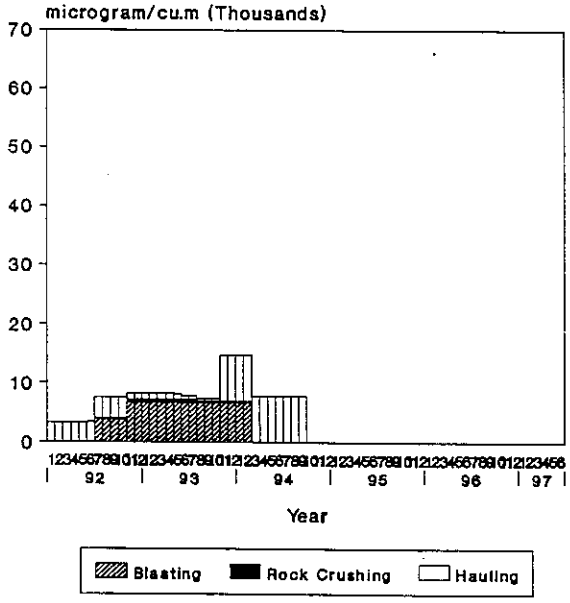
1 Hour TSP
Group 1 - Tai Ho (A)



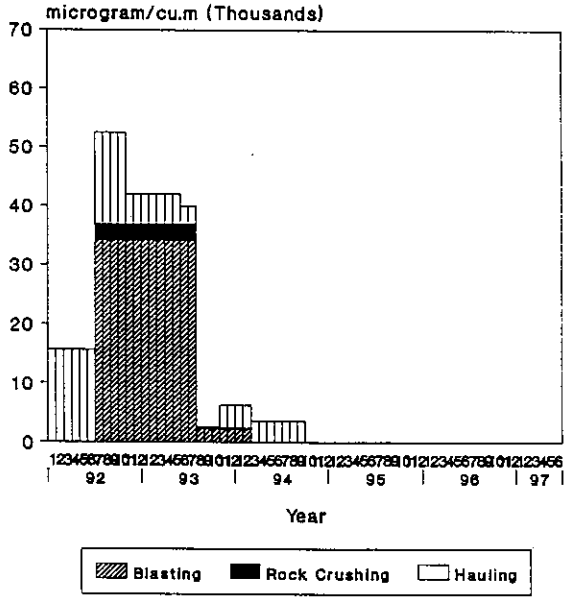
1 Hour TSP
Group 2 - Tai Ho (B)



1 Hour TSP
Group 3 - Pak Mong

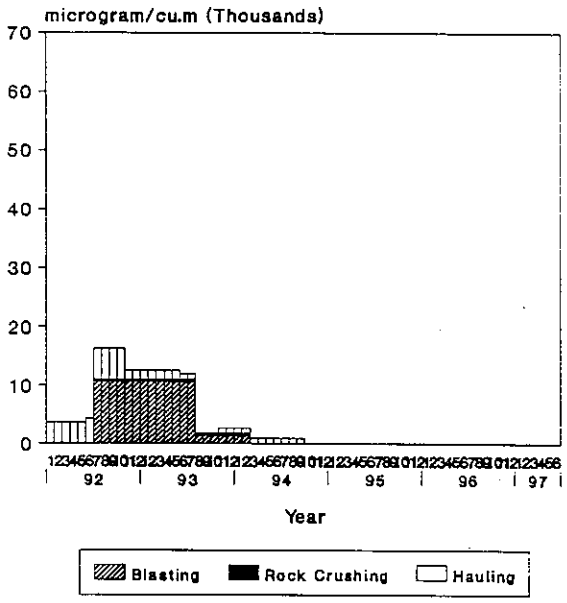


1 Hour TSP
Group 4 - Tai Po

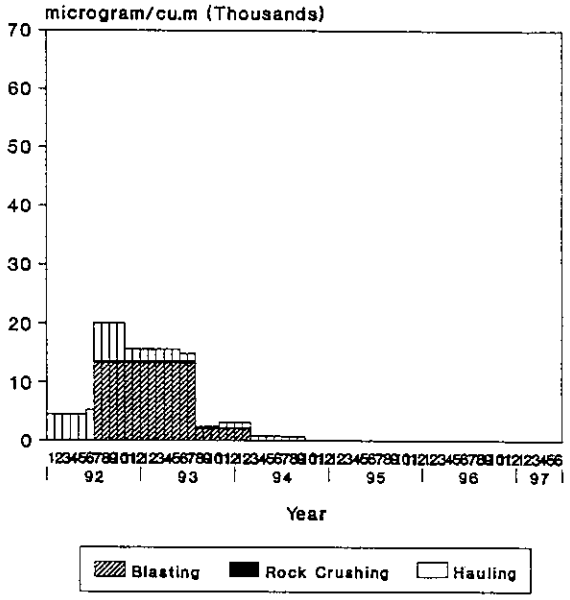


Appendix A4 (Continued)

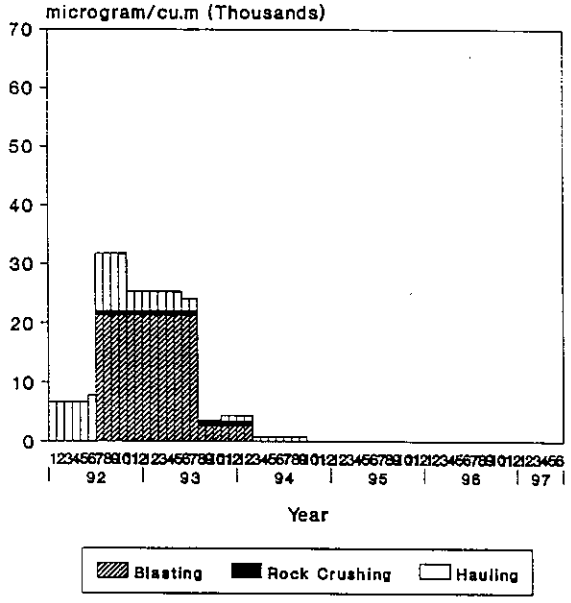
1 Hour TSP
Group 5 - Mok Ka



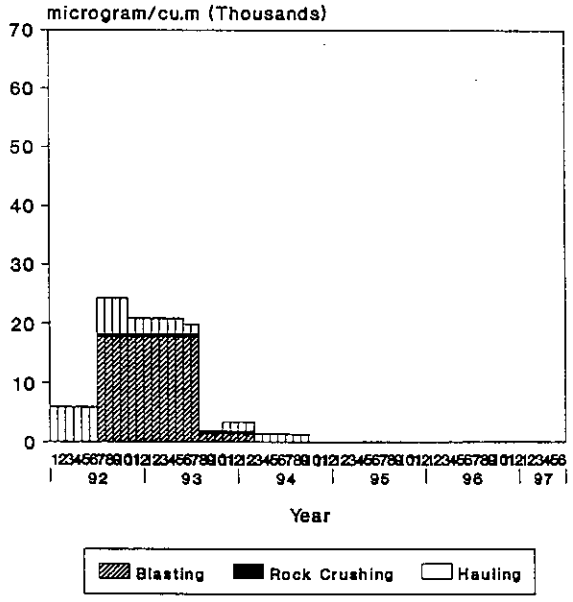
1 Hour TSP
Group 6 - Shek Lau Po



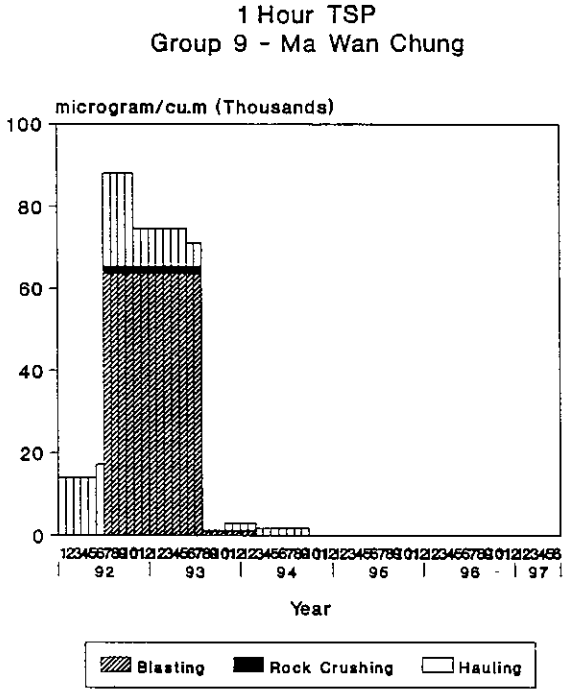
1 Hour TSP
Group 7 - Sheung Ling Pei



1 Hour TSP
Group 8 - Tin Sam

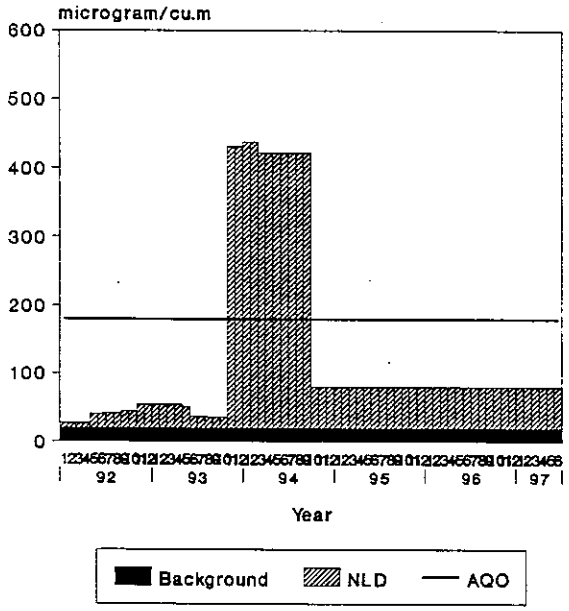


Appendix A4 (Continued)

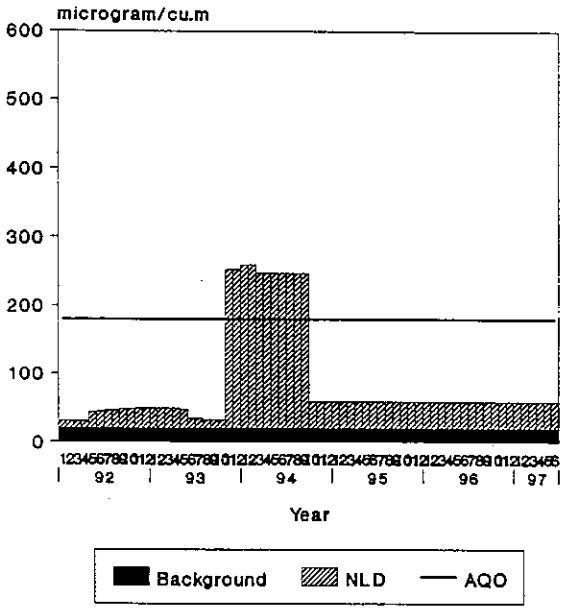


Appendix A4 (Continued)

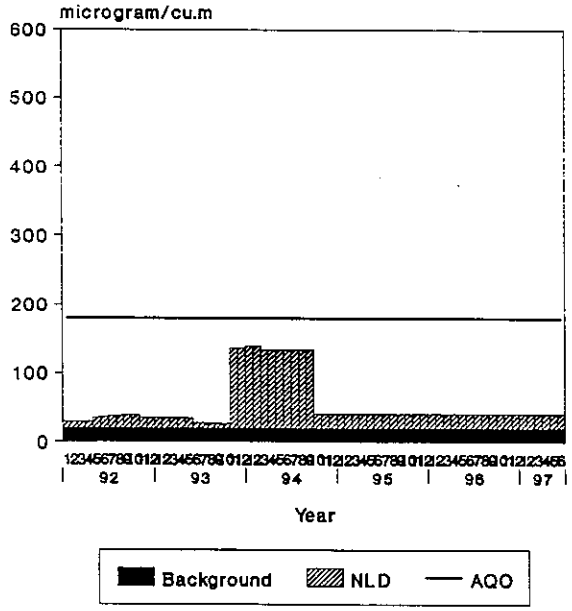
24 Hour RSP
Group 1 - Tai Ho (A)



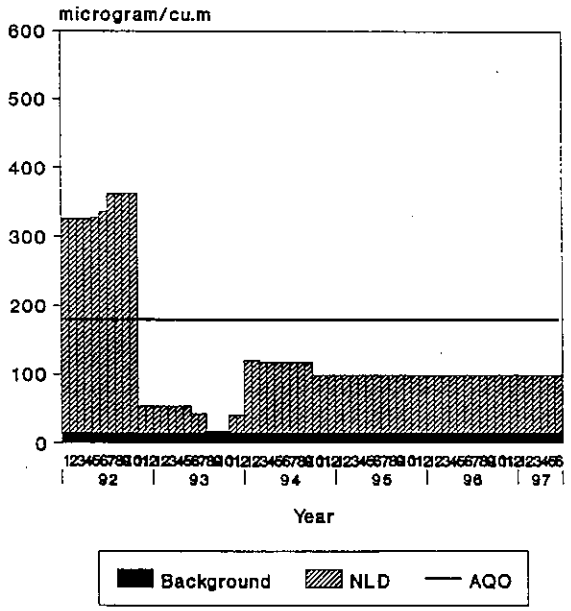
24 Hour RSP
Group 2 - Tai Ho (B)



24 Hour RSP
Group 3 - Pak Mong

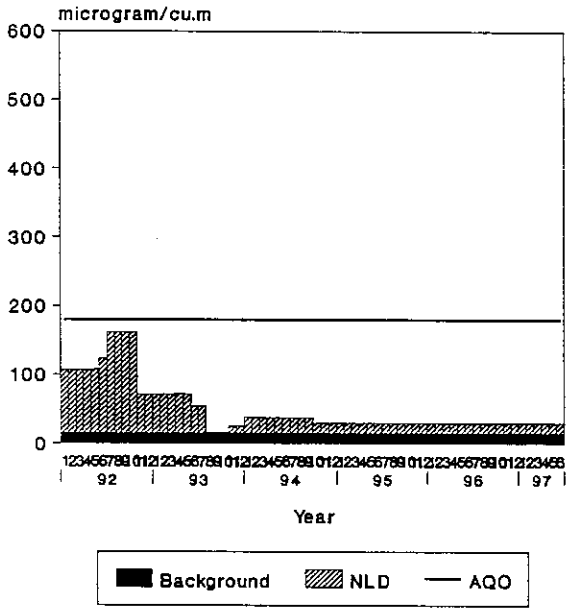


24 Hour RSP
Group 4 - Tai Po

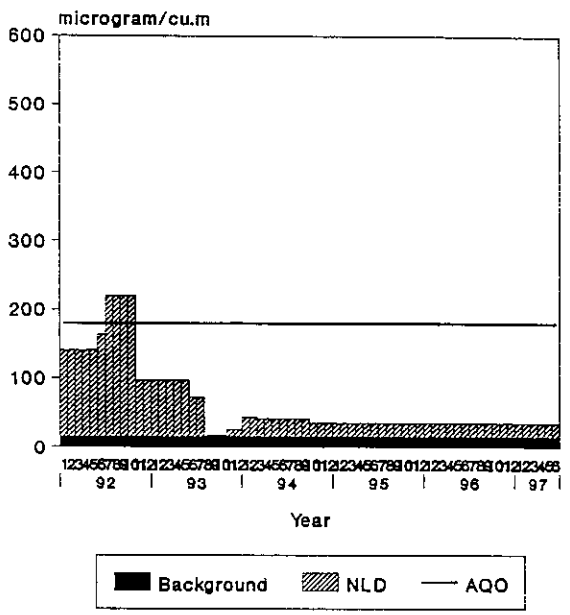


Appendix A4 (Continued)

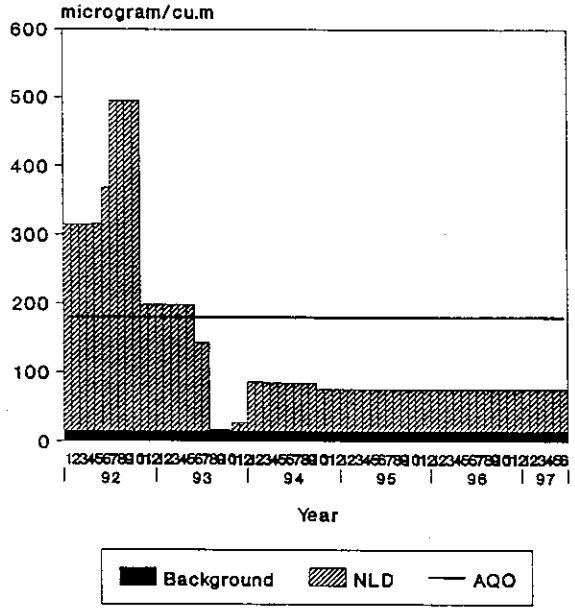
24 Hour RSP
Group 5 - Mok Ka



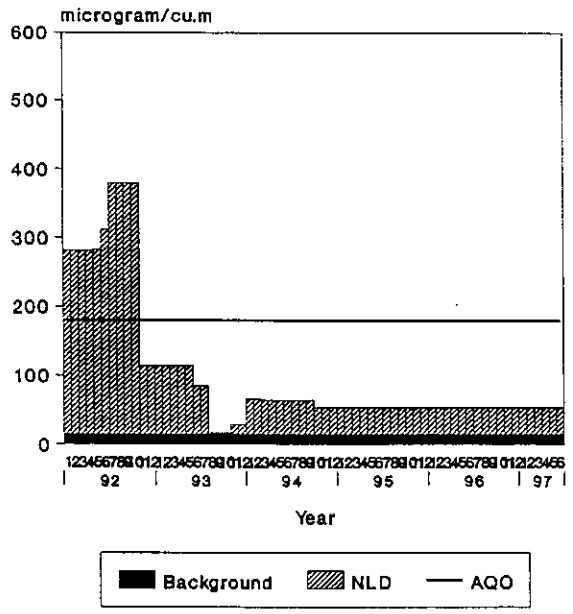
24 Hour RSP
Group 6 - Shek Lau Po



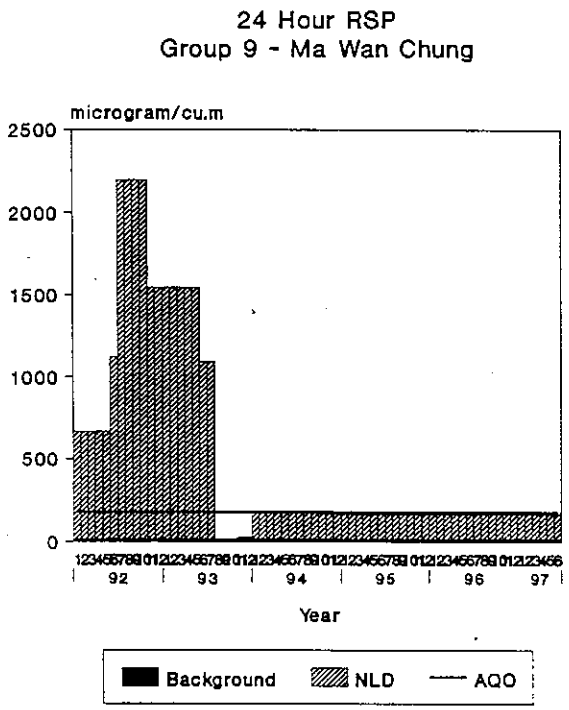
24 Hour RSP
Group 7 - Sheung Ling Pei



24 Hour RSP
Group 8 - Tin Sam

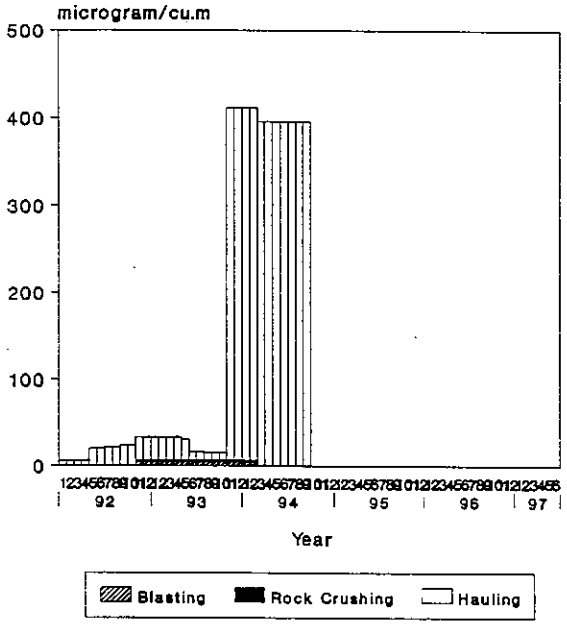


Appendix A4 (Continued)

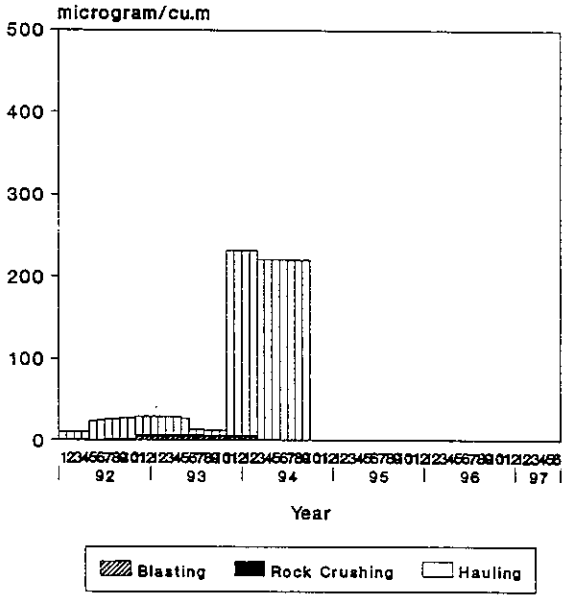


Appendix A4 (Continued)

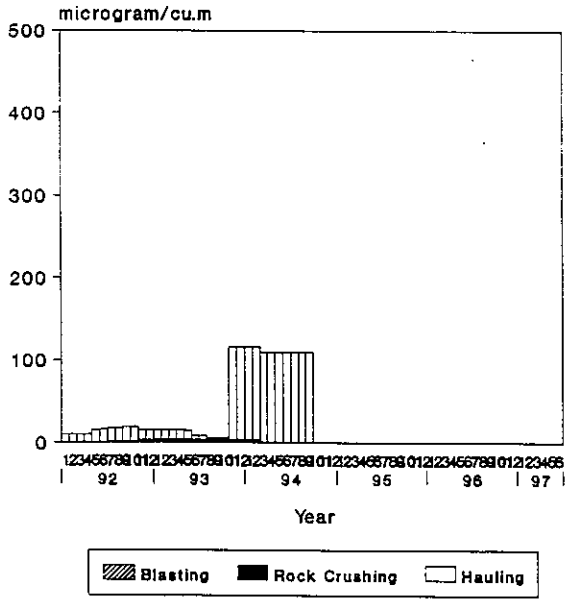
24 Hour RSP
Group 1 - Tai Ho (A)



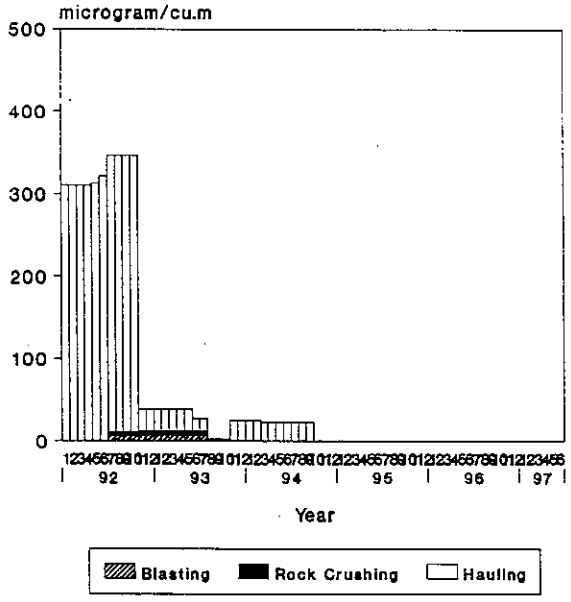
24 Hour RSP
Group 2 - Tai Ho (B)



24 Hour RSP
Group 3 - Pak Mong

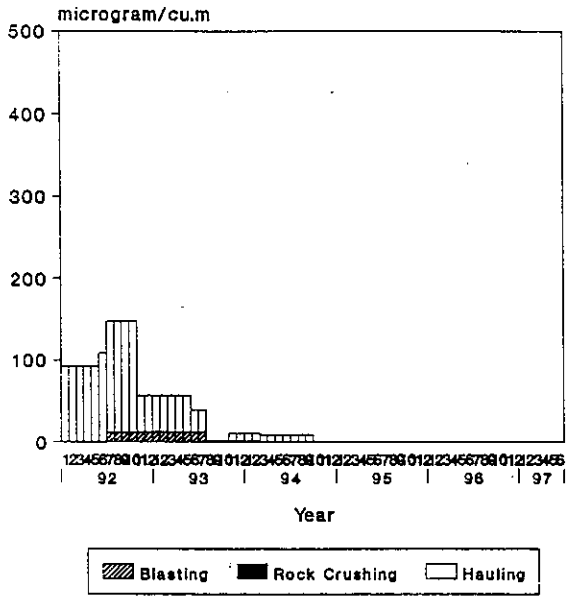


24 Hour RSP
Group 4 - Tai Po

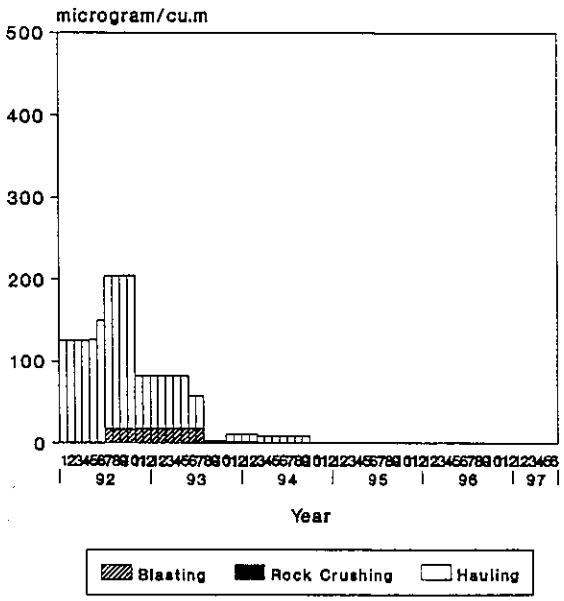


Appendix A4 (Continued)

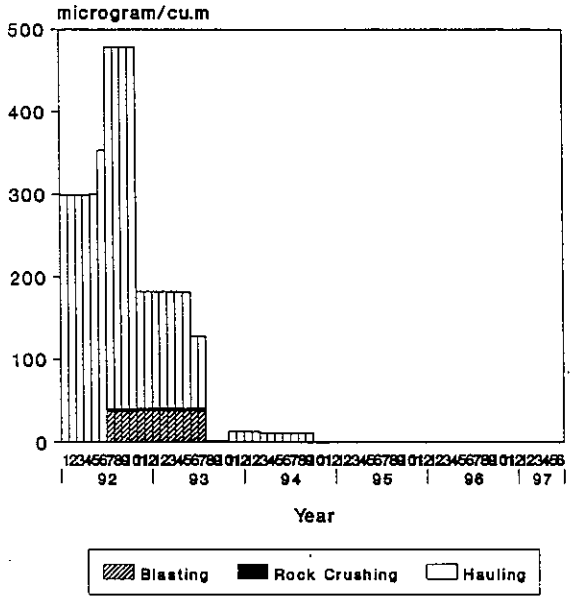
24 Hour RSP
Group 5 - Mok Ka



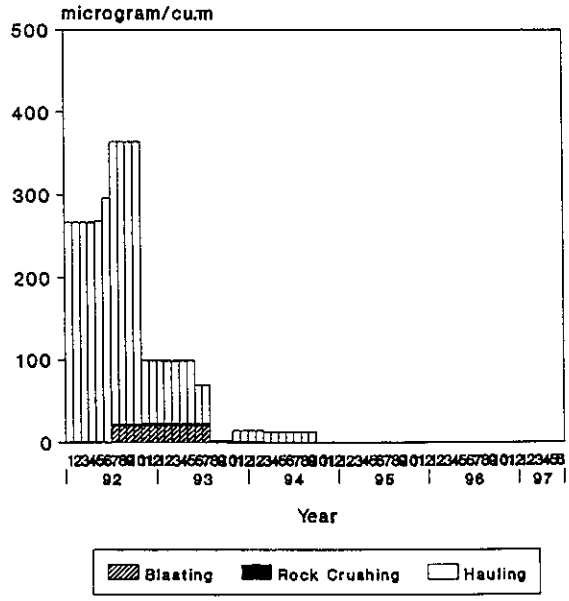
24 Hour RSP
Group 6 - Shek Lau Po



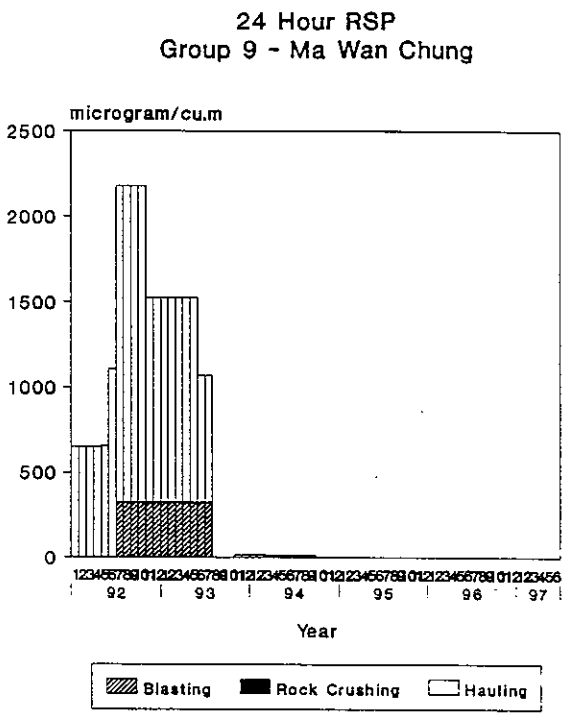
24 Hour RSP
Group 7 - Sheung Ling Pei



24 Hour RSP
Group 8 - Tin Sam



Appendix A4 (Continued)



Appendix B

Noise

Appendix B1 Major Construction Activities

CONSTRUCTION ACTIVITIES	
ACTIVITY I.D.	ACTIVITY DESCRIPTION
A.1	Tung Chung Phase I Reclamation
A.1.1	Seawall
A.1.2.1	Site Formation
A.1.2.2	Reclamation
A.1.3	Concrete
A.1.4	Road Paving/Asphalt
A.1.5	Infrastructure/Building
A.1.6	Piling
A.1.7	Dredging
A.2	Phase I Tung Chung Land Formation
A.2.1	Rock Excavation
A.3	Temporary Ferry Pier
A.3.1	Piling
A.3.2	Concrete
B.1	Sewage Treatment Works at Siu Ho Wan
B.1.1	Seawall
B.1.2	Reclamation
B.1.3	Concrete
B.1.4	Road Paving/Asphalt
B.1.5	Infrastructure/Building
B.1.6	Piling
B.1.7	Dredging
B.2	Refuse Transfer Station at Sham Shui Kok
B.2.1	Seawall
B.2.2	Reclamation
B.2.3	Concrete
B.2.4	Infrastructure/Building
B.2.5	Piling
B.2.6	Dredging
B.3	Rail Depot at Siu Ho Wan
B.3.1	Seawall
B.3.2	Reclamation
B.3.3	Concrete
B.3.4	Road Paving/Asphalt
B.3.5	Infrastructure/Building
B.3.6	Dredging
B.4	Water Treatment Works at Siu Ho Wan
B.4.1	Soil Excavation
B.4.2	Rock Excavation
B.4.3	Concrete

Appendix B2 Types, Numbers and Sound Power Levels of Items of Powered Mechanical Equipment

ACTIVITY I.D.	EQUIPMENT DESCRIPTION	QTY	SWL dB(A)
A.1.1	1. Barges mounted with crane & grab	6	112
A.1.2.1	1. Bucket loaders 955	10	118
	2. Trucks	20	117
	3. Bulldozers D6	10	115
	4. Roller 10 ton	3	108
	5. Grader	2	113
A.1.2.2	1. Suction dredger (9000 cu.m.)	1	112
	2. Suction dredger (6000 cu.m.)	1	112
	3. Booster pump and sludge pipe	1	103
	4. Barges	4	104
A.1.3	1. Small batching plant	1	108
	2. Mobile crane 25 ton	1	112
	3. Truck mixers	4	109
A.1.4	1. Pneumatic compactors	2	105
A.1.5	1. Bitumen batching plant	1	108
	2. Concrete batching plant	3	108
	3. Truck mixers	12	109
	4. Concrete pumps	3	109
	5. Mobile cranes	2	112
	6. Tower cranes	15	95
	7. Trucks	10	117
A.1.6	* 1. Piling rigs (diesel percussion)	12	115
A.1.7	1. Dredger (grab)	3	112
A.2.1	1. Bucket loaders 955	7	118
	2. Trucks	14	117
	3. Bulldozers D6	7	115
	4. Mobil pneumatic drills	10	128
	5. Backhoe excavator	4	112
A.3.1	* 1. Piling rigs (diesel percussion)	2	115
A.3.2	1. Generator	1	100
	2. Concrete mixer lorries	2	109
	3. Poker vibrators	4	113
	4. Crane	1	112

Appendix B2 (Continued)

ACTIVITY I.D.	EQUIPMENT DESCRIPTION	QTY	SWL dB(A)
B.1.1	1. Barges	3	104
B.1.2	1. Bucket loaders 955	4	118
	2. Trucks	8	117
	3. Bulldozers D6	3	115
	4. Roller 10 ton	2	108
	5. Grader	1	113
	6. Suction dredger (6000 cu.m.)	1	112
B.1.3	1. Mobile crane 25 ton	1	112
	2. Truck mixers	3	109
B.1.4	1. Pneumatic compactor	1	105
B.1.5	1. Truck mixers	6	109
	2. Concrete pumps	1	109
	3. Mobile cranes	1	112
	4. Tower cranes	2	95
	5. Trucks	3	117
B.1.6	* 1. Piling rigs (diesel percussion)	6	115
B.1.7	1. Dredger (grab)	1	112
B.2.1	1. Barges	2	104
	2. Barges mounted with crane & grab	3	112
B.2.2	1. Bucket loaders 955	2	118
	2. Trucks	3	117
	3. Bulldozers D6	1	115
	4. Roller 10 ton	1	108
	5. Grader	1	113
	6. Suction dredger (6000 cu.m.)	1	112
B.2.3	1. Mobile crane 25 ton	1	112
	2. Truck mixers	2	109
B.2.4	1. Truck mixers	4	109
	2. Concrete pumps	1	109
	3. Mobile crane	1	112
	4. Trucks	2	117
B.2.5	* 1. Piling rigs (diesel percussion)	6	115
B.2.6	1. Dredger (grab)	1	112

Appendix B2 (Continued)

ACTIVITY I.D.	EQUIPMENT DESCRIPTION	QTY	SWL dB(A)
B.3.1	1. Barges	3	104
	2. Barges mounted with crane & grab	4	112
B.3.2	1. Bucket loaders 955	10	118
	2. Trucks	20	117
	3. Bulldozers D6	10	115
	4. Roller 10 ton	3	108
	5. Grader	2	113
	6. Suction dredger (9000 cu.m.)	1	112
	7. Suction dredger (6000 cu.m.)	1	112
	8. Booster pump and sludge pipes	1	103
B.3.3	1. Mobile crane 25 ton	1	112
	2. Truck mixers	2	109
B.3.4	1. Pneumatic compactor	1	105
B.3.5	1. Truck mixers	6	109
	2. Concrete pumps	2	109
	3. Mobile cranes	1	112
	4. Tower cranes	1	95
	5. Trucks	3	117
B.3.6	1. Dredger (grab)	3	112
B.4.1	1. Bucket loaders 955	3	118
	2. Trucks	6	117
	3. Bulldozers D6	3	115
	4. Backhoe excavators	3	112
B.4.2	1. Bucket loaders 955	7	118
	2. Trucks	14	117
	3. Bulldozers D6	7	115
	4. Mobile pneumatic drill	10	128
	5. Backhoe excavators	4	112
B.4.3	1. Truck mixer	4	109
	2. Concrete pump	1	109
	3. Mobile crane	1	112
	4. Trucks	2	117

Appendix B3 Noise Neighbourhoods in the Study Area

NOISE NEIGHBOURHOOD IN THE STUDY AREA	
NOISE NEIGHBOURHOOD	VILLAGE
N 1	(R17) Tai Po, (R23) Youth Camp
N 2	(R18) Ma Wan Chung, (R19) Ma Wan
N 3	(R1) Shan Ha
N 4	(R2) Fui Yiu Ha, (R3) Sheung Ling Pei, (R4) Ha Ling Pei, (R5) Wong Ka Wai, (R6) Lung Tseng Tau
N 5	(R21) Sha Tsui Tau, (R22) Outdoor Recreation Camp
N 6	(R20) Shek Lau Po
N 7	(R7) Shek Mun Kap, (R8) San Keng, (R9) Shek Pik Au
N 8	(R10) Mok Ka, (R11) Nim Yuen, (R12) Tung Hing, (R13) Ngau Au
N 9	(R14) Kau Liu, (R15) San Tau, (R16) Tin Sam
N 10	(T1) Pak Mong
N 11	(T2) Ngau Kwu Long (T3) Tin Liu (T4) Tai Ho San Tsuen

Appendix B4 Predicted Noise Levels for Single Activities

ACT.I.D.	N1a	N1b	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11
A.1.1	70	67	51	43	43	50	40	37	45	51	37	34
A.1.2.1	80	83	63	58	56	62	52	49	57	63	49	47
A.1.2.2	64	68	47	42	40	46	36	34	41	47	33	31
A.1.3	65	69	48	43	41	47	37	35	42	48	34	32
A.1.4	53	56	36	31	29	35	25	22	30	36	22	20
A.1.5	76	80	59	54	52	58	48	46	53	59	45	43
A.1.6	74	77	57	51	49	55	46	43	50	57	42	40
A.1.7	65	68	48	42	40	46	37	34	41	48	33	31
A.2.1	74	77	78	66	65	67	60	58	60	60	53	51
A.3.1	55	55	41	38	37	38	35	33	35	46	34	31
A.3.2	58	57	43	41	40	40	37	36	37	48	36	34
B.1.1	25	24	18	18	17	17	16	16	16	26	25	25
B.1.2	44	43	37	37	36	36	35	35	35	45	44	44
B.1.3	32	31	25	25	24	24	23	23	23	33	32	32
B.1.4	21	20	14	14	13	13	12	12	12	22	21	21
B.1.5	39	39	32	33	32	32	31	30	31	41	39	40
B.1.6	39	38	31	32	31	31	30	30	30	40	39	39
B.1.7	28	27	21	21	20	20	19	19	19	29	28	28
B.2.1	32	31	25	25	24	24	24	23	24	34	31	31
B.2.2	39	38	32	32	32	32	31	31	31	41	38	38
B.2.3	30	29	23	23	22	22	21	21	21	31	29	29
B.2.4	36	36	30	30	29	29	28	28	28	38	35	36
B.2.5	37	37	31	31	30	30	29	29	29	39	36	36
B.2.6	27	26	20	20	19	19	18	18	18	28	26	26
B.3.1	38	37	30	30	29	29	28	28	28	38	52	50
B.3.2	50	50	43	43	42	42	41	41	41	51	63	62
B.3.3	44	33	26	26	25	25	24	24	24	34	46	45
B.3.4	24	23	16	16	15	15	14	14	14	24	36	35
B.3.5	42	41	34	35	34	34	33	32	33	43	55	54
B.3.6	35	35	28	28	27	27	26	25	26	36	48	47

Appendix B4 (Continued)

ACT.I.D.	N1a	N1b	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11
B.4.1	42	41	35	35	35	34	34	33	34	44	42	42
B.4.2	54	52	47	47	46	46	46	45	46	55	53	54
B.4.3	37	36	30	30	29	29	29	28	29	39	36	37

Note : Shaded noise levels are those which exceed the ANL of 50 dB(A) in Period 2