

TAI PO DEVELOPMENT:  
FORMATION & SERVICING OF AREA 12 (PART) & 39

Phase I Environmental Monitoring and Audit Manual  
(Final)

JUNE 1996



CONSULTANTS IN  
ENVIRONMENTAL  
SCIENCES (ASIA) LTD


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TERRITORY DEVELOPMENT DEPARTMENT

TAI PO DEVELOPMENT:  
FORMATION & SERVICING OF AREA 12 (PART) & 39

Phase I Environmental Monitoring and Audit Manual  
(Final)

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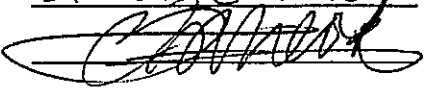
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## 1 INTRODUCTION

This Manual details the Environmental Monitoring and Audit (EM&A) Programme for Phase I of the Tai Po Development: Formation and Servicing of Areas 12 (Part) and 39. The recommendations have been made following the Environmental Impact Assessment (EIA) Study, reported in *Tai Po Development: Formation and Servicing of Areas 12 (Part) and 39 : Phase I Environmental Impact Assessment (Final)*, June 1996, undertaken by Consultants in Environmental Sciences (Asia) Ltd (CES).

This Manual has been prepared by CES as subconsultants to Maunsell Consultants Asia Limited. Additional specialist inputs were provided by Ecosystems Ltd. The project proponent is the Territory Development Department (TDD).

The Environmental Protection Department (EPD) provided a study brief for the EIA Study of the project (DEP fax Ref: (34) in Annex (15) to EP1/N5/01 dated 8 March 1995). This requires consideration to be given in the EIA to the key environmental issues identified in the Preliminary Project Feasibility Study, defines the reporting requirements for the EIA and includes a requirement for the production of an EM&A Manual.

Preliminary assessment studies were presented as four Working Papers, including *Working Paper 3: Phase I Environmental Monitoring and Audit Manual (Final)*, April 1996.

### 1.1 Manual Objectives

The Manual provides a series of systematic environmental procedures for monitoring and controlling the environmental impacts associated with the Phase I construction works, and if necessary, the operation of the development. These allow any deterioration in environmental quality to be detected at an early stage, enabling a rapid active response to mitigate impacts. The EM&A programme also aims to ensure compliance with environmental legislation and contractual controls.

Hong Kong environmental regulations for air quality, noise, water quality and ecology, including the Hong Kong Planning Standards and Guidelines, and recommendations from the EIA Study Working Papers and Final EIA Report have served as environmental standards and guidelines in the preparation of this report.

The following areas have been identified as necessitating environmental monitoring and auditing including the implementation status of environmental mitigation measures: construction impacts on water quality, noise, air quality and ecology. Monitoring of operational impacts was not considered to be necessary.

### 1.2 Project Background

The Tai Po Development Project will complete the site formation and servicing of Area 39 and provide the infrastructure to accommodate the demand for expansion of the villages Cheung Shue Tan and Tai Po Mei (Area 12 - part), and improve the existing environment of the two villages.

The Tai Po Development site is located in the North East New Territories in Tai Po Areas 12 (Part) and 39, between Shatin and Tai Po. The majority of the site is currently bounded by the Chinese University and a loop between the original Kowloon Canton Railway (KCR) embankment and the Tolo Highway. A KCR track was recently constructed alongside the Tolo Highway and the KCR has ceased using the original alignment. The development site of Area 12 (Part) is restricted to two villages, Cheung Shue Tan and Tai Po Mei. Area 39 is approximately 25 hectares of flat, low-lying (+2.5 mPD), reclaimed land which was formed under the Tolo Highway Project. The location of the project site is given in Figure 1.1.

### 1.3 Phasing of Works

The proposed formation and servicing works have been divided into two phases.

Phase I of the Tai Po Development Project will complete the site formation and servicing of the northern half of Area 39. This area will ultimately be zoned for G/IC purposes. The duration of Phase I works is expected to be from April 1997 until December 1998. A preliminary project programme is given in Figure 1.2. The following works will be undertaken during Phase I.

- Site formation in the northern part of Area 39 (filling to approximately +6.0 mPD and associated drains). All fill will need to be imported.
- Provision of an access road for the site formation works by widening the existing Yau King Lane and construction of Road L39/1 (north) to link Area 39 to Tai Po Road. Part of Road L39/1 will be constructed on the existing KCR embankment and track.

Phase II works will include completion of the site formation and servicing in the southern part of Area 39, completion of Road L39/1 and construction of Roads L39/2, L12/1 L12/2, culverting the existing nullah, training of stream channels and other associated works.



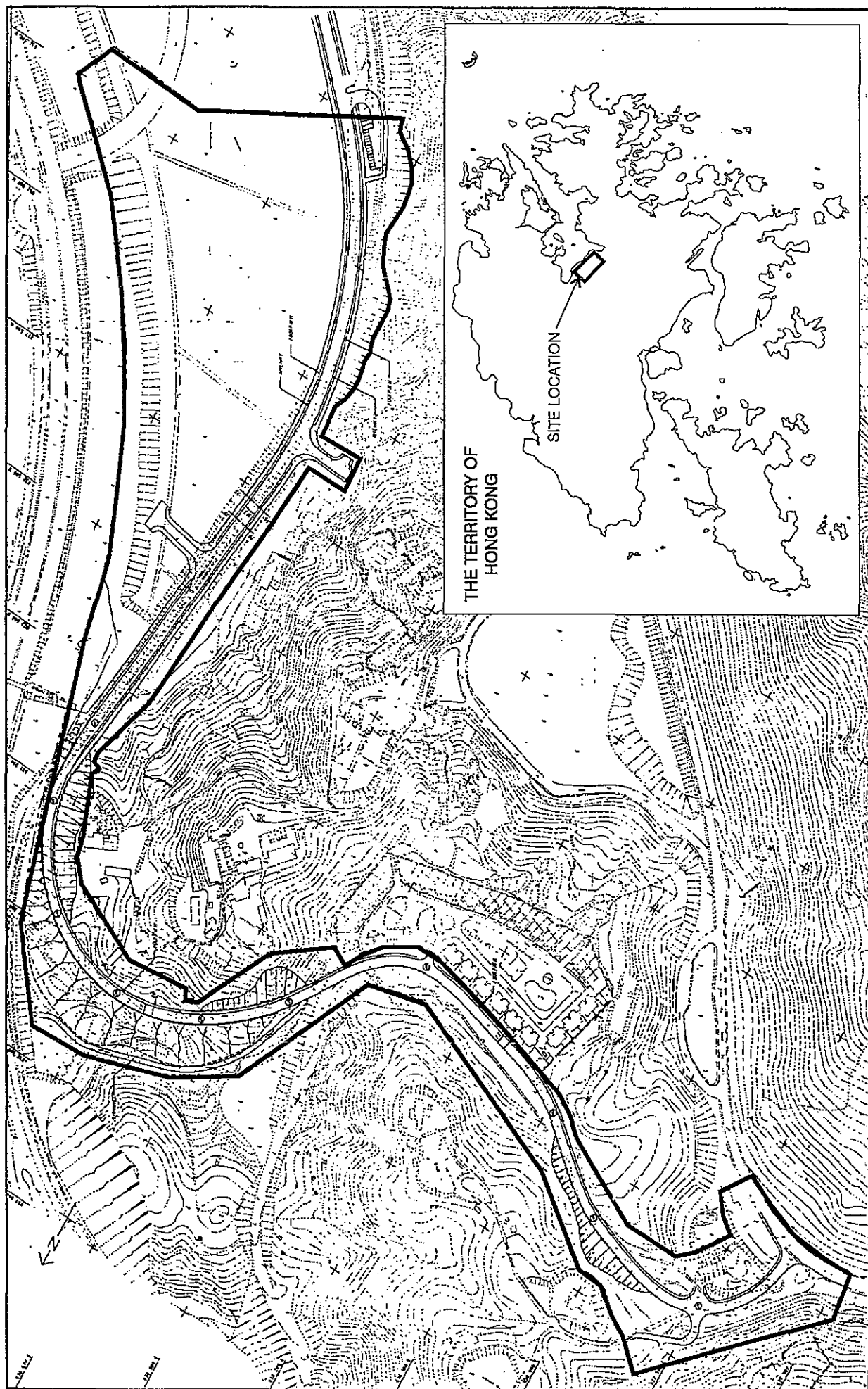


Figure 1.1 Project Site Location : Phase I

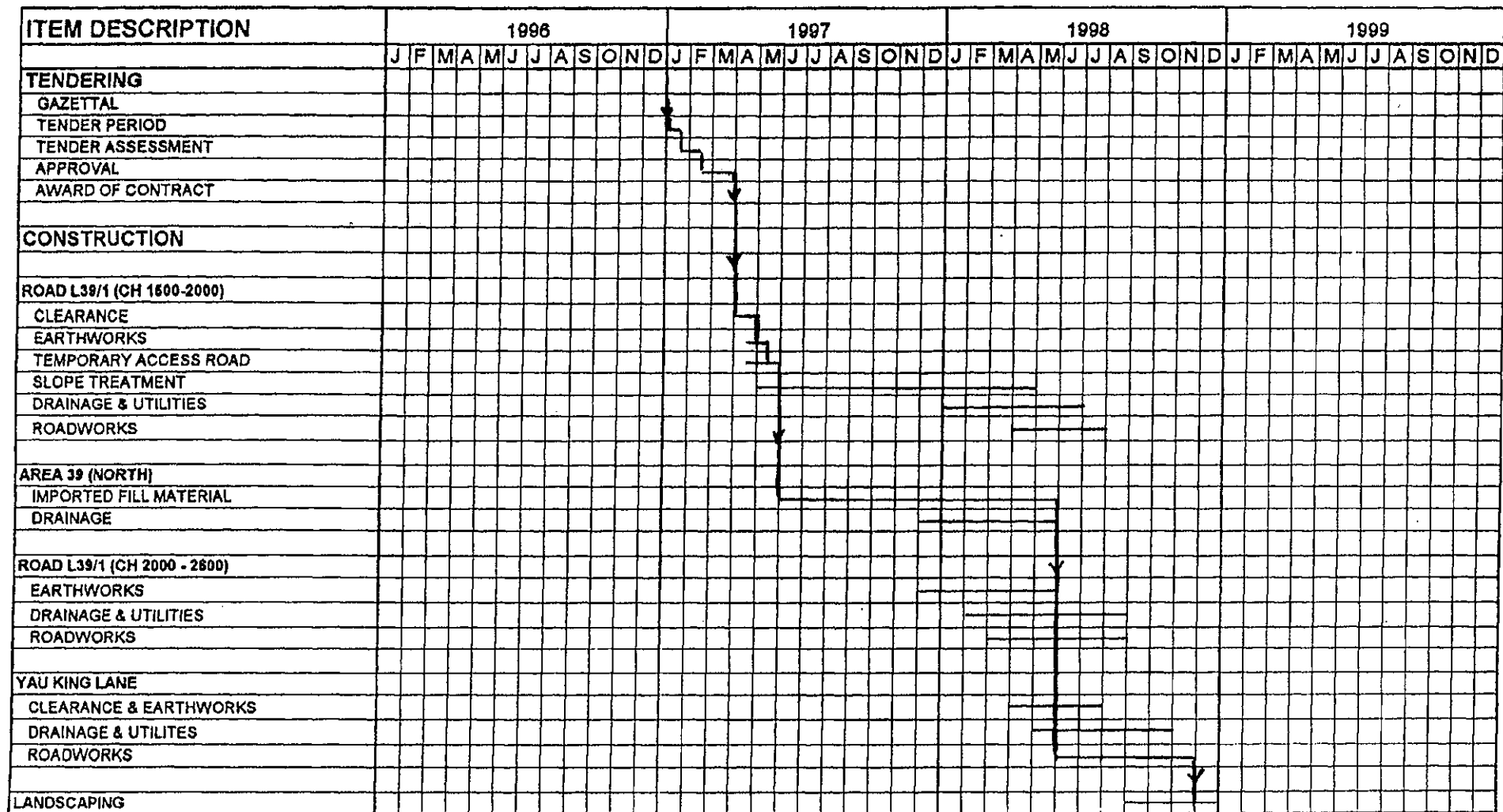


Figure 1.2 Project Programme Phase I



## 2 SUMMARY OF ENVIRONMENTAL ASSESSMENT STUDIES

### 2.1 Air Quality (Dust)

#### 2.1.1 Dust Impact Assessment

Modelling results predicted that there will be no exceedances of the 1-hour guideline level or the 24-hour Air Quality Objective for averaged Total Suspended Particulates (TSP) at the representative air sensitive receivers during the construction works, provided the proposed good site practice procedures are adopted to minimise dust arisings. It is recommended that these are included as contractual controls as far as possible.

#### 2.1.2 Mitigation Measures

In the air quality assessment, the following impact mitigation measures of good site practice have been proposed and taken into account in the modelling analysis. These measures are required if air quality is to be kept within acceptable levels.

##### *Good Site Practice Procedures*

- (a) Mean vehicle speed of haulage trucks at 20 km hr<sup>-1</sup>.
- (b) Twice daily watering of all open site areas (assumed 50% dust reduction as from AP-42).
- (c) Vehicle wheel washing facilities.
- (d) Suitable side and tailboards on haulage vehicles.
- (e) Watering of temporary stockpiles.

### 2.2 Noise

#### 2.2.1 Impact Assessment

The construction noise assessment has indicated that exceedances of the 75 dB(A) non-statutory day time limit will occur at NSRs 1, 6 and 7, if no mitigation is implemented. However, if mitigation is implemented as recommended, then it has been predicted that noise levels at all NSRs affected by the Phase I works will be reduced to within acceptable guidelines.

#### 2.2.2 Mitigation Measures

It is recognised that some form of mitigation will be required at Villa Castell (NSRs 1, 6 & 7) in order to reduce noise to acceptable levels.

To ensure acceptable noise levels at Villa Castell, mitigation will be required for the following tasks: road improvement earthworks, remaining road improvement works and retaining wall installation.

- 1) Noise levels arising from road improvement earthworks can be reduced to acceptable levels at all NSRs provided the hand held breaker is acoustically screened at source.
- 2) Noise levels arising from remaining road improvement works can be reduced to acceptable levels at all NSRs provided that all activities involving PME are effectively screened at source from the line of sight of the NSRs. Since many of the NSRs at Villa Castell directly overlook the proposed operational site for this construction task, it will be necessary to schedule works in such a way that areas of activity are at all times screened from the line of sight by an effective acoustic barrier.
- 3) Noise levels arising from retaining wall installation can be reduced to acceptable levels at all NSRs provided that vibratory pokers are effectively screened from the line of sight of the NSRs by means of an effective acoustic barrier.

The acoustic barriers described above will be positioned to screen sensitive facades. The barriers must be absorptive, having a noise reduction capability of up to 10 dB(A) and must have no gaps. Barrier material should have a mass per unit surface area in excess of 7 kg/m<sup>2</sup>. Some sound will pass around the ends of a short barrier. To minimise this occurrence, the length of the barrier should be about five times its height, or the barrier should be curved around the noise source. The minimum height of the barrier should be such that no part of the noise source is visible from the NSR (BS 5228: Part 1: 1984, Appendix D4 & Table 15).

In addition to the mitigation measures recommended above, it is also recommended that the following list of 'good site practice' procedures should be observed.

*Good Site Practice Procedures*

- (a) Noisy equipment and activities to be sited by the Contractor as far from sensitive receivers as is practical.
- (b) Noisy plant or processes to be replaced by quieter alternatives where possible. For example, pneumatic concrete breakers can be silenced with mufflers and bit dampers. If appropriate, a concrete cruncher (hydraulically-powered jaws) may be used; the cruncher emits a sound power level about 20 dB(A) lower than that of an electric breaker. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained. Manual operations are generally quietest, but may require long periods of time. The power units of non-electric stationary plant and earth-moving plant can be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.
- (c) Intermittent noisy activities to be scheduled to minimise exposure of nearby NSRs to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background



noise (such as during peak traffic hours). Prolonged operation of noisy equipment close to dwellings to be avoided.

- (d) Idle equipment to be turned off or throttled down. Noisy equipment to be properly maintained and used no more often than is necessary.
- (e) Construction activities can be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.
- (f) If possible, a reduction in the numbers of operating items of powered mechanical equipment should be achieved.
- (g) Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g., bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

## 2.3 Water Quality

### 2.3.1 Impact Assessment

Water quality impacts due to construction works could arise from surface run-off potentially containing high levels of suspended solids (SS). However, if the potential for impacts is adequately addressed, then the residual impacts after adoption of standard mitigation measures should in general be low. It is recommended that run-off from the construction works is controlled and discharge of SS minimised through strict observance of "best engineering practices" as defined in the *Practice Note for Professional Persons PN 1/94* issued by EPD, including provision of sedimentation basins where required and a silt curtain at the nullah outlet. It has been noted that the quality of the existing freshwater streams and drainage channels is poor, and these have been severely impacted by uncontrolled sediment laden run-off from construction activities elsewhere in the catchments.

Other areas of minor concern during the construction phase include leakage of liquors with significant quantities of cement derived materials resulting in localised effects of increased pH and turbidity in receiving water bodies, and spillage, leakage and/or indiscriminate disposal of petroleum products from construction sites. All fuel storage areas should be bunded and drainage directed towards an oil interceptor.

### 2.3.2 Mitigation Measures

Impacts on water quality runoff can be mitigated by implementing control measures recommended in 'Construction Site Drainage' Practice Note for Professional Persons PN 1/94, supported by the recommended environmental monitoring and audit programme.

Mitigation measures are recommended as follows:

- To minimise construction site runoff, it is recommended that during site formation, drainage from the site should be channelled to sedimentation basins comprised of a series of tanks below ground level separated by baffles that reduce water velocity sufficiently to permit the majority of solids to be deposited. Maintenance of the sedimentation basins on a regular basis, through frequency digging out is essential to ensure their continued efficiency.
- Installation of a silt curtain to enclose the nullah outlet.
- Oil and fuel storage facilities should be drained through an oil inceptor; chemical facilities should be bunded (to hold 120% of maximum storage volume) and covered with an impervious liner.
- Oil and grease shall be removed by grease trap and petrol interceptor and their design shall be in accordance with "*Construction Site Drainage*", ProPECC PN 1/94, EPD. Provide a by-pass to prevent flushing during rain storm events.
- Connect all sewage discharges to either a treatment facility, or alternatively provide chemical toilet facilities on works sites.
- Construct a trench to divert run-off from the stream to avoid contamination.
- Hydroseed excavated area as soon as possible to reduce erosion.
- Cover short-term stockpiles with tarpaulins to reduce sediment laden run-off, where possible.
- Provide appropriate effluent treatment facilities at site works areas.

In addition it is recommended that contractual clauses concerning water quality are strictly adhered to.

## 2.4 Ecology

### 2.4.1 Impact Assessment

Since the large majority of the study area is already disturbed by human activity, the overall ecological impacts of the proposed Project on the existing environment are predicted to be small. Phase I of the Project will result in losses of 1.61 ha of woodland, 0.22 ha of grassland, 0.54 ha of agriculture/orchard, and 8.74 ha of various disturbed areas. Of these, the losses of greatest concern are those to woodland and agriculture/orchard, as these will directly decrease the availability of foraging and nesting habitat for the associated fauna. Woodland 1 at Yau King Lane contains individuals of *Pavetta hongkongensis*, a species protected under the Forestry Regulations. Impacts on stream areas will include degradation of an already impoverished stream at Yau King Lane in Phase I. Specific mitigation measures are therefore proposed to minimise negative impacts to these resources.

### 2.4.2 Mitigation Measures

Loss of individuals of *Pavetta hongkongensis* at Woodland 1 can be mitigated by transplantation prior to construction. A detailed survey should be conducted to mark all the individuals within the construction boundary. The species can be transplanted to nearby woodlands which will not be disturbed by the construction.

The loss of woodland may be partially mitigated through revegetation of soft slopes and other suitable areas, using plant species indigenous to the site which provide cover and forage value for wildlife. It is recommended that woodland losses be mitigated by tree planting for woodland restoration. The areas available on-site in the Phase I and II areas provide room for re-vegetation of an area slightly larger than that lost to construction (1.64 ha : 1.61 ha).



### 3 PROJECT ORGANISATION

#### 3.1 Project Organisation

An independent Environmental Team (ET) of suitably qualified persons shall be established by the Engineer for implementation of the EM&A programme during the construction phase. The ET shall be independent of the contractor. The team will consist of (i) a Team Leader who is experienced in monitoring and audit of construction work, and (ii) a field team of technical staff who are competent in the measurement of environmental parameters on site using instrumentation and in the collection, storage and transport of environmental samples. Figure 3.1 outlines the organisation and communication structure of the management team.

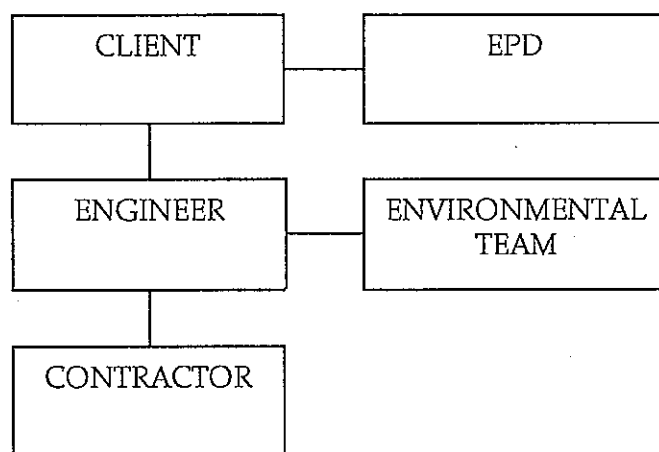


Figure 3.1 Proposed Structure of Project Management Team

#### 3.2 Responsibilities

The Contractor will be responsible for:

- Implementing measures to reduce impacts where TAT levels are exceeded.

The Engineer will be responsible for:

- Informing the Contractor when action is required to reduce impacts in accordance with the Action Plan.
- Establishing an independent environmental team to undertake monitoring, laboratory analysis and reporting.



The Environmental Team will be responsible for:

- Providing all necessary equipment for the monitoring programme.
- Collection of any baseline data required and for monitoring and laboratory analysis during construction activities.
- Reporting the monitoring and audit findings.
- Auditing site activities and implementation of mitigation measures.



## 4 ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

### 4.1 Monitoring Schedule

Monitoring and audit is recommended for water quality, noise, air quality and ecology.

### 4.2 Levels of Monitoring

#### 4.2.1 Baseline Monitoring

Baseline monitoring of air and marine water quality before the project starts is required to ascertain the site area's existing conditions for setting the trigger, action and target (TAT) levels. Baseline noise monitoring is also recommended to establish the existing noise levels prior to construction works.

#### 4.2.2 Compliance Monitoring

Compliance monitoring of air, noise and water quality during the construction phase will be required to assess environmental impacts caused by the project, and to facilitate immediate action when problems arise.

#### 4.2.3 Operational Monitoring

Monitoring of the operational impacts is not considered necessary at this stage. However, this will be reviewed during the Stage II EIA Study.

### 4.3 Trigger, Action, and Target Levels

Environmental quality performance limits of the monitored parameters are used as a framework for interpreting monitoring results during environmental auditing. A preset range of Trigger, Action and Target (TAT) levels will be used to represent these performance limits. The TAT levels are defined as follows:

<i>Trigger</i> -	An exceedance of the Trigger level provides an indication of deteriorating environmental quality.
<i>Action</i> -	Exceedance of the Action level indicates the necessity to adopt appropriate remedial actions to prevent the environmental quality from reaching the target limits. It also serves as a notice of preparation to increase the environmental monitoring frequency.
<i>Target</i> -	Target levels are stipulated in relevant pollution control ordinances, Technical Memoranda, Hong Kong Planning Standards and Guidelines. These are the maximum levels at which the works could be permitted to proceed. If levels go above the target, appropriate remedial action, including critical review of plant and work methods would be required.

Background levels for air, noise and water quality shall be established using results of baseline monitoring. This shall be conducted prior to the commencement of construction works, in order to ascertain the existing conditions of the site area.

Upon completion of the baseline monitoring, the TAT levels for this project may be established in accordance with the criteria given in Table 4.1, subject to the existing baseline conditions and confirmation with EPD. In cases where the exceedance of guidelines and statutory standards already exists, TAT levels must take account of this.

**Table 4.1 Air, Noise and Water TAT Levels**

Parameter		Trigger Level	Action Level	Target Level
Air Quality (dust)	TSP (1 hr)	95 %ile of baseline	Average of Trigger and Target Levels	Air Quality Objective and Guidelines: 500 $\mu\text{gm}^{-3}$ (TSP-1 hr) 260 $\mu\text{gm}^{-3}$ (TSP-24 hr)
	TSP (24 hr)			
Noise	$L_{Aeq}$ (30 min) <sup>1</sup>	1 complaint	> 1 independent complaint per day	75 dB(A)
Fresh <sup>2</sup> Water Quality	pH	-	-	Relevant TM standards Relevant TM standards 10 NTU
	SS Turbidity	- 8 NTU	- 9 NTU	
Marine <sup>3</sup> Water Quality	SS Turbidity	90 %ile of baseline 90 %ile of baseline	Average of Trigger and Target Levels	99 %ile of baseline 99 %ile of baseline

- NB:
- 1 Applies during non-restricted hours (0700-1900 hrs weekdays, except for public holidays) for works not involving percussive piling. During restricted hours a Construction Noise Permit would be required, and the conditions stipulated in the CNP should be followed. Acceptable Noise Levels (ANLs) would serve as Target Levels during restricted hours.
  - 2 TAT levels set on the rationale that there is no TM standard for turbidity. However as turbidity measurement gives an immediate result, it is recommended that this is used as a surrogate for SS measurements. The levels have been set based on past experience of the approximate relationship between SS and turbidity, and may be reviewed periodically.
  - 3 Alternatively TAT levels may be set using data from EPD routine monitoring at TM4, allowing a greater consideration of seasonal variation than using data from a short-term baseline monitoring programme. TAT levels will be set in consultation with EPD.

#### 4.4 TAT Action Plans

When exceedance of TAT levels occurs, recommended action has to be undertaken to control environmental impacts to acceptable levels. The action plan in event of exceedance of TAT levels is shown in Table 4.2 for air, noise and water quality.

Table 4.2 Action Plan For Exceedance of TAT Levels

Exceedance	Action		
	Environmental Team	Contractor	Engineer
Trigger Level - Once	<ul style="list-style-type: none"> <li>• Inform Contractor and Engineer</li> </ul>	<ul style="list-style-type: none"> <li>• Rectify unacceptable practice</li> </ul>	
Trigger Level - More than two consecutive sampling days	<ul style="list-style-type: none"> <li>• Repeat in-situ measurement to confirm findings</li> <li>• Inform Contractor &amp; Engineer. Identify source</li> <li>• Check monitoring data &amp; site activities</li> <li>• Discuss mitigation with Engineer &amp; Contractor</li> <li>• Assess effectiveness of mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss with ET &amp; Engineer &amp; propose mitigation</li> <li>• Consider changes in working practices</li> <li>• Implement agreed mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss proposed mitigation with ET &amp; Contractor</li> <li>• Agree mitigation to be implemented</li> <li>• Review effectiveness of mitigation</li> </ul>
Action Level - Once	<ul style="list-style-type: none"> <li>• Repeat in-situ measurement to confirm findings</li> <li>• Inform Contractor &amp; Engineer. Identify source</li> <li>• Check monitoring data &amp; site activities</li> <li>• Discuss mitigation with Engineer &amp; Contractor</li> <li>• Repeat measurement on following day</li> <li>• Assess effectiveness of mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss with ET &amp; Engineer &amp; propose mitigation</li> <li>• Consider changes in working practices</li> <li>• Implement agreed mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss proposed mitigation with ET &amp; Contractor</li> <li>• Agree mitigation to be implemented</li> <li>• Review effectiveness of mitigation</li> </ul>
Action Level - More than two consecutive sampling days	<ul style="list-style-type: none"> <li>• Repeat in-situ measurement to confirm findings</li> <li>• Inform Contractor &amp; Engineer. Identify source</li> <li>• Check monitoring data &amp; site activities</li> <li>• Discuss mitigation with Engineer &amp; Contractor</li> <li>• Repeat measurement on following day</li> <li>• Prepare to increase monitoring frequency</li> <li>• Review implementation of mitigation</li> <li>• Assess effectiveness of mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss with ET &amp; Engineer &amp; propose mitigation within 3 days of notification</li> <li>• Check site activities, rectify problems</li> <li>• Critically review working methods</li> <li>• Consider changes in working practices</li> <li>• Implement agreed mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Discuss proposed mitigation with ET &amp; Contractor</li> <li>• Agree mitigation to be implemented</li> <li>• Review effectiveness of mitigation</li> </ul>



Table 4.2 Action Plan For Exceedance of TAT Levels (Cont'd)

Exceedance	Action		
	Environmental Team	Contractor	Engineer
Target Level - Once	<ul style="list-style-type: none"> <li>Repeat in-situ measurement to confirm findings</li> <li>Inform Contractor, Eng. &amp; EPD. Identify source</li> <li>Check monitoring data &amp; site activities</li> <li>Discuss mitigation with Engineer &amp; Contractor</li> <li>Repeat measurement on following day</li> <li>Review implementation of mitigation</li> <li>Monitor daily until Target no longer exceeded</li> <li>Assess effectiveness of mitigation</li> </ul>	<ul style="list-style-type: none"> <li>Discuss with ET &amp; Engineer &amp; propose mitigation within 3 days</li> <li>Check site activities, rectify problems</li> <li>Critically review working methods</li> <li>Implement agreed mitigation</li> </ul>	<ul style="list-style-type: none"> <li>Discuss proposed mitigation with ET &amp; Contractor</li> <li>Request Contractor to review working methods</li> <li>Agree mitigation measures for implementation</li> <li>Review effectiveness of mitigation</li> </ul>
Target Level - More than two consecutive sampling days	<ul style="list-style-type: none"> <li>Monitor daily until Target not exceeded for 2 days</li> <li>Repeat in-situ measurement to confirm findings</li> <li>Inform Contractor, Eng. &amp; EPD. Identify source</li> <li>Check monitoring data &amp; site activities</li> <li>Discuss mitigation with Engineer &amp; Contractor</li> <li>Repeat measurement on following day</li> <li>Review implementation of mitigation</li> <li>Assess effectiveness of mitigation</li> </ul>	<ul style="list-style-type: none"> <li>Discuss with ET &amp; Engineer &amp; propose mitigation within 3 days</li> <li>Check site activities, rectify problems</li> <li>Critically review working methods</li> <li>Implement agreed mitigation</li> <li>Slow or stop activities causing exceedances according to directions from Engineer</li> </ul>	<ul style="list-style-type: none"> <li>Discuss proposed mitigation with ET &amp; Contractor</li> <li>Request Contractor to review working methods</li> <li>Agree mitigation measures for implementation</li> <li>Review effectiveness of mitigation</li> <li>If necessary, instruct Contractor to slow or stop activities causing exceedances until no exceedance of Target level.</li> </ul>

- NB: 1 In the case of noise monitoring, the frequency of sample exceedance corresponds to the number of complaints received. Any follow-up monitoring will be undertaken at the affected NSRs.
- 2 In the event of creeping ambient noise levels, trigger level = 1 complaint, action level = 2 complaints.  
All TAT exceedances will be reported in the Monthly Progress Report

## 4.5 Baseline Monitoring

Baseline monitoring of air and marine water quality before the project starts is required to ascertain the existing conditions of the site area for setting the trigger, action and target (TAT) levels required during construction. Baseline monitoring of noise is also recommended to determine the existing noise levels prior to construction works. TAT levels may be initially based upon monitoring work conducted as part of the EIA Study, but revised once additional baseline monitoring has been completed.

Baseline monitoring of fresh water quality is not required as the compliance monitoring locations are discharge points from the site. The existing quality of the freshwater bodies is poor. Monitoring the site discharge would provide a more accurate review of the environmental performance of this Contractor.

### 4.5.1 Air Quality (Dust)

Baseline monitoring should be carried out prior to the commencement of the construction work to determine the ambient dust (TSP) levels at 2 monitoring stations (Receiver numbers 7 and 9, see Figure 4.1). The baseline monitoring should be carried out for a period of at least 14 days prior to commissioning of the construction work - daily for 24-hour sampling, at least 3 times per day for 1-hour sampling while the highest dust level is expected.

### 4.5.2 Noise

Baseline monitoring should be carried out prior to the commencement of the construction work to determine the existing noise levels at 2 monitoring stations (Receiver numbers 7 and 9, see Figure 4.1). Noise monitoring should be undertaken for  $L_{Aeq(30 \text{ min})}$  during non-restricted day time (0700-1900 hours) on normal weekdays for 14 days. If construction work is to be conducted during restricted hours, including evening and/or night time work, a baseline of six consecutive evening/night time measurements of  $L_{Aeq(5 \text{ min})}$  for each of 14 days are required, allowing the calculation of the  $L_{Aeq(30 \text{ min})}$ .

### 4.5.3 Marine Water Quality

Baseline monitoring should be carried out prior to the commencement of the construction work to determine the existing water quality. Monitoring should be carried out four times a week for a minimum of three weeks, for the parameters of suspended solids and turbidity. Samples will be taken at both mid-flood and mid-ebb tides at 1 m below water surface, mid depth, and 1 m above sea bed. Alternatively TAT levels may be set using data from EPD routine monitoring at TM4, allowing a greater consideration of seasonal variation than using data from a short-term baseline monitoring programme. TAT levels will be set in consultation with EPD.

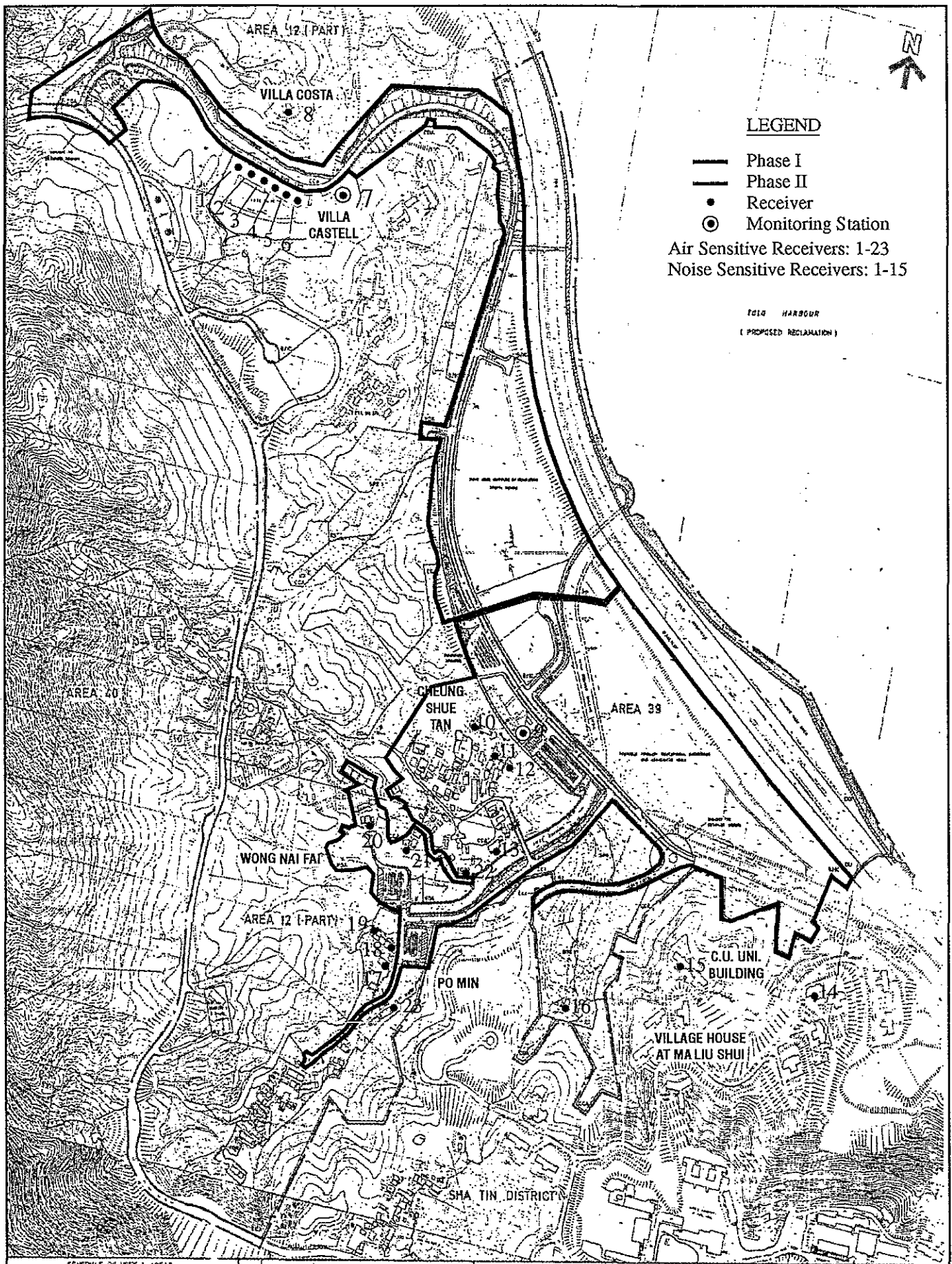


Figure 4.1

Location of Air & Noise Sensitive  
Receivers and Monitoring Stations

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#### 4.6 Compliance Monitoring

Compliance monitoring of air, noise and water quality during construction shall be undertaken with respect to TAT levels. This will provide an early indication if any of the environmental control measures or construction practices are failing to achieve the required standards, so that mitigation measures can be adopted to reduce the impacts to acceptable levels.

##### 4.6.1 Air Quality (Dust)

Compliance monitoring during the course of the construction should be undertaken for TSP (24-hour) once every six days. A spot check of TSP (1-hour) should be undertaken three times every six days, while construction work is taking place. Wind data (speed and direction) and precipitation should be recorded continuously at one monitoring station.

##### 4.6.2 Noise

Noise monitoring should be undertaken for  $L_{Aeq(30 \text{ min})}$  during non-restricted day time (0700-1900 hours) on normal weekdays at the monitoring stations once per week (ie. 0.5 hours per station per week). During restricted hours, including evening and/or night time work, six consecutive night time measurements of  $L_{Aeq(5 \text{ min})}$  once a week are required, allowing calculation of the  $L_{Aeq(30 \text{ min})}$ .

##### 4.6.3 Fresh Water Quality

Monitoring is to be undertaken for turbidity, suspended solids and pH at the sedimentation basin discharge points, once per week. These parameters may be amended to accord with license conditions should EPD's Local Control Office (Territory North) require a license to control such discharges.

##### 4.6.4 Marine Water Quality

Monitoring will be undertaken for turbidity and suspended solids, three times per week. Samples will be taken at both mid-flood and mid-ebb tides at 1 m below water surface, mid depth, and 1 m above sea bed.

#### 4.7 Monitoring Locations and Parameters

##### 4.7.1 Air Quality (Dust)

Air quality is to be measured at two monitoring stations, Receiver Numbers 7 and 9. Figure 4.1 shows the location of the Receivers. The stations should be close to the site boundary and free from local obstructions or shelters. The site would need to be secure from vandalism, theft or damage and also requires a power supply and access permission. The exact locations should be reviewed in relation to practical site constraints. The Contractor would be responsible for obtaining the necessary permission for location, installation and use of mains electricity supply for the dust monitor.

#### 4.7.2 Noise

Measurements are to be carried out at two stations, 1 m from the worst-affected external facades of Receiver Numbers 7 and 9. Figure 4.1 shows the location of the Receivers. The locations shall be dependent on site constraints and ability to obtain access permission to a suitable location. The Contractor shall be responsible for obtaining the necessary access permission.

#### 4.7.3 Fresh Water Quality

Monitoring is to be undertaken for turbidity, suspended solids and pH at the sedimentation basin discharge points, once per week.

#### 4.7.4 Marine Water Quality

Monitoring is to be undertaken at station MW1 (838980 E, 832380 N) for turbidity and suspended solids, three times per week. Samples will be taken at both mid-flood and mid-ebb tides at 1 m below water surface, mid depth and 1 m above sea bed. The location of MW1 is shown on Figure 4.2.

### 4.8 Monitoring Equipment

#### 4.8.1 Air Quality (Dust)

For air quality monitoring, the following or equipment of an equivalent standard shall be used:

- GMWL-2000 High Volume Air Sampling System
- Haz-dust HD-1000 portable dust meter
- WD401 Wind Speed and Direction Sensor connected to a MET EL8 Data Logger will be used to collect meteorological data in accordance with the monitoring programme.

The TSP monitor shall be a high volume sampler as referenced in the USEPA CFR Part 50, Appendix B.

#### 4.8.2 Noise

Noise shall be monitored using Bruel and Kjaer modular precision sound level meter type 2231, with statistical analysis module BE 7101 or other suitable instruments which comply with the International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) specifications.



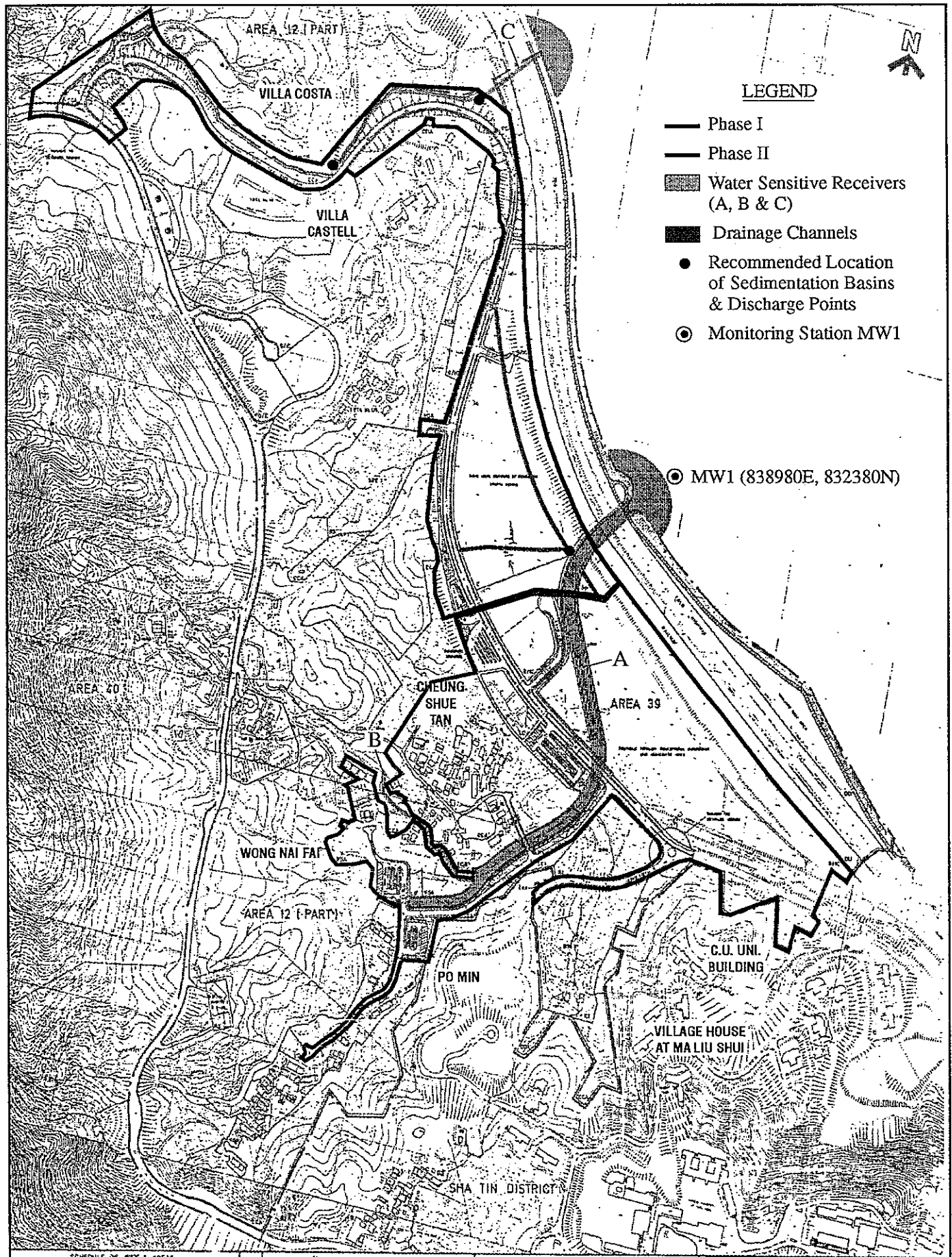


Figure 4.2 Water Sensitive Receivers, Recommended Location of Sedimentation Basins & Location of Marine Water Quality Monitoring Station

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#### 4.8.3—Water Quality—

Turbidity is to be measured using a HACH 2100P Turbidimeter or equipment with similar specifications. The instrument shall operate on a nephelometric principle and shall be portable, weatherproof and with a comprehensive operation manual. The equipment shall be operable from a DC power source and with a photoelectric sensor capable of measuring turbidity between 0-200 NTU.

Water samples for turbidity and SS analysis shall be taken using a Kahlisco Water sampler or equivalent. An accurate electronic balance with a precision of 0.1 mg and a dry oven shall be used for SS analysis.

A meter to measure pH within 0.1 units should be provided.

#### 4.9 Calibration

All monitoring equipment shall be maintained in calibration at all times. Re-calibration shall be carried out in accordance with requirements stated in this manual or that recommended by the manufacturers.

##### 4.9.1 Air Quality (Dust)

The flow rate of each high volume sampler with mass flow controller shall be calibrated using an orifice calibrator. Initial five point calibration shall be conducted upon installation and prior to commissioning. One point flow rate calibration shall be carried out every two months. Five point calibration shall be carried out initially and every six months thereafter.

The portable dust meters shall be calibrated against a known standard on each occasion the meter is used.

##### 4.9.2 Noise

The sound level meters to be calibrated using a Bruel and Kjaer Sound Level Calibrator Type 4230, or other similar equipment, prior to and after each set of measurements. The results of the calibration shall be recorded on a field data form. The measurement shall be discarded if the calibrations before and after do not agree to within 1 dB(A), then repeated until the calibrations before and after agree to within 1 dB(A). An annual calibration check shall be carried out by the manufacturer.

##### 4.9.3 Water Quality

The Turbidimeter shall be standardised with reference formazin gel solutions every time before use. Every two months the Turbidimeter shall be calibrated using standard formazin solutions, by an independent laboratory which is HOKLAS accredited for this test.

The balance shall be calibrated against an internationally traceable standard at intervals recommended by the manufacturer.

The pH meter should be standardised on the day of monitoring using at least two buffers of known pH.

#### 4.10 Methodology

##### 4.10.1 Air Quality (Dust)

TSP is sampled by drawing air through a conditioned, pre-weighed filter paper inside the high volume sampler at a controlled flow rate. After 24 hours of sampling the filter paper with retained particulates would be collected and returned to the laboratory for drying in a desiccator, followed by accurate weighing. TSP levels are calculated from the ratio of mass of particulates retained on the filter paper to the total volume of air sampled. The analysis process normally takes approximately two days. All procedures will follow USEPA CFR, Part 50, Appendix B.

Sample collection filters will comprise of glass fibre, quartz fibre or teflon fibres in order to minimise sample degradation.

##### 4.10.2 Noise

Noise measurements shall be made in terms of the A-weighted equivalent continuous sound pressure level ( $L_{eq}$ ) measured with an integrating sound level meter. Where applicable, such measurements shall be made over a 30 minute period to give 6 consecutive  $L_{eq}$ (5 min) readings. The readings must be undertaken in accordance with the methodology specified in the relevant Technical Memorandum on construction noise. Where applicable, the  $L_{eq}$ (30 minute) reading shall be calculated from the  $L_{eq}$ (5 minute) readings within the noise meter, based on standard acoustical principles. Noise measurements should not be made during periods of high background noise (such as during peak traffic hours), or in the presence of fog, rain, or excessive steady or gusty winds.

##### 4.10.3 Fresh Water Quality

Two consecutive readings of turbidity shall be taken at each specified location. If the two consecutive readings do not agree to within 25 %, the readings shall be discarded and repeated.

Water samples for suspended solids measurement shall be collected in high density polythene bottles, stored in an ice box and delivered to the laboratory as soon as possible after collection. The samples shall be analysed in accordance with the method 2540D of the APHA Standard Methods for the Examination of Water and Wastewater, 17 th edition, or equivalent method approved by EPD.

#### 4.10.4 Marine Water Quality

Samples will be taken at both mid-flood and mid-ebb tides at 1 m below water surface, mid depth and 1 m above sea bed.

Two consecutive readings of turbidity shall be taken at each specified location. If the two consecutive readings do not agree to within 25%, the readings shall be discarded and repeated.

Water samples for suspended solids measurement shall be collected in high density polythene bottles, stored in an ice box and delivered to the laboratory as soon as possible after collection. The samples shall be analysed in accordance with the method 2540D of the APHA Standard Methods for the Examination of Water and Wastewater, 17<sup>th</sup> edition, or equivalent method approved by EPD.

#### 4.11 Ecological Monitoring

##### 4.11.1 Monitoring Objectives

The following ecological issues shall be addressed through the EM&A programme. The objective of monitoring is to determine the effectiveness of impact avoidance and mitigation measures and to document the success of vegetation and habitat restoration.

- timing and success of transplantation of protected species
- efficacy of revegetation measures
- efficacy of wildlife habitat restoration

##### 4.11.2 Ecological Monitoring and Maintenance

Establishment, survival and growth in the revegetated areas should be monitored every 6 months for the first 2 years through examination of permanently delineated areas. Management decisions on thinning or replanting will be made based on the results of this monitoring. Photographic records should be made on each occasion from fixed photo-points to demonstrate the development of the new woodland.

#### 4.12 Data Recording

Standard pro-formas shall be used for recording field data. The data shall then be input into a computerised database. These shall serve as a systematic method of recording and storing data. In the event of complaints or evidence of unacceptable environmental impacts being obtained from the monitoring results, these data should be easy to reference.

Monitoring staff shall also record observations regarding activities/events that could affect the monitoring results.

Provisions are to be made for the case of equipment failure or theft. The Environmental Team is to have access to back-up equipment, which can be made available within 1 week of equipment failure or theft. This is to assure that the monitoring programmes will not be interrupted for an extended time period due to equipment failure or loss. Should changes in the schedule occur due to any of the above reasons, the client and EPD are to be notified as soon as possible of the inability to sample according to the original schedule. The monitoring is to be rescheduled as soon as practicable.

#### 4.13 Construction Phase Audit

Construction phase audit shall be carried out in conjunction with the construction compliance monitoring programme. The audit shall be conducted every month by the Environmental Team as part of the preparation for the monthly report. The audit shall check:

- Records of monitoring procedures
- Records of monitoring results
- Records of exceedance of any regulatory requirements/target levels
- Control and mitigation taken in response to unacceptable environmental impacts
- Records of any complaints from SRs and actions taken
- Site inspection to ensure that all mitigation measures are properly and effectively implemented and review of the adequacy of the implemented measures
- Contractor malpractice
- Activities against contract requirements

Audit findings by the Environmental Team shall be presented in the Monthly Monitoring and Audit Report. The report shall identify any unanticipated impacts and improvements required for future monitoring programme.

#### 4.14 Site Inspection

A site inspection shall be undertaken by the Environmental Team at a frequency of not less than two times per month. The aims shall be to confirm that there are no unacceptable practices on site, to identify any potential impacts, to evaluate the effectiveness of implemented mitigation measures and to assess the need for additional mitigation. Inspection reports shall be prepared for each site visit and included in the Monthly EM&A Progress Report.

#### 4.15 Impact Prediction Review

A review shall be undertaken on a monthly basis by the Environmental Team, of where and when environmental impacts are likely to occur during the following month. This shall be based on work schedule information, to be updated and supplied monthly by the Engineer, giving locations and dates relative to described activities. The impact prediction review shall be included in the EM&A Monthly Report.



## 5 REPORTING

### 5.1 Baseline Monitoring Report

The Environmental Team (ET) shall prepare and submit a Baseline Environmental Monitoring Report on completion of the baseline monitoring. Copies of the Baseline Environmental Monitoring Report shall be submitted to each of the three parties: the Contractor, the Engineer and EPD. The ET shall liaise with the relevant parties to determine the number of copies required. The format of the report and the format of the baseline monitoring data in magnetic media to be submitted to EPD shall be agreed with EPD.

The report shall include:

- Executive Summary of the main points of the report.
- Brief project background information.
- Maps showing locations of baseline monitoring stations.
- Monitoring results, monitoring methodology, equipment used and calibration details, parameters monitored, monitoring locations (and depth if appropriate), monitoring date, time, frequency and duration.
- Details on influencing factors, such as if any major activities are being carried out on site during the monitoring, and weather conditions.
- Determination of the Trigger, Action and Target Levels for each monitoring parameter and statistical analysis of the baseline data.
- Revisions if any for inclusion in the EM&A Manual.
- Comments and conclusions.

### 5.2 Monthly EM&A Report

A monthly Monitoring and Audit Report shall be prepared by the ET at the end of each month with the first report due in after the first month of construction commencing. Reports shall be submitted to the Client, the Engineer and EPD.

#### 5.2.1 Initial Monthly EM&A Report.

The report shall include:

- Executive Summary of the main points of the report.
- Synopsis of the project organisation, project programme, and management liaison structure. Summary of works progress during the month.
- A summary of the EM&A requirements, including monitoring parameters, TAT levels, TAT exceedance Action Plan, mitigation measures recommended in the EIA Study, environmental requirements in the contract documents.
- Maps of the area showing locations of monitoring stations and sensitive receivers.
- Monitoring Progress: Calibration schedule, scheduled and actual monitoring dates during the reported month.



- Monitoring Results: Parameter, date, time, environmental conditions and locations. Results should be presented as full page graphs of each parameter on a cumulative time basis at all the stations with TAT levels clearly shown on the graph. Summary of the number of TAT level exceedances in the month.
- Audit Result: Review of the reasons for and the implications of exceedance of TAT levels including a review of pollution sources and working procedures. Results of site investigation. Summary of weather conditions throughout the month.
- Description of action taken in the event of non-compliance.
- Compliance with environmental legislation.
- Implementation status of specified mitigation measures.
- Complaints: Liaison and consultation undertaken, subsequent action taken and follow-up procedures. Documentation of telephone/written complaints.
- Comments, recommendations and conclusions for the month.

It should be noted that under normal circumstances, non-compliance and remedial action will be addressed in the monthly Environmental Monitoring and Audit reports, but would also need to be dealt with on a day to day basis through the issue of action plans detailing deviations from the specification and requesting the contractor to correct the deviations.

### 5.2.2 Subsequent Monthly Reports

The reports shall contain at least the following:

- Executive Summary
- Basic project information including brief synopsis of monitoring programme with figure of monitoring locations.
- Summary of works progress during the month. Summary of weather conditions during the month.
- Monitoring Progress: Calibration schedule, scheduled and actual monitoring dates during the reported month.
- Monitoring Results: Parameter, date, time, environmental conditions and locations. Results should be presented as full page graphs of each parameter on a cumulative time basis at all the stations with TAT levels clearly shown on the graph. Summary of the number of TAT level exceedances in the month. Graphical plots to demonstrate trends in monitored parameters over the past four reporting periods.
- Audit Result: Review of the reasons for and the implications of exceedance of TAT levels including a review of pollution sources and working procedures. Results of site investigation.
- Description of action taken in the event of non-compliance; and follow up procedures related to earlier non-compliance actions.
- Compliance with environmental legislation.
- Implementation status of specified mitigation measures.
- Complaints: Liaison and consultation undertaken, subsequent action taken and follow-up procedures. Documentation of telephone/written complaints.
- Monitoring schedule for the next reporting period.
- Comments, recommendations and conclusions for the month.

### 5.3 Quarterly EM&A Report

The report should be of approximately five pages and include at least the following:

- Executive summary.
- Brief synopsis of the project organisation, programme, contacts of key management, and a synopsis of the work undertaken during the quarter.
- Brief summary of the project requirements including monitoring parameters, TAT levels, environmental mitigation measures as recommended in the EIA Study and their implementation status.
- Figures to show area, monitoring locations and sensitive receivers.
- Graphical plots to demonstrate trends in monitored parameters over the past four reporting periods, annotated against the major activities carried out, weather conditions during the period and any other factors that may affect the monitoring results.
- Summary of the number of TAT level exceedances in the quarter.
- Brief review of the reasons for and the implications of exceedance of TAT levels including a review of pollution sources and working procedures.
- Summary description of actions taken in the event of non-compliance; and follow up procedures related to earlier non-compliance actions.
- Summary record of all complaints received for each media, liaison and consultation taken, actions and follow-up procedures taken.
- Comments, recommendations and conclusions for the quarter.
- Proponents contacts and any hotline telephone number for public enquiries.



## 6 ENVIRONMENTAL COMPLAINTS RESPONSE PROCEDURE

Complaints regarding environmental quality arising from the project area may be received via the EPD hotline, the Contractor or the Engineer. Any complaints received shall be passed to the ET. The following steps shall be taken by the ET upon receipt of complaints:

- log complaint and date of receipt onto the complaint database
- investigate the complaint to determine its validity, and to assess whether the source of the problem is due to recurring works activities
- if complaint is valid and due to works, inform the Contractor and Engineer who are required to identify and implement mitigation measures
- undertake additional monitoring and audit to verify the situation as necessary, and address the issue in the Monthly Monitoring and Audit report
- log the data and results of the investigation onto the database
- ET shall respond to the complainant within 24-48 hours of receipt of complaint
- the complainant shall be notified of result of complaint investigation





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