

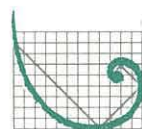
Civil Engineering Department

Agreement No CE 5/97 :
*Construction of Roads and Drains to
Serve the Housing Development in
Area 56, Tuen Mun: Environmental
Impact Assessment*

Environmental Monitoring & Audit
Manual

6 March 1998

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6 March 1998

Reference C1672

For and on behalf of ERM-Hong Kong, Ltd

Approved by: FREEMAN CHEUNG

Signed: 

Position: Deputy Managing Director

Date: 6 March 1998

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1 INTRODUCTION

1.1 BACKGROUND

ERM-Hong Kong Ltd, in association with Wilbur Smith, have been commissioned by the Government of Hong Kong, Civil Engineering Department (CED) to undertake the design and construction of roads and drains to serve the Housing Department in Area 56 at Tuen Mun, Agreement No CE 5/97 (hereafter referred to as the Project). An Environmental Impact Assessment (EIA) was required as part of the Study and was undertaken by ERM-Hong Kong Ltd. The purpose of the EIA is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the road, and to obtain Advisory Committee on the Environment (ACE) approval prior to detailed design stage of the same project. The project site is shown in *Figure 1.1a*.

In accordance with the Brief, this document presents a stand alone Environmental Monitoring and Audit (EM&A) Manual to accompany the EIA report, to prescribe necessary EM&A requirements based on the finding of the EIA. The EIA identifies that construction noise and dust would lead to exceedance of environmental criteria and therefore mitigation measures and EM&A are recommended to reduce the environmental impacts.

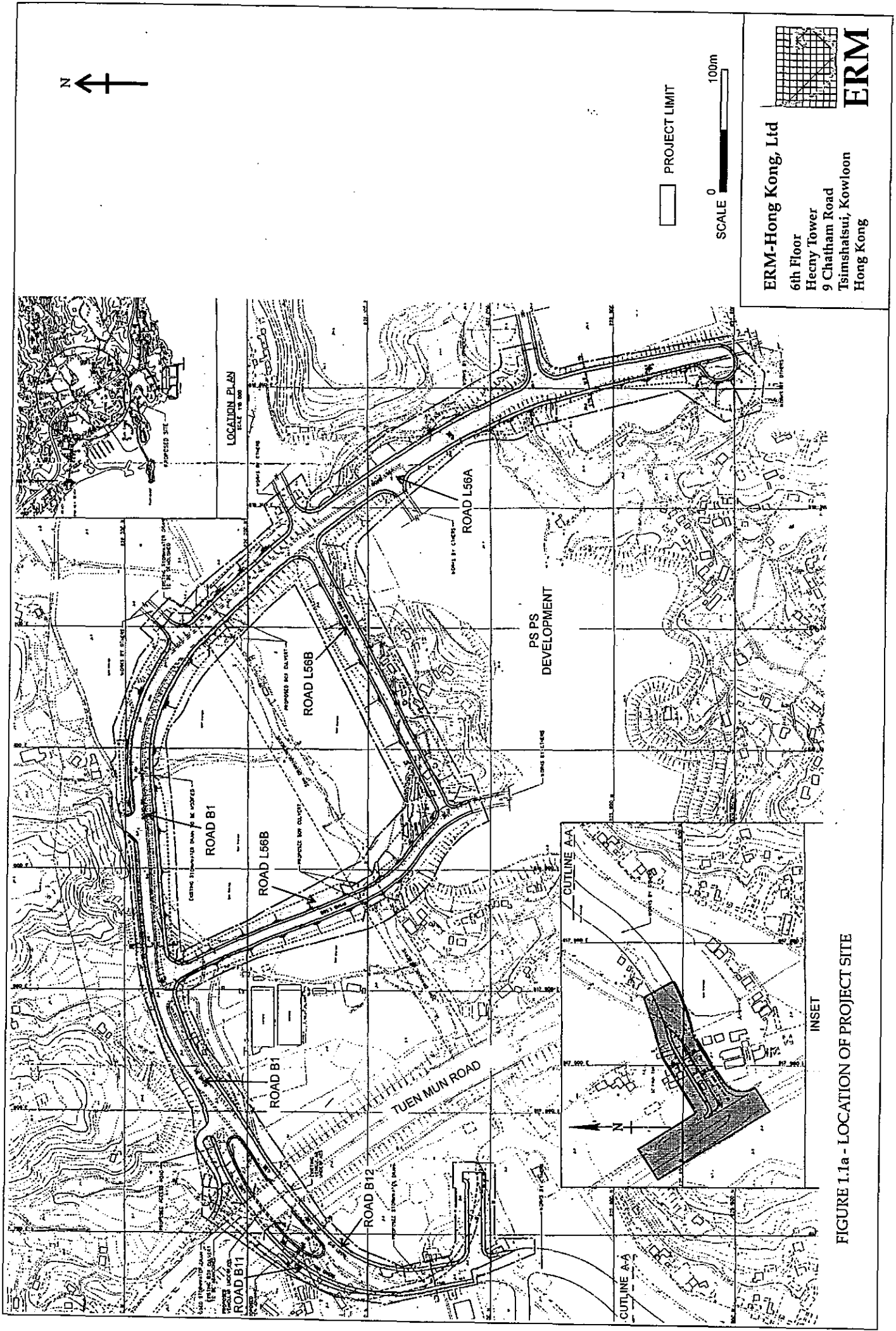
1.2 OBJECTIVES OF ENVIRONMENTAL MONITORING & AUDIT

This Environmental Monitoring and Audit (EM&A) Manual provides information, guidance and instruction to site staff who are in charge of environmental issues and are undertaking environmental monitoring works for the Project. The objectives of carrying out the EM&A Manual for the alignment include the following:

- to provide a database against which environmental impact of the Project can be determined;
- to provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- to monitor the performance of the Project and the effectiveness of mitigation measures;
- to verify the environmental impacts predicted in the EIA Study;
- to determine project compliance with regulatory requirements, standards and government policies;
- to take remedial action if unexpected problems or unacceptable impacts arise; and
- to provide data to enable an environmental audit.

This EM&A Manual is prepared for the construction of the Project. The scope of the EM&A Study are summarised below:

- to establish baseline dust and noise levels at specified locations and review these baseline levels every six months;
- the implementation and maintenance of dust and noise impact monitoring programmes;
- to liaise with and provide environmental advice (as requested or when otherwise necessary) to construction site staff in the comprehension and consequences of the EM&A Study, identification and resolution of environmental issues and other functions as they may arise from the works;
- the checking and quantification of the Contractor's overall environmental performance, implementation of Event Contingency Plans (ECP's) and recommending and implementing remedial actions to mitigate adverse environmental effects as identified by the EM&A programme, the EIA and others;
- to conduct monthly reviews of monitored impact data as the basis for assessing compliance with defined criteria and to ensure that necessary mitigation measures are identified, designed and implemented, and to undertake additional *ad hoc* monitoring and auditing as required by special circumstances;
- the evaluation and interpretation of all environmental monitoring data, to provide an early indication, should any of the environmental control measures or practices fail to achieve the acceptable standards and to verify the environmental impacts predicted in the EIA;
- management and liaison with other individuals or parties concerning any other environmental issues deemed to be relevant to the construction process;
- to conduct regular site audits of a formal or informal nature to assess:
 - the level of the Contractors general environmental awareness;
 - the Contractor's implementation of the recommendations in the EIA;
 - the Contractor's performance as measured by the EM&A;
 - the need for specific mitigation measures to be implemented or the continued usage of those previously agreed;
 - to advise the site staff of any identified potential environmental issues; and
- the submission of monthly EM&A reports which summarise project monitoring and auditing data, with full interpretation and graphical presentation illustrating the acceptability or otherwise of any environmental impacts and identification or assessment of the implementation status of agreed mitigation measures.



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FIGURE 1.1a - LOCATION OF PROJECT SITE

STRUCTURE OF THE EM&A MANUAL

Following this introductory Section, the Manual is set out as follows:

- *Section 2* of the Manual provides details of the organisation and structure of the Environmental Team, outlines the various parties involved in the EM&A process, the responsibilities and contact details of key individuals;
- the general elements of the EM&A process are set out in *Section 3*, including summary details of the EM&A monitoring programme;
- *Sections 4* and *5* detail the requirements for baseline and impact monitoring for air and noise and set out the relevant monitoring locations, compliance criterion, event contingency plans (ECPs) governing the monitoring process and the summary of mitigation measures recommended in the EIA Report;
- *Section 6* describes the scope and frequency of onsite audits works;
- *Section 7* details the requirements for reporting;

The EM&A Manual is an evolving document that will be updated as necessary during the construction phase of the Project.

2 ORGANISATION AND STRUCTURE OF THE ENVIRONMENTAL TEAM

2.1 PROJECT ORGANISATION

An Environmental Team (ET), employed by the Engineer under the Contract and independent from the Contractor, shall be set up for the construction of the Project. The project organisation and lines of communication with respect to environmental works is shown in *Figure 2.1a*.

2.2 ENVIRONMENTAL TEAM

The ET shall not be in any way an associated body of the Contractor. The duties of the ET are:

- to monitor the various environmental parameters as required in the Final EIA Report;
- to investigate and audit the Contractors' equipment and work methodologies with respect to pollution control and environmental mitigation, and anticipate environmental issues for proactive action before problem arise;
- to audit and prepare audit reports on the environmental monitoring data and the site environmental conditions;
- to report on the environmental monitoring and audit results to the Contractor, the Engineer and the EPD.

The roles and responsibilities of the ET and key members of the ET are presented below.

2.2.1 *Environmental Manager*

The Environmental Manager (EM) is responsible for and in charge of the ET. He is responsible for:

- the supervision of the EM&A Study Programme, its members and in the timely production and quality of the outputs;
- meeting the agreed objectives and deadlines as set out in this Manual; and
- ensuring the quality of the deliverables.

2.2.2 *Engineer's Representative*

The Engineer Representative (ER), shall appoint an appropriate member of the resident site staff, who shall:

- monitor the Contractor's compliance with contract specifications, including the effective implementation and operation of mitigation measures;
- instruct the Contractor to follow the agreed protocols or those in the Contract

Specifications in the event of exceedances or complaints; and

- comply with the agreed ECP in the event of any exceedances.

2.2.3

Environmental Technician

The Environmental Technician (ET) is responsible for:

- day to day noise and air monitoring activities; and
- environmental site inspection works.

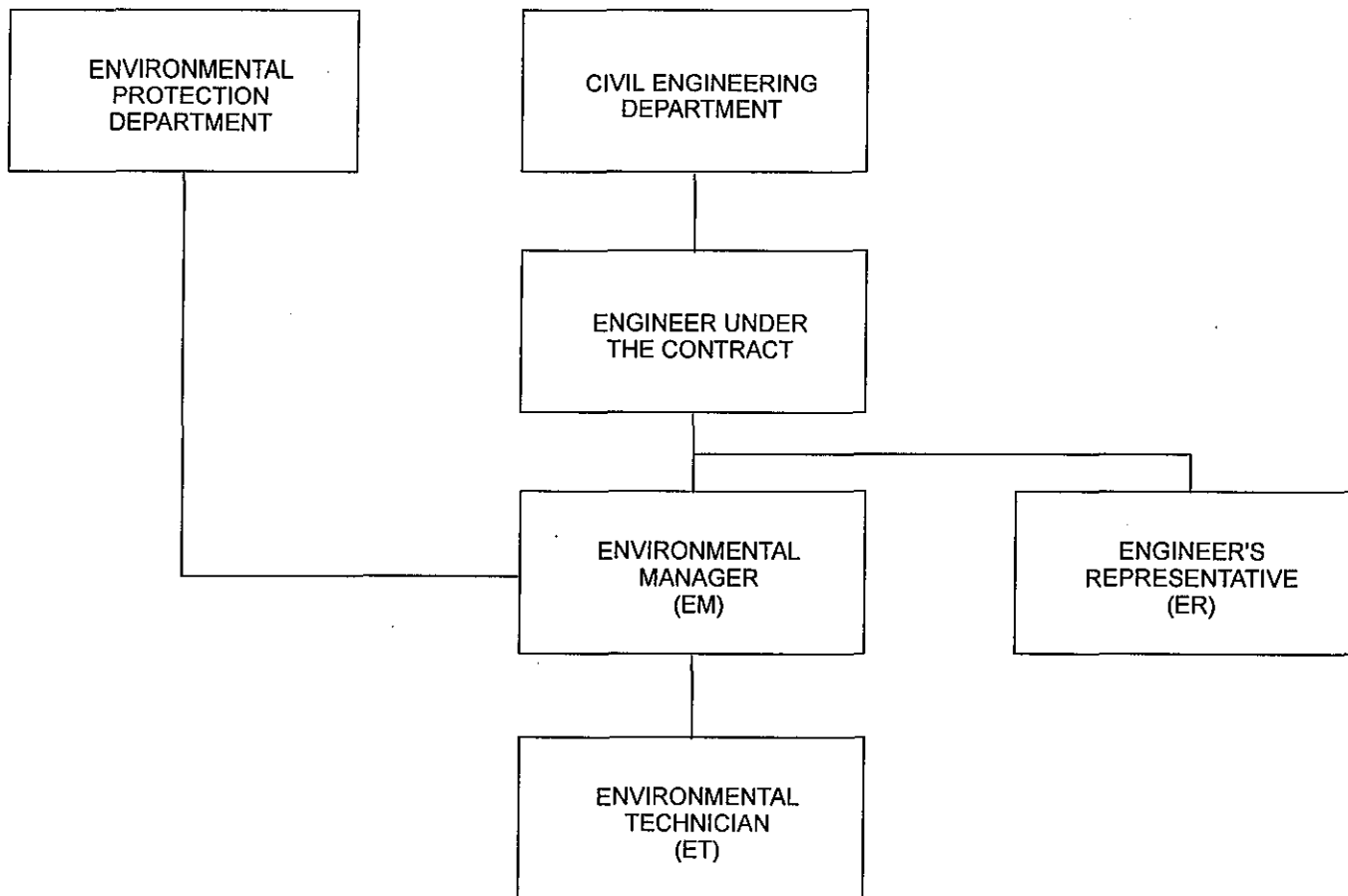



FIGURE 2.1a - STRUCTURE AND ORGANISATION OF ENVIRONMENTAL TEAM

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3 *EM&A REQUIREMENTS*

3.1 *INTRODUCTION*

In this Section, the requirements and scope of the EM&A are described and the means by which these interrelate are discussed.

Figure 3.1a illustrates theoretically, how an environmental problem identified by the EM&A monitoring process should be resolved and how the results of increased monitoring will feedback into the EM&A process and provide details on mitigation performance.

3.2 *SUMMARY OF THE FINDINGS OF THE EIA*

Findings of the EIA Report indicate that the sensitive receivers would be impacted by construction noise and dust. Environmental mitigation measures and EM&A requirements have been identified for the Project to protect the sensitive receivers.

The measures required to mitigate the environmental impacts for the Project are presented in *Section 4 & 5*. Construction phase EM&A requirements have been identified and can be separated into:

- monitoring of dust and noise impacts; and
- auditing of mitigation measures and other contractual requirements for air quality and noise.

3.3 *CONSTRUCTION PHASE*

The general requirements for the monitoring of air and noise and for conducting site audits are presented below.

3.3.1 *Environmental Monitoring*

Monitoring Programme

The monitoring of environmental impacts will be carried out by the ET; the monitoring work will comprise dust and noise impacts at sensitive receivers in the vicinity of the works.

The monitoring programme for the Project is summarised in *Table 3.3a*.

Table 3.3a *Summary of Monitoring Programme*

| | Dust | Noise |
|-------------------------|---|---|
| Parameters | TSP 1-hour and 24-hour | Restricted period: three consecutive L_{Aeq} 5 minutes; Unrestricted period: six consecutive readings L_{Aeq} 5 minutes. |
| Locations | See Figure 4.4a | See Figure 5.4a |
| Initial Baseline | 24-hour TSP daily for two weeks prior to construction and three 1-hour TSP daily for two weeks. 1-hour sample should be conducted at three times per day while the highest dust impact is expected. | Daily at 30 minute intervals for two weeks prior to construction. |
| Baseline Check | Every three months | Twice per year |
| Impact Monitoring | One 24-hour TSP and three 1-hour TSP every six days, undertaking when the highest dust impacts occur. | One set of measurement (three consecutive L_{Aeq} 5 min) in restricted hours and one set of measurement (six consecutive L_{Aeq} 5 min) in unrestricted periods every week when noise generating activities are underway. |
| Additional Requirements | <i>Ad hoc</i> monitoring as required. | <i>Ad hoc</i> monitoring as required. |

3.3.2 *Action and Limit Levels*

Action and Limit (A/L) Levels are defined levels of impact recorded by the environmental monitoring activities which represent levels at which a prescribed response is required. These levels are quantitatively defined later in the relevant sections of this manual and described in principle below:

- *Action Limits*: beyond which there is a clear indication of a deteriorating ambient environment for which appropriate remedial actions are likely to be necessary to prevent environmental quality from falling outside the *Limit Levels*, which would be unacceptable; and
- *Limit Levels*: Statutory and/or agreed contract limits stipulated in the relevant pollution control ordinances, HKPSG or Environmental Quality Objectives established by EPD. If these are exceeded, works should not proceed without appropriate remedial action, including a critical review of plant and working methods.

3.3.3 *Event Contingency Plans*

The purpose of the Event Contingency Plans (ECP's) is to provide, in association with the monitoring and audit activities, procedures for ensuring that if any significant environmental incident (either accidental or through inadequate implementation of mitigation measures on the part of the Contractor) does occur, that the cause is quickly identified and remedied, and that the risk of a similar event recurring is reduced. This also applies to the exceedance of statutory or agreed A/L criteria identified by the EM&A programme.

The format of the ECP's to be used during construction of the Project is set out in *Section 4.8 and Section 5.8.*

3.3.4 *Environmental Auditing*

In addition to the monitoring of dust and noise levels as a means of assessing the ongoing performance of the Contractor, the ET will undertake regular audits of the Contractor's onsite practices and procedures. The primary objective of the audit programme will be to assess the effectiveness of the management systems established by the Contractor to implement the environmental mitigation measures recommended in the EIA for air quality and noise.

Whilst the audit programme will undoubtedly complement the monitoring activity with regard to the effectiveness of dust suppression and noise attenuation measures, the criteria against which the audits will be undertaken will be derived from the clauses within the Contract Document which seek to enforce the recommendations of the EIA and the established management systems.

The findings of site audits will be made known to site staff at the time of the audit to enable the rapid resolution of identified non-compliances. Non-compliances, and the corrective actions undertaken, will also be reported in the monthly EM&A Report.

Section 6 presents the scope and frequency of onsite audits and defines the range of issues the audit protocols will be designed to address.

3.3.5 *Enquiries, Complaints and Requests for Information*

Enquiries, complaints and requests for information can be expected from a wide range of individuals and organisations including members of the public, Government departments, the press and television media and community groups. The vast majority of the correspondence is likely to be received directly by CED, although the other major receiver will be the site offices.

All enquiries concerning the environmental effects of the works, irrespective of how they are received, shall be reported to the ET who shall set up procedures for the handling, investigation and storage of such information. The following steps shall then be followed.

- 1) The ET will notify the ER of the nature of the enquiry.
- 2) An investigation will be initiated to determine the validity of the complaint and to identify the source of the problem.
- 3) The ER shall undertake the following steps, as necessary:
 - investigate and identify the source of the problem (the ER may request additional dust or noise monitoring);
 - liaise with the EM&A Consultants to identify remedial measures;
 - require the Contractor to take action to mitigate the situation;

- repeat monitoring to check compliance with A/L level criteria; and
 - if monitoring results show exceedances, repeat review procedures to identify further possible areas of improvement.
- 4) The outcome of the investigation and the action taken will be documented on the complaints proforma (*See Annex A*). Where possible, a formal response to each complaint received will be prepared, within a maximum of seven days, in order to notify the concerned person(s) that action has been taken.
 - 5) All enquiries which trigger this process will be reported in the monthly reports to the EPD which will include details of the mitigation measures taken and the additional monitoring results recorded for the period.

It should be noted that the receipt of complaints or enquiries will not, in itself, be sufficient reason to introduce additional mitigation measures. They will however initiate the ECP and this procedure may lead to the introduction of further measures if they are considered necessary.

In all cases the complainant will be notified of the findings of the ECP and audit procedures put in place to ensure that the problem does not recur.

4 AIR QUALITY MONITORING

4.1 INTRODUCTION

In this section, the requirements, methodology, equipment, monitoring locations, criteria and protocols for the monitoring and audit of air quality impacts during the construction of the Project are presented.

4.2 MONITORING AND AIR QUALITY CRITERIA

The impact of fugitive dust on ambient air pollution depends on the quantity, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and particles that are 30 - 100 μm in diameter are likely to undergo impeded settling. These particles, depending on the extent of atmospheric turbulence, would settle within a distance of 100 m from the source. The main dust impact will arise from particles of a diameter less than 30 μm , measured as Total Suspended Particulate (TSP), dispersed over greater distances from the sources. TSP levels will, therefore, be monitored to evaluate the dust impact during the construction phase of the Project. The data sheet for dust monitoring is shown in *Annex B*.

24-hour average TSP concentrations are measured by drawing air through a high volume sampler (HVS) fitted with a conditioned, pre-weighed filter paper, at a controlled rate. After sampling for 24-hours, the filter paper with retained particles is collected and returned to the laboratory for drying in a desiccator followed by accurate weighing. 24-hour average TSP levels are calculated from the ratio of the mass of particulate retained on the filter paper to the total volume of air sampled. The analysis process normally takes approximately two days.

1-hour average TSP concentrations can be measured either by the same monitoring method as 24-hour average TSP or with hand-held real-time aerosol monitor. 1-hour average TSP concentrations measured by a hand-held real-time aerosol monitor require no laboratory analysis and will give an instant reading of the dust levels. Air samples are drawn through the optically-sensitive area of the monitor for a continuous period of 1-hour and the monitor will calculate the time-averaging dust levels. The differences in the analytical methods for the HVS and aerosol monitor mean that results obtained from the two systems are not directly comparable.

Objectives and Criterion

The objectives of TSP monitoring are:

- to identify the extent of construction dust impacts on sensitive receivers;
- to determine the effectiveness of mitigation measures to control dust from construction activities;
- auditing the compliance of the Contractor with regard to dust control contract conditions and the relevant dust impact criteria;

- to recommend further mitigation measures if found to be necessary; and
- to verify the prediction of the dust impacts in the EIA during each phase of the construction works.

The criterion against which the dust (measured as TSP) monitoring shall be assessed are:

- the Hong Kong Air Quality Objectives (AQO) for TSP, 24-hour TSP levels of $260 \mu\text{g m}^{-3}$; and
- the Technical Memorandum of Environmental Impact Assessment Process (TMEIA) 1-hour TSP limit of $500 \mu\text{g m}^{-3}$.

These levels are not to be exceeded at the Air Sensitive Receivers (ASRs).

The TSP monitoring shall be carried out by the Consultants, employing suitably experienced personnel using the monitoring procedures laid down in the methodology of *USEPA 40 CFR Part 50 Appendix B*.

4.3

MONITORING EQUIPMENT

Dust shall be measured using the High Volume Method for 24-hour TSP levels, as described by the US EPA in 40CFR Part 50. For 1-hour TSP, a hand-held real time aerosol monitor, sampling in the range of $0.1-100 \text{ mg m}^{-3}$ and capable of achieving results comparable to a high volume air sampler shall be used.

Equipment shall be maintained in calibration at all times and recalibration will be carried out in accordance with requirements stated in the manufacturers operating manual and as described below.

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

The samplers shall be properly maintained and frequently calibrated. Prior to dust monitoring commencing, appropriate checks shall be made to ensure that all equipment and necessary power supply are in good working condition.

Table 4.3a presents the recommended types and quantities of TSP monitoring equipment.

Table 4.3a TSP Monitoring Equipment

| Description | Quantity |
|---|-----------|
| High volume sampler as described by the US EPA in 40CFR Part 50 | Two units |
| Hand-held real-time aerosol monitor | One unit |

4.4

MONITORING LOCATIONS

The Construction of the alignment in Area 56 at Tuen Mun EIA has identified two dust monitoring locations for the Project. Locations of the monitoring stations are presented in *Figure 4.4a*.

Prior to the commencement of the EM&A programme, the proposed dust monitoring stations will be discussed and agreed with the EPD.

4.5

BASELINE MONITORING

Baseline monitoring shall be carried out to determine the ambient 1-hour and 24-hour TSP levels at the monitoring locations prior to the commencement of the construction works.

Baseline monitoring shall be carried out for a continuous period of at least two week under typical weather conditions with the 24-hour and three 1-hour ambient measurements taken daily at each monitoring location. As noted above, 1-hour HVS and aerosol monitoring results are not directly comparable and the same method must be used for baseline and impact monitoring. General meteorological conditions (wind speed and direction and precipitation) and notes regarding any significant adjacent dust producing sources shall also be recorded throughout the baseline monitoring period.

The baseline monitoring will provide data for the determination of the appropriate action levels with the limit levels set against statutory or otherwise agreed limits.

Baseline checking of ambient dust levels shall be carried out every three months at each monitoring location. The checking shall be carried out when dusty alignment construction activities are not taking place and detailed notes shall be provided by the monitoring personnel as to any significant dust producing sources during the baseline checking.

4.6

IMPACT MONITORING

The monthly schedule of the compliance and impact monitoring programme will be drawn up by the EC, one month prior to the commencement of the scheduled construction period. TSP monitoring shall include the following:

- collection of 24-hour samples once every six days; and
- collection of three 1-hour measurements every six days, the measurements shall coincide with the construction activities with significant dust emissions.

Dust monitoring data shall be recorded on a standard record form developed for the Project.

4.7

COMPLIANCE CHECK

Environmental limits, termed Action and Limit (A/L) levels provide an appropriate framework for the interpretation of monitoring results. The air quality monitoring data shall be checked against the agreed A/L levels as listed in *Tables 4.7a & 4.7b*.

Table 4.7a *Derivation of Action and Limit Levels for 24-Hour Air Quality Monitoring*

| Level | Total Suspended Particulates (TSPs) |
|----------|--|
| Baseline | Derived from physical measurements prior to construction commencing |
| Action | For baseline $<108 \mu\text{g m}^{-3}$, average of 130% of baseline and the Limit level For $108 < \text{baseline} > 154 \mu\text{g m}^{-3}$, $200 \mu\text{g m}^{-3}$ For baseline $>154 \mu\text{g m}^{-3}$, 130% of baseline level |
| Limit | AQO for TSP : $260 \mu\text{g m}^{-3}$ averaged over 24-hours |

Table 4.7b *Derivation of Action and Limit Levels for 1-hour Air Quality Monitoring*

| Level | Total Suspended Particulates (TSPs) |
|----------|--|
| Baseline | Derived from physical measurements prior to construction commencing |
| Action | For baseline $<154 \mu\text{g m}^{-3}$, average of 130% of baseline and the Limit level For $154 < \text{baseline} > 269 \mu\text{g m}^{-3}$, $350 \mu\text{g m}^{-3}$ For baseline $>269 \mu\text{g m}^{-3}$, 130% of baseline level |
| Limit | AQO for TSP : $500 \mu\text{g m}^{-3}$ over 1-hour |

4.8

EVENT CONTINGENCY PLAN

The principle upon which the ECP is based is the prescription of procedures and actions associated with the measurement of certain defined levels of air pollution (the Action and Limit levels), recorded by the environmental monitoring process for the Project. The ECP for exceedance of various levels and the responsibilities of relevant parties in the event of an exceedance of the dust A/L levels is given in *Table 4.8a*.

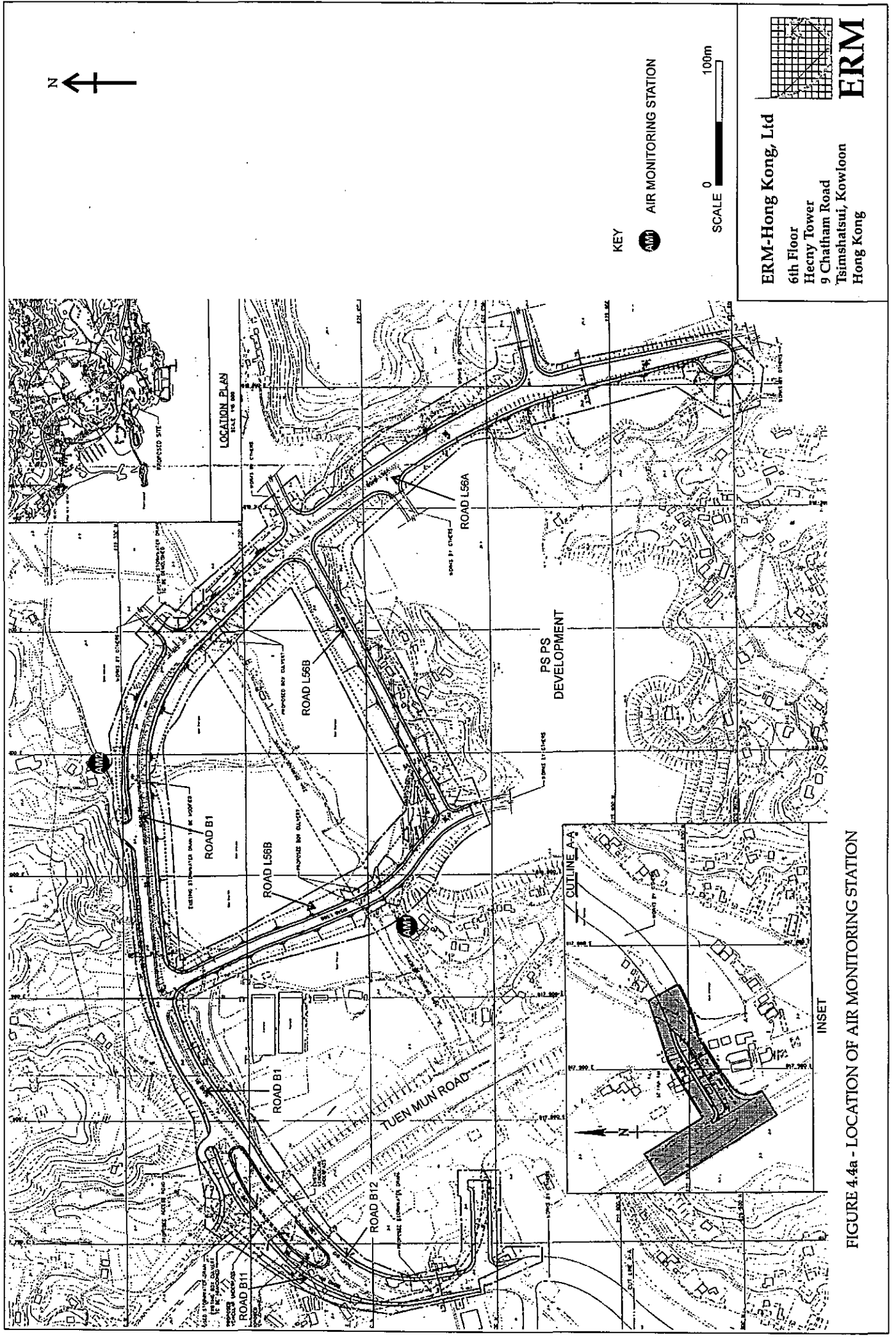


FIGURE 4.4a - LOCATION OF AIR MONITORING STATION

Table 4.8a *Dust Monitoring Event Contingency Plan.*

| Event | Environmental Manager | Engineer Representative | Contractor |
|--|---|--|--|
| Action Level Exceedance | Inform the ER and identify main dust source. | Inform Contractor immediately. | Submit proposals within three working days to the ER for remedial actions to reduce dust exposure. |
| | Repeat dust measurement to confirm findings. | Review Contractor's working methods and check the monitoring data. | Amend proposals if required by the ER. |
| | If exceedance continues, discuss with the ER and further appropriate mitigation measures. | Discuss with the EM and the Contractor remedial actions required. | Implement immediately the agreed proposals. |
| | Increase dust monitoring frequency to demonstrate efficacy of remedial measures. If exceedance stops, additional dust monitoring can be ceased. | Assess the effectiveness of remedial actions and keep the Contractor informed. | |
| Limit Level Exceedance | Inform the ER and EPD. | Inform Contractor immediately. | Take immediate action to avoid further exceedance. |
| | Investigate the cause of the exceedance and identify main dust source. | Review the Contractor's working methods and check monitoring data. | Submit a further proposal for remedial actions to the ER within 3 working days. |
| | Repeat dust measurement to confirm findings. | Discuss with the EM and the Contractor remedial actions required. | Implement the agreed proposals immediately. |
| | Liaise with the EM to develop appropriate remedial measures. | Assess the effectiveness of remedial actions and keep Contractor informed. | Resubmit proposals if problem still not resolved. |
| | Increase dust monitoring frequency to demonstrate efficacy of remedial measures. | | Stop the relevant portion of works as determined by the ER until the exceedance is abated. |
| | Assess efficacy of remedial actions and keep EM informed of the results. | | |
| If exceedance stops, additional dust monitoring can be ceased. | | | |

DUST MITIGATION MEASURES

Dust mitigation measures for the construction activities at the alignment in Area 56 at Tuen Mun, including material handling, are listed below.

- the heights from which materials are dropped should be controlled to a minimum practical height to control fugitive dust arising from unloading;
- materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport;
- effective water sprays should be used on the site at potential dust emission sources such as unpaved area and active construction area;
- wheel washing facilities should be provided at the exit of the site.

5 NOISE MONITORING

5.1 INTRODUCTION

In this section, the requirements, methodology, equipment, monitoring locations and mitigation measures for the monitoring and audit of noise impacts from the Project are presented.

5.2 METHODOLOGY AND NOISE CRITERIA

Noise level measurements shall be carried out by suitably qualified members of the ET using the methodology set out in *Section 3* of the *Technical Memorandum on Noise from Construction Work other than Percussive Piling*.

The appropriate parameter for measuring construction noise impacts shall be the equivalent A-weighted sound pressure level (L_{Aeq}) measured in decibels (dB). The data record sheet for noise monitoring is shown in *Annex C*.

The criterion against which the recorded noise levels shall be assessed refers to the noise level 1 m from the nearest part of the building façade and at a height approximately 1.2 m above the ground or at the height that has the least obstructed view of the construction activity in relation to the receiver.

Whilst the *Noise Control Ordinance* (NCO) does not provide for the statutory control of construction activities occurring on weekdays during normal working hours (i.e. Monday to Saturday inclusive 0700-1900), a voluntary daytime limit of $L_{Aeq, 30 \text{ min}}$ 75 dB, recommended in the *Practice Note for Professional Persons - Noise from Construction Activities - Non-statutory Controls, EPD, May 1993* (ProPECC PN 2/93) was proposed in the EIA and agreed with EPD as the appropriate criterion for all residential dwellings.

The *Technical Memorandum on Noise from Construction Work Other than Percussive Piling* and *Technical Memorandum on Noise from Construction Work in Designated Areas* specifies the Acceptable Noise Levels (ANLs) for restricted hours working. On all days during the evening (1900-2300) and general holidays including Sundays (0700-2300), the statutory noise limit shall be 50/45 dB(A); during the night-time period (2300-0700) on any day, the maximum noise level shall be 35/30 dB(A), depending on the Area Sensitivity Rating of the Site..

5.3 MONITORING EQUIPMENT

The EM&A Consultant shall provide sufficient numbers of noise metres to conduct the necessary baseline sampling at the agreed monitoring locations. Sound level metres and calibrators shall comply with the *International Electrotechnical Commission (IEC) Publication 651:1979 (Type 1) and 804:1985 (Type 1)* specification as referred to in the TM. The sound level metres shall be supplied and used with the manufacturers recommended wind shield and with a tripod.

The calibration of the sound level metres and their respective calibrators shall be carried out in accordance with the manufacturer's requirements. The sound level metres, including the calibrators, shall be verified by the manufacturers once every two years to ensure they perform to the same level of accuracy as stated in the manufacturers specifications. Calibrated hand-held anemometers shall also be supplied for the measurement of wind speeds during noise monitoring periods.

Noise measurements should not be made in the presence of fog, rain, wind with a steady speed exceeding 5 ms^{-1} or wind with gusts exceeding 10 ms^{-1} . The wind speed shall be checked with a portable wind speed metre capable of measuring the wind speed in m s^{-1} .

The equipment shall be kept in a good state of repair in accordance with the manufacturer's recommendations and maintained in proper working order with sufficient spare equipment available in the event of breakdown to maintain the planned monitoring programme.

Table 5.3a presents recommended noise monitoring equipment.

Table 5.3a *Noise Monitoring Equipment*

| Description | Quantity |
|-------------|----------|
| Noise metre | One unit |
| Calibrator | One unit |

5.4 *MONITORING LOCATIONS*

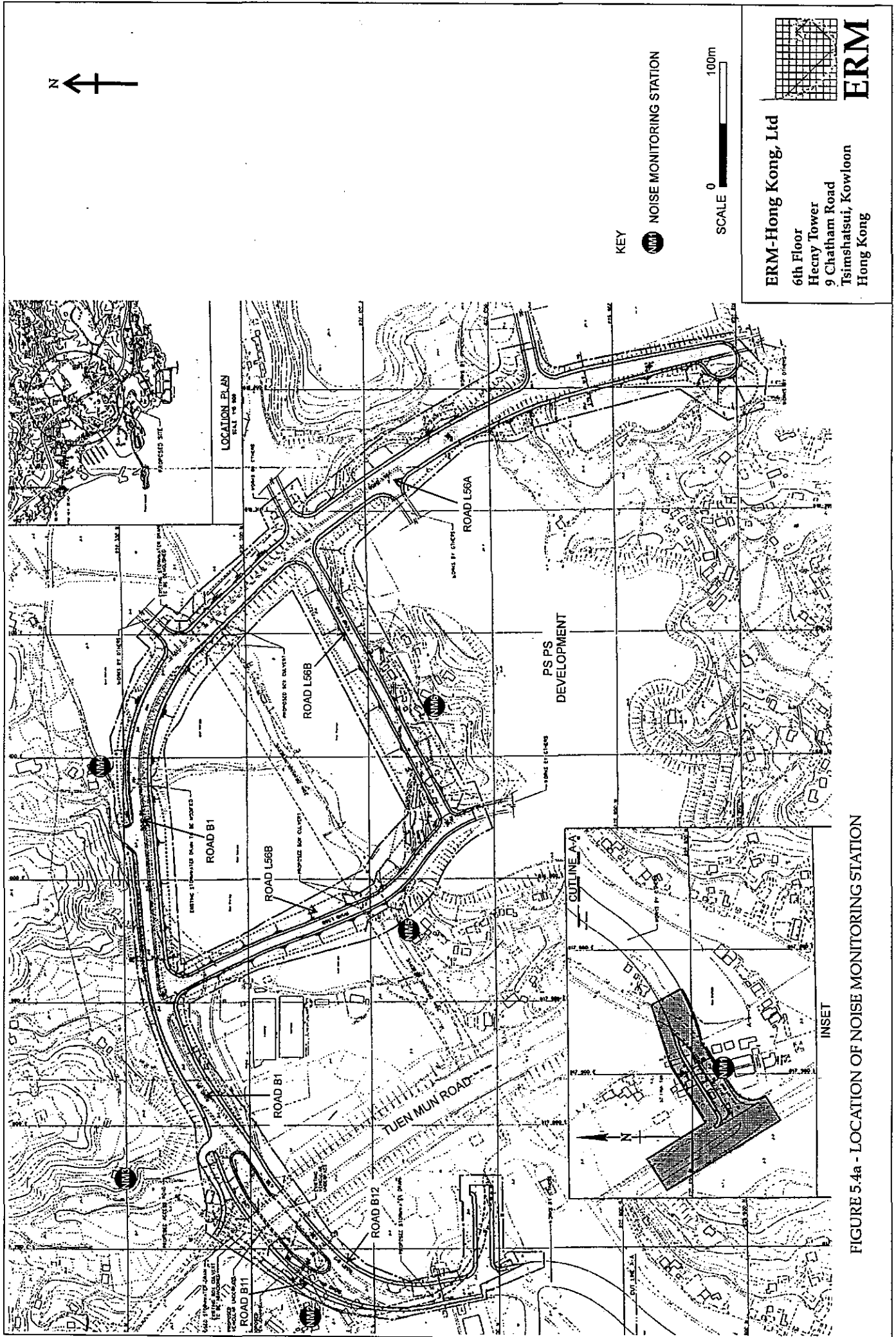
Noise monitoring stations have been identified for the Project and their are shown in *Figure 5.4a*. Prior to the commencement of the EM&A Programme, the proposed noise monitoring locations will be discussed and agreed with the EPD.

5.5 *BASELINE MONITORING*

To obtain fully satisfactory baseline results, a waterproof sound level metre and noise logger shall be used. Baseline noise levels shall be measured over two weeks at interval of 30 minutes. The quantities L_{Aeq} , L_{10} and L_{90} shall be recorded at the specified interval. The survey period shall be selected prior to the commencement of construction activities and so as to avoid other atypical noise sources. The proper functioning of the logger shall be ensured during this period and shall be visited for a period not less that one hour every two days to ensure its continued operation and to detail specific noise sources audible at the monitoring location. Measurements shall be recorded to the nearest 0.1 dB.

5.6 *IMPACT MONITORING*

During normal construction working hours (0700-1900 Monday to Saturday), monitoring of $L_{Aeq, 30min}$ noise levels (as six consecutive $L_{Aeq, 5 min}$ readings) shall be carried out at the agreed monitoring locations once every six days in accordance with the methodology in the TM. If restricted hours works are undertaken,



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FIGURE 5.4a - LOCATION OF NOISE MONITORING STATION

monitoring of $L_{Aeq, 15min}$ noise levels (as three consecutive $L_{Aeq, 5min}$ readings) shall be carried out at the agreed monitoring stations at the same frequency as specified for normal working hours.

In relation to the monitored noise levels, other noise sources such as road traffic may make a significant contribution to the overall noise environment. Therefore, the results of noise monitoring activities will take into account such influencing factors which were not present during the baseline monitoring period. All measurements shall be recorded to the nearest 0.1 dB.

5.7

COMPLIANCE ASSESSMENT

The A/L Levels provide an appropriate framework for the interpretation of monitoring results. The noise impact monitoring data shall be checked against the agreed A/L Levels of the technical memoranda as listed in *Table 5.7a*.

Table 5.7a Action and Limit Levels for Construction Noise dB(A)

| Time Period | Action | Limit, dB(A) | |
|--|---|--------------|--------|
| | | PME | SPME |
| 0700-1900 on normal weekdays; | When one documented complaint is received | 75 | 75 |
| 0700-2300 hrs on holidays; and 1900-2300 hrs on all other days | When one documented complaint is received | 60/65 | 45/50 |
| 2300-0700 of next day | When one documented complaint is received | 45/50 | 30/ 35 |

To account for cases where ambient noise levels as identified by baseline monitoring approaches or exceeds the stipulated Limit Level prior to commencement of construction, an Exceedance Level may be defined and agreed with EPD, which incorporates the baseline noise level and the 75 dB(A), construction Limit level specified in the ProPECC. The exceedance level will be therefore greater than 75 dB(A) and represents the maximum acceptable noise level at each monitoring station. Correction factors for the effects of acoustic screening and/or architectural features of NSRs may also be applied for from the EPD as specified in the TM.

For the purposes of compliance checking, after taking into account any adjustments agreed with EPD, comparison with either the Limit or Exceedance Level shall represent the governing criteria for noise impact assessment of the Project.

5.8

EVENT CONTINGENCY PLAN

The principle on which the ECP is based is the prescription of procedures and actions associated with the measurement of defined levels of noise impact recorded by the environmental monitoring process and defined in the tables above. In cases where exceedance of these criteria occurs, the EM, ER and the Contractor shall strictly observe the relevant actions of the ECP shown in *Table 5.8a*.

Good site practice

Good site practice and noise management can considerably reduce the impact of construction site activities on the identified NSRs. The following measures should be followed during each phase of construction:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;
- machines and plant (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, should, where possible, be orientated so that the noise is directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be utilized and should be properly maintained during the construction programme;
- mobile plant should be sited as far away from NSRs as possible; and material stockpiles and other structures should be effectively utilized, where practicable, to screen NSRs from noisy on-site construction activities.

Selecting "quiet" plant and working methods

The Project Contractor may be able to obtain particular models of plant that are quieter than the noise levels given in the TM. "Quiet" plant is defined as PME whose actual SWL is less than the value specified in TM for the same piece of equipment. Examples of SWLs for specific silenced PME, which are known to be available, are given below:

| | |
|-----------------|--------------------|
| Bulldozer: | 100 dB(A) max; |
| Breaker (Hand): | 110 dB(A) max; |
| Compressor: | 100 dB(A) max; |
| Concrete Pumps: | 105 dB(A) max; |
| Dump Truck: | 110 dB(A) max; |
| Excavator: | 105 dB(A) max; |
| Generator: | 100 dB(A) max; |
| Lorry: | 105 dB(A) max; |
| Loader: | 105 dB(A) max; and |
| Poker Vibrator: | 110 max. |

It should be noted that various types of silenced equipment can be found in Hong Kong. However, EPD, when processing a CNP application, will apply the noise levels contained in the relevant statutory TM unless the noise emission of a particular piece of equipment can be validated by a certificate or demonstration.

Temporary Noise Barriers

Temporary noise barriers that can be located close to noisy plant can be very effective at screening NSRs from particular plant.

The effectiveness of noise barriers of between 3 and 5 metres high, located within

a few metres of static plant and approximately 5 m from mobile plant was analysed. Based on the NSR heights and site geometry, it is estimated that, if properly used, movable noise barriers of this type can provide noise reduction up to $L_{Aeq, (30min)}$ 10 dB for static plant and $L_{Aeq, (30min)}$ 5 dB for mobile plant. The noise screening benefit for each plant considered in this study is listed as follows:

- stationary plant such as piling plant, compressor, drilling plant, concrete pump, bentonite filtering plant and generator: $L_{Aeq, (30min)}$ 10 dB attenuation.
- mobile plant such as bulldozer, loader, mobile crane, paver and excavator: $L_{Aeq, (30min)}$ 5 dB attenuation.

Reducing the Numbers of Plant Operating in Critical Areas Close to NSRs

In general the numbers of plant should be left to the choice of the Contractor. However, in some cases it may be appropriate to restrict the number of particularly noisy plant operating within certain parts of the site that are very close to NSRs.

If construction work is required in restricted hours in daytime or evenings (including Sundays), further mitigation will be required to reduce noise levels. Such work will require the issuance of a Construction Noise Permit by EPD, and the Contractor would be required to demonstrate that compliance with the $L_{Aeq, (5min)}$ 45 & 60 dB (ASR: A) or 50 & 65 (ASR: B) dB, as appropriate to the NSR, would be achieved. It is likely that this would require further reductions in the numbers of plant operating, limitations to only the quieter construction activities, or the selection of particularly quiet equipment.

Table 5.8a Noise Monitoring Event Contingency Plan.

| Event | Environmental Manager | Engineer Representative | Contractor |
|---|--|--|---|
| Action Level Exceedance | Discuss with the ER and seek to identify potential noise source. | Inform Contractor immediately. | Submit proposals within three working days to the ER for remedial actions to reduce noise exposure. |
| | Undertake noise measurement to confirm the validity of the complaint. | Review Contractor's working methods. | |
| | If an exceedance is recorded, discuss with the ER further appropriate mitigation measures. | Discuss with the EM and the Contractor remedial actions required. | Amend proposals if required by the ER. |
| | Increase noise monitoring frequency to demonstrate efficacy of remedial measures. | Assess the effectiveness of remedial actions and keep the Contractor informed. | Implement immediately the agreed proposals. |
| | If exceedance stops, additional noise monitoring can be ceased. | Inform Complainant of the Actions taken. | |
| Limit Level Exceedance | Inform the ER. | Inform Contractor immediately. | Take immediate action to avoid further exceedance. |
| | Investigate the cause of the exceedance and identify main noise source. | Review the Contractor's working methods. | Submit a further proposal for remedial actions to the ER immediately. |
| | Repeat noise measurement to confirm findings. | Discuss with the EM and the Contractor remedial actions required. | Implement immediately the agreed proposals. |
| | Liaise with the ER to develop appropriate remedial measures. | Assess the effectiveness of remedial actions and keep Contractor informed. | Resubmit proposals if problem still not resolved. |
| | Increase noise monitoring frequency to demonstrate efficacy of remedial measures. | | |
| | Assess efficacy of remedial actions and keep ER informed of the results. | | |
| If exceedance stops, additional noise monitoring can be ceased. | | | |

6.1

SITE INSPECTIONS

Site Inspections provide a direct means to trigger and enforce the specified environmental protection and pollution control measures. They shall be undertaken routinely to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control mitigation measures are properly implemented. With well defined pollution control and mitigation specifications and a well established site inspection, deficiency and action reporting system, the site inspection is one of the most effective tools to enforce the environmental protection requirements on the construction site.

The EM is responsible for formulation of the environmental site inspection, deficiency and action reporting system, and for carrying out the site inspection works. He shall submit a proposal on the site inspection, deficiency and action reporting procedures within 21 days of the construction contract commencement to the Contractor for agreement and to the ER for approval.

Regular site inspections shall be carried out at least once per week. The areas of inspection shall not be limited to the environmental situation, pollution control and mitigation measures within the site; it should also review the environmental situation outside the site area which is likely to be affected, directly or indirectly, by the site activities. The EM shall make reference to the following information in conducting the inspection:

- the EIA recommendations on environmental protection and pollution control mitigation measures;
- works progress and programme;
- individual works methodology proposals (which shall include proposal on associated pollution control measures);
- the contract specifications on environmental protection;
- the relevant environmental protection and pollution control laws; and
- previous site inspection results.

The Contractor shall update the EM with all relevant information of the construction contract for him to carry out the site inspections. The inspection results and its associated recommendations on improvements to the environmental protection and pollution control works shall be submitted to the ER and the Contractor within 24 hours, for reference and for taking immediate action. The Contractor shall follow the procedures and time-frame as stipulated in the environmental site inspection, deficiency and action reporting system formulated by the EM to report on any remedial measures subsequent to the site inspections.

Ad hoc site inspections shall also be carried out if significant environmental problems are identified. Inspections may also be required subsequent to receipt of an environmental complaint, or as part of the investigation work, as specified

in Action Plan for environmental monitoring and audit.

6.2

COMPLIANCE WITH LEGAL AND CONTRACTUAL REQUIREMENTS

There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control laws in Hong Kong which the construction activities shall comply with.

In order that the works are in compliance with the contractual requirements, all the works method statements submitted by the Contractor to the ER for approval shall be sent to EM for vetting to see whether sufficient environmental protection and pollution control measures have been included.

The EM shall also review the progress and programme of the works to check that relevant environmental laws have not been violated, and that the any foreseeable potential for violating the laws can be prevented.

The Contractor shall regularly copy relevant documents to the EM so that the checking work can be carried out. The document shall at least include the updated Work Progress Reports, the updated Works Programme, the application letters for different licence/permits under the environmental protection laws, and all the valid licence/permit. The site diary shall also be available for the EM's inspection upon his request.

After reviewing the document, the EM shall advise the ER and the Contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the EM's review concludes that the current status on licence/permit application and any environmental protection and pollution control preparation works may not cope with the works programme or may result in potential violation of environmental protection and pollution control requirements by the works in due course, he shall also advise the Contractor and the ER accordingly.

Upon receipt of the advice, the Contractor shall undertake immediate action to remedial the situation. The ER shall follow up to ensure that appropriate action has been taken by the Contractor in order that the environmental protection and pollution control requirements are fulfilled.

6.3

ENVIRONMENTAL COMPLAINTS

Complaints shall be referred to the EM for carrying out complaint investigation procedures. The EM shall undertake the following procedures upon receipt of the complaints:

- log complaint and date of receipt onto the complaint database;
- investigate the complain to determine its validity, and to assess whether the source of the problem is due to works activities;
- if a complaint is valid and due to works, identify mitigation measures;
- if mitigation measures are required, advise the Contractor accordingly;

- review the Contractor's response on the identified mitigation measures, and the updated situation;
- if the complaint is transferred from EPD, submit interim report to EPD on status of the complaint investigation and follow-up action within the time frame assigned by EPD;
- undertake additional monitoring and audit to verify the situation if necessary, and review that any valid reason for complaint does not recur;
- report the investigation results and the subsequent actions to the source of complaint for responding to complainant (If the source of complaint is EPD, the results should be reported within the time frame assigned by EPD); and
- record the complaint, investigation, the subsequent actions and the results in the monthly EM&A reports.

During the complaint investigation work, the Contractor and ER shall cooperate with the EM in providing all the necessary information and assistance for completion of the investigation. If mitigation measures are identified in the investigation, the Contractor shall promptly carry out the mitigation. The EM shall ensure that the measures have been carried out by the Contractor.

7 REPORTING

7.1 INTRODUCTION

In this section, the reporting requirements based upon a paper documented approach are described.

7.2 BASELINE MONITORING REPORT

The EM shall prepare and submit a Baseline Monitoring Report (BMR) within 10 working days of completion of the baseline monitoring. Copies of the BMR shall be submitted to the Contractor, the ER and the EPD.

The BMR shall include the following:

- brief project background information;
- drawings showing locations of the baseline monitoring stations;
- monitoring results together with monitoring methodology, equipment used and calibration details, parameters monitored, monitoring locations, date, time, frequency and duration;
- revisions for inclusion in the EM&A Manual; and
- comments and conclusions.

7.3 MONTHLY EM&A REPORTS

The results and findings of all EM&A work required in this Manual shall be recorded in the monthly EM&A reports prepared by the EM. The EM&A Report shall be prepared and submitted within 10 working days of the end of each reporting month, with the first report due in the month after construction commences. Each monthly EM&A report shall be submitted to the Contractor, the ER and the EPD.

The EM shall review the number and location of monitoring stations and parameters to monitor every 6 months or on as needed basis in order to cater for the changes in surrounding environment and nature of works in progress.

The monthly EM&A Report shall include the following:

- basic project information including a synopsis of the project organization, programme and management structure, and the work undertaken during the month;
- a brief summary of EM&A requirements including all monitoring parameters, environmental quality performance limits (Action and Limit levels), Event-Action Plans, environmental mitigation measures, as recommended in the EIA Study and environmental requirements in the Contract;

- advice on mitigation measures, as recommended in the project EIA study report, summarized in the updated implementation schedule;
- drawings showing the project area, environmental sensitive receivers and locations of the monitoring and control stations;
- monitoring results together with monitoring methodology, equipment used and calibration details, parameters monitored, monitoring locations, monitoring date, time, frequency, and duration;
- a summary of noncompliance (exceedances) of the environmental quality performance limits (Action and Limit levels);
- a summary record of all complaints received (written or verbal);
- comments (e.g. effectiveness and efficiency of the mitigation measures), recommendations (e.g. any improvement in the EM&A programme); and
- an account of the future key issues as reviewed from the works programme and work method statements.

7.4 DATA KEEPING

The site document such as the monitoring field records, laboratory analysis records, site inspection forms, etc. should be well kept by the EM and be ready for inspection upon request. All relevant information shall be clearly and systematically recorded in the document. All the document and data shall be kept for at least one year after completion of the construction contract.

7.5 INTERIM NOTIFICATIONS OF ENVIRONMENTAL QUALITY LIMIT EXCEEDANCES

With reference to Event/Action Plans in *Tables 2.2, 3.2 and 4.2*, when the environmental quality limits are exceeded, the EM shall immediately notify the ER & EPD, as appropriate. The notification shall be followed up with advice to EPD on the results of the investigation, proposed action and success of the action taken, with any necessary follow-up proposals. A template for the interim notifications is shown in *Annex D*.

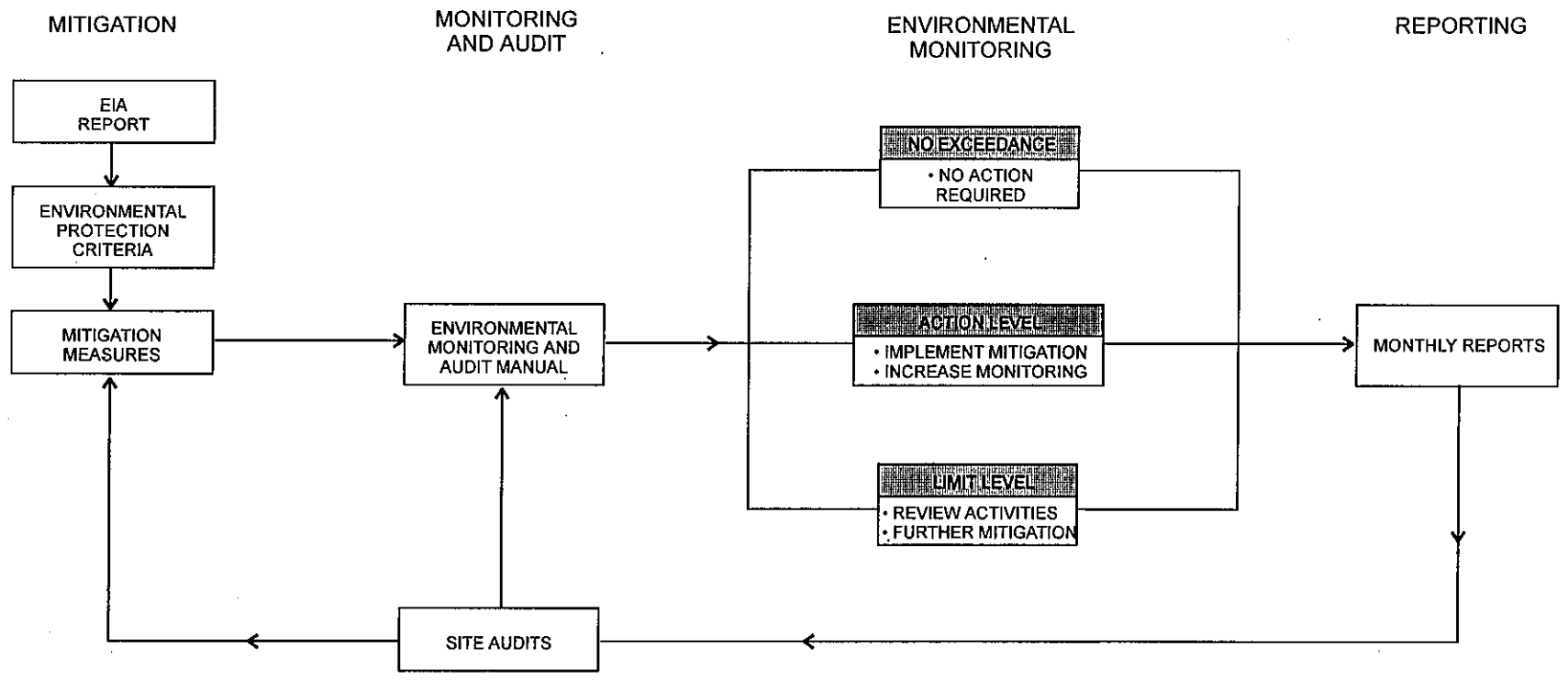


FIGURE 3.1a - IMPLEMENTATION OF MITIGATION AND ENVIRONMENTAL MONITORING AND AUDIT

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Annex A

Complaints Proforma

Table A1

Complaints Proforma

| | | | |
|---|--|---|-----------------|
| Construction of Roads and Drains to Serve the Housing Department in Area 56, Tuen Mun Report Form for Complaints | | Sheet ____ of ____ Unit Reference: _____ | |
| RECIPIENT | | | |
| Name: _____ | | Location: _____ | Tel: _____ |
| COMPLAINANT | | | |
| Name: _____ | | Tel: _____ | |
| Address: _____ | | Fax: _____ | |
| COMPLAINT | | | |
| Type: Noise/Dust | | | |
| Date: _____ | | Time: _____ | Location: _____ |
| Description: _____ | | | |
| Copy fax to: _____ | | Original to: _____ | |
| Date: _____ | | Date: _____ | |
| REVIEW RESULTS | | | |
| Signed: _____ Date: _____ | | | |
| RECOMMENDATIONS | | | |
| Signed: _____ Date: _____ | | | |
| ATTACHMENTS: | | | |
| Copy to: _____ | | Date/Time: _____ | |
| PR Manager: _____ | | Date: _____ | Time: _____ |
| Engineer Representative: _____ | | Date: _____ | Time: _____ |
| Environmental Manager: _____ | | Date: _____ | Time: _____ |

Annex B

Data Sheet for Dust Monitoring

Table B1 Data Sheet for Dust Monitoring

**Construction of the Roads and Drains to Serve the
Housing Development in Area 56, Tuen Mun**

Data Sheet for Dust Monitoring

| | | |
|------------------------------------|------------------------|--|
| Monitoring Location | | |
| Details of Location | | |
| Sampler Identification | | |
| Sampler Identification | | |
| Date & Time of Sampling | | |
| Elapsed-time Meter Reading | Start (min) | |
| | Stop (min) | |
| Total Sampling Time (min) | | |
| Weather Conditions | | |
| Site Conditions | | |
| Initial Flow Rate, Q_{si} | P_i (mmHg) | |
| | T_i (°C) | |
| | H_i (in.) | |
| | Q_{si} (Std. m^3) | |
| Final Flow Rate, Q_{sf} | P_f (mmHg) | |
| | T_f (°C) | |
| | H_f (in.) | |
| | Q_{sf} (Std. m^3) | |
| Average Flow Rate (Std. m^3) | | |
| Total Volume (Std. m^3) | | |
| Filter Identification No. | | |
| Initial Wt. of Filter (g) | | |
| Final Wt. of Filter (g) | | |
| Measured TSP Level ($\mu g/m^3$) | | |

| | <u>Name & Designation</u> | <u>Signature</u> | <u>Date</u> |
|------------------|-------------------------------|------------------|-------------|
| Field Operator | : _____ | _____ | _____ |
| Laboratory Staff | : _____ | _____ | _____ |
| Checked by | : _____ | _____ | _____ |

Annex C

Noise Monitoring Field Record Sheet

Table C1 Noise monitoring Field Record Sheet

**Construction of the Roads and Drains to Serve the
Housing Development in Area 56, Tuen Mun**

Noise Monitoring Field Record Sheet

| | | |
|--|-------------------------|--|
| Monitoring Location | | |
| Description of Location | | |
| Date of Monitoring | | |
| Measurement Start Time (hh:mm) | | |
| Measurement Time Length (min.) | | |
| Noise Meter Model/Identification | | |
| Calibrator Model/Identification | | |
| Measurement Results | L ₉₀ (dB(A)) | |
| | L ₁₀ (dB(A)) | |
| | L _{eq} (dB(A)) | |
| Major Construction Noise Source(s) During Monitoring | | |
| Other Noise Source(s) During Monitoring | | |
| Remarks | | |

| | <u>Name & Designation</u> | <u>Signature</u> | <u>Date</u> |
|-------------|-------------------------------|------------------|-------------|
| Recorded By | : _____ | _____ | _____ |
| Checked By | : _____ | _____ | _____ |

Annex D

Template for Interim
Notifications of
Environmental Quality
Limits Exceedances

Table D1. *Sample Template for Interim Notifications*

***Construction of the Roads and Drains to Serve the
Housing Development in Area 56, Tuen Mun***

Incident Report on Action Level or Limit Level Non-compliance

| | |
|--|--|
| Date | |
| Time | |
| Monitoring Location | |
| Parameter | |
| Action & Limit Levels | |
| Measured Level | |
| Possible reason for Action or Limit Level Non-compliance | |
| Actions taken / to be taken | |
| Remarks | |

Prepared by : _____

Designation : _____

Signature : _____

Date : _____