

**Highways Department
New Territories Region**

**Agreement No. CE 38/97
PWP Item B645TH
Sai Sha Road Widening between Kam
Ying Road and Proposed Road T7 Junction
Investigation Assignment**

**Environmental Impact Assessment Report
EM &A Manual**

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Maunsell Consultants Asia Ltd.
in association with
ERM (Hong Kong) Ltd.
Hassell Ltd.

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1 INTRODUCTION

1.1 Purpose of the Manual

1.1.1 The purpose of this Environmental Monitoring and Audit (EM&A) Manual, hereafter referred to as the Manual, is to guide the set-up of an EM&A programme to ensure compliance with the Environmental Impact Assessment (EIA) study recommendations, to assess the effectiveness of the recommended mitigation measures and to identify any further need for additional mitigation measures or remedial action. This Manual outlines the monitoring and audit programme to be undertaken for the construction and operational phases of the Sai Sha Road Widening Scheme. It aims to provide systematic procedures for monitoring, auditing and minimising the environmental impacts associated with the Scheme. A flow chart identifying the main tasks and procedures associated with the EM&A programme is presented in *Figure 1*.

1.1.2 Relevant Hong Kong environmental regulations, the Hong Kong Planning Standards and Guidelines, and recommendations in the EIA final report have served as environmental standards and guidelines in the preparation of this Manual.

1.1.3 This Manual contains the following:

- (a) responsibilities of the Contractor, the Engineer or Engineer's Representative (ER) and Environmental Team (ET) with respect to the environmental monitoring and audit requirements during the course of the project;
- (b) information on project organisation and programming of construction activities for the project;
- (c) the hypotheses of potential impacts, the basis for and description of the broad approach underlying the environmental monitoring and audit programme;
- (d) requirements with respect to the construction schedule and the necessary environmental monitoring and audit programme to track the varying environmental impact;
- (e) the specific questions and testable hypotheses that the monitoring programme is designed to answer;
- (f) full details of the methodologies to be adopted, including all field, laboratory and analytical procedures, and details on quality assurance and quality control programme;
- (g) the rationale on which the environmental monitoring data will be evaluated and interpreted and the details of the statistical procedures that will be used to interpret the data;

- (h) definition of Action and Limit levels (AL Levels);
 - (i) establishment of Event and Action Plans;
 - (j) requirements of reviewing pollution sources and working procedures required in the event of non-compliance of the environmental criteria and complaints;
 - (k) requirements of presentation of environmental monitoring and audit data and appropriate reporting procedures; and
 - (l) requirements for review of EIA predictions and effectiveness of the environmental monitoring and audit programme.
- 1.1.4 For the purpose of this Manual, the "Engineer" shall refer to the Engineer as defined in the Contract and the Engineer's Representative (ER), in cases where the Engineer's powers have been delegated to the ER, in accordance with the Contract. The ET leader, who shall be responsible for and in charge of the ET, shall refer to the person delegated the role of executing the environmental monitoring and audit requirements.

1.2 Background

- 1.2.1 On 19 November 1997, the New Territories Region of Highways Department of the Hong Kong SAR Government commissioned Maunsell Consultants Asia Ltd (hereafter known as Maunsell) as the lead consultant for the Environmental Impact Assessment Study (hereafter known as the EIA Study) for the Sai Sha Road Widening between Kam Ying Road and the junction of the proposed trunk road T7 (hereafter known as the project or road widening).
- 1.2.2 The project site boundary is shown in *Figure 2*.
- 1.2.3 As part of this Assignment, ERM-Hong Kong, Ltd. have been commissioned to undertake the Environmental Impact Assessment (EIA) to assess the environmental feasibility of the preferred alignment to ensure compliance with Government standards and guidelines.
- 1.2.4 Hassell have been commissioned to undertake the Landscape/Visual and Land Use Impact studies which have been included as part of this EIA.
- 1.2.5 The EIA have produced various deliverables during the Assignment for consideration by the Environmental Study Management Group which include the following:
- **EIA Report** The purpose of this report is to consolidate all the findings of the environmental assessment. The findings and recommendations of this report will be incorporated into the Preliminary Design of the alignment;

- **Environmental Monitoring and Audit (EM&A Manual)** The purpose of this manual is to design and specify the EM&A requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures recommended in the EIA Report; and
- **Executive Summary** The purpose of the Executive Summary is to provide a non technical summary of all the findings in the EIA Study.

1.2.6 The objectives of the EIA Study are as follows:

- to describe the Project and associated works together with the requirements for carrying out the Project;
- to identify and describe the elements of the community and environment likely to be affected by the Project, and/or likely to cause adverse impacts upon the Project, including both the natural and man-made environment;
- to identify and quantify emission sources where appropriate and determine the significance of impacts on sensitive receivers;
- to propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the Project;
- to identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction and operation phases of the Project in relation to the sensitive receivers;
- to identify, assess and specify methods, measures and standards to be included in the preliminary design, construction, operation of the Project which are necessary to mitigate these impacts and reduce them to acceptable levels;
- to design and specify the environmental monitoring and audit requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted;
- to investigate the extent of side-effects of proposed mitigation measures that may lead to other forms of impacts;
- to identify constraints associated with the mitigation measures recommended in the study; and
- to identify any additional studies necessary to fulfil the objectives to the requirements of this EIA study.

1.3 Environmental Monitoring and Audit Requirements

Noise

- 1.3.1 It is recommended that noise monitoring be carried out as part of the EM&A programme during the construction and operational phases of the Sai Sha Road Widening works at three locations each. The proposed monitoring locations are shown in *Figure 3a* and *3b* and are described in *Table 1.3a* and *1.3b*, respectively..

Table 1.3a Noise Monitoring Stations

Monitoring Station	NSR	Location
CNM1	NSR1 and NSR2	Wu Kwai Sha New Village / Lok Wo Sha
CNM2	NSR3 and NSR4	Kam Lung Court / Lee On Estate
CNM3	NSR7	Residential development at Wu Kai Sha DD206

Table 1.3b Noise Monitoring Stations

Monitoring Station	NSR	Location
ONM1	NSR2	Houses at the south of Lok Wo Sha Village facing Sai Sha Road (top floor of low rise dwelling)
ONM2	NSR3	Flat 9 of block 7 in Kam Lung Court (mid floor of high rise dwelling)
ONM3	NSR4	Flat 18/19 of northernmost block in Lee On Estate (mid floor of high rise dwelling)

- 1.3.2 Monitoring is required to ensure compliance with the Environmental Impact Assessment Ordinance (EIAO) in providing feedback to the Contractors for the management of their operations.

Landscape and Visual

- 1.3.3 A baseline visual survey, carried out by the Contractor, to the approval of the ET, at key viewpoints and sensitive receivers identified in the EIA will be required prior to starting any construction activity on-site.
- 1.3.4 A tree survey will also be required to verify the existing tree locations and their existing condition prior to the commencement of site works.

1.4 Project Organisation

- 1.4.1 The project organisation and lines of communication with respect to environmental protection works is shown in *Figure 5*.
- 1.4.2 The Environmental Team (ET) shall not be in any way an associated body of the Contractor. The ET leader shall have relevant professional qualifications, or have sufficient relevant EM&A experience subject to approval of the Engineer's Representative (ER) and the Environmental Protection Department (EPD).
- 1.4.3 Appropriate staff shall be included in the ET, under the supervision of the ET Leader, to fulfil the EM&A duties of the ET Leader specified in this manual. Basically, the duties comprise the following:
- (a) To monitor the various environmental parameters as required in EIA study final report;
 - (b) 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 problems arise;
 - (c) To audit and prepare audit reports on the environmental monitoring data and the site environmental conditions; and
 - (d) To report on the environmental monitoring and audit results to the Contractor, the ER, and the EPD or its delegate.
- 1.4.4 Appropriate resources shall also be allocated under the Contractor and the ER to fulfil their duties specified in this manual.
- 1.4.5 The Independent Checker (Environmental), IC(E), shall be an independent person or company with a minimum of 5 years EIA experience and proven track record in EM&A similar to the scope proposed in this Manual.

1.5 Construction Programme

- 1.5.1 The road widening is scheduled to commence in early 2001 and be completed within 26 months. The anticipated construction sequence is shown in the construction programme in *Figure 5*.
- 1.5.2 The Sai Sha Road widening works will be divided into three main categories, namely:
- the main Sai Sha Road works;
 - the construction of the footbridge; and
 - the subway construction.

- 1.5.3 It is anticipated that the construction activities associated with the Sai Sha Road widening will coincide with the construction of the Ma On Shan Rail (MOS Rail) link between Kam Ying Road and the station at Lee On (LEO).
- 1.5.4 The construction of MOS Rail is scheduled to commence in early 2000 and be completed in 2004. The MOS Rail alignment to the east of the proposed footbridge will be on elevated bridge structure. This will be formed by precast concrete members prefabricated off-site and supported on cast in-situ concrete columns on bored pile foundations. West of the proposed footbridge the MOS Rail alignment will be underground. This section is likely to be constructed using open cut methods using sheet piles as temporary supports. LEO is assumed to be constructed of reinforced concrete built on bored pile foundations.

2 NOISE

2.1 Introduction

Construction Phase

- 2.1.1 As the noise sensitive receivers (NSRs) near the Sai Sha Road working area will be subjected to daytime, and possibly restricted-hour construction noise, a noise monitoring programme shall be developed by the ER to include daytime and restricted-hour (if necessary) noise measurement at the sensitive receivers. The programme shall be carried out by the ET to ensure that the noise level of construction works complies with the criteria of the Noise Control Ordinance (NCO) and other adopted noise criteria.

Operational Phase

- 2.1.2 As noise sensitive receivers close to the Sai Sha Road will be exposed to traffic noise during the operational phase, a noise monitoring programme shall be developed by the IC(E) to include noise measurements at noise sensitive receivers during the peak traffic hour. The programme shall be carried out by the ET to ensure that the traffic noise levels are comparable to those predicted in the Environmental Impact Assessment (EIA).

2.2 Noise Parameters

Construction Phase

- 2.2.1 The construction noise level shall be measured in terms of the A-weighted equivalent continuous sound pressure level (L_{Aeq}). $L_{Aeq(30 \text{ min})}$ shall be used as the monitoring parameter for the time period between 0700-1900 hours on normal weekdays. For all other time periods, $L_{Aeq(5 \text{ min})}$ shall be employed for comparison with the NCO criteria.
- 2.2.2 As supplementary information for data auditing, statistical results such as L_{A10} and L_{A90} shall also be obtained for reference. A sample data record sheet is shown in *Annex A* for reference

Operational Phase

- 2.2.3 The traffic noise level shall be measured within the first year of the road opening. Measurements shall be made in terms of the A-weighted L_{A10} over 3 half hour periods during the peak traffic hour at each measurement point at two elevations a two locations and one elevation at the other location. A traffic census including traffic flow and the percentage of heavy vehicles (for definition of heavy vehicles refer to CRTN) shall also be conducted during the measurement period and the average speed of vehicles estimated. A sample data record sheet is shown in *Annex A* for reference.

2.3 Monitoring Equipment

- 2.3.1 As referred to in the Technical Memorandum on Noise From Construction Work other than Percussive Piling (GW-TM) issued under the Noise Control Ordinance (NCO), sound level metres in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications shall be used for carrying out the noise monitoring. Immediately prior to and following each noise measurement the accuracy of the sound level meter shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the calibration level from before and after the noise measurement agree to within 1.0 dB(A).
- 2.3.2 Noise measurements should be made in accordance with standard acoustical principles and practices in relation to weather conditions.
- 2.3.3 The ET Leader is responsible for the provision and maintenance of the monitoring equipment. He shall ensure that sufficient noise measuring equipment and associated instrumentation are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. All the equipment and associated instrumentation shall be clearly labelled.

2.4 Monitoring Locations

- 2.4.1 The noise monitoring locations are shown in *Figure 3a* and *3b* and summarised in *Table 2.4a* and *2.4b* for the construction phase and operational phase, respectively. The status and locations of noise sensitive receivers may change after issuing this manual. If such cases exist, the ET Leader shall propose updated monitoring locations and seek approval from ER, and agreement from the IC(E) and EPD of the proposal.

Table 2.4a Construction Noise Monitoring Stations

Noise Monitoring Station	Noise Monitoring Location
CNM1 (NSRs 1&2)	Wu Kwai Sha New Village / Lok Wo Sha
CNM2 (NSRs 3&4)	Kam Lung Court / Lee On Estate
CNM3 (NSR7)	Residential development at Wu Kai Sha DD206

Table 2.4b Operational Noise Monitoring Stations

Monitoring Station	Location	Floor
ONM1	N317	20 & 35
ONM2	N405	15 & 25
ONM3	N102	1

2.4.2 When alternative monitoring locations are proposed, the monitoring locations shall be chosen based on the following criteria:

- (a) alternative location shall be similarly exposed to potential noise impacts;
- (b) it shall be close to the noise sensitive receivers ; and
- (c) shall be located so as to cause minimal disturbance to the occupants.

2.4.3 The construction noise monitoring station shall normally be at a point 1m from the exterior of the sensitive receivers building facade and be at a position 1.2 m above the ground. If there is a problem with access to the normal monitoring position, an alternative position may be chosen, and a correction to the measurements shall be made. For reference, a correction of +3 dB(A) shall be made to the free field measurements. The ET Leader shall agree with the IC(E) on the monitoring position and the corrections adopted. Once the positions for the monitoring stations are chosen, the baseline monitoring and the impact monitoring shall be carried out at the same positions.

2.4.4 The operational noise monitoring shall be carried out at a distance of 1 m from the openable window and 1.2 m above the floor level of the noise sensitive receivers identified in *Table 2.4b*. The ET Leader shall agree with the IC(E) on any necessary corrections adopted.

2.5 Baseline Monitoring

2.5.1 The ET Leader shall carry out baseline noise monitoring prior to the commencement of the construction works. The baseline monitoring shall be carried out daily for a period of at least two weeks. A schedule on the baseline monitoring shall be submitted to the ER for approval before the monitoring starts.

2.5.2 There shall not be any construction activities in the vicinity of the stations during the baseline monitoring. Baseline monitoring measurements shall be evenly spread throughout the assessment period to be conducted at the some frequency and duration throughout all periods of the day for which works are anticipated to be constructed (e.g. daytime, evening and night-time).

2.5.3 In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with EPD to agree on an appropriate set of data to be used as a baseline reference and submit to the ER for approval.)

2.5.4 No baseline operational noise monitoring is required.

2.6 Impact Monitoring

Construction Noise

2.6.1 Noise monitoring shall be carried out at all the designated monitoring stations. The monitoring frequency shall depend on the scale of the construction activities. The following is an initial guide on the regular monitoring frequency for each station on a per week basis when noise generating activities are underway:

- (a) one set of measurements between 0700-1900 hours on normal weekdays;
- (b) one set of measurements between 1900-2300 hours;
- (c) one set of measurements between 2300-0700 hours; and
- (d) one set of measurements between 0700-1900 hours on holidays.

General construction work carried out during restricted hours is controlled by CNP system under the NCO.

2.6.2 For the measurements (b), (c) and (d) above, one set of measurements shall at least include 3 consecutive $L_{Aeq(5 \text{ min})}$ results.

2.6.3 In case of non-compliance with the construction noise criteria, more frequent monitoring as specified in the Action Plan in *Section 2.7* shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities.

Operational Noise

- 2.6.4 Noise monitoring shall be carried out at all the designated traffic noise monitoring stations. The following is an initial guide on the traffic noise monitoring requirements during the operational phase:
- (a) three locations (at total of 5 measurement points; two elevations at two locations and one elevation at the other location) within the first year of the road opening;
 - (b) the measurement period shall be three half hour periods during the peak traffic hour;
 - (c) a concurrent census of traffic flow and percentage heavy vehicle shall be conducted for the widened road and the existing road network in the vicinity of each measuring point; and
 - (d) the average vehicle speed estimated.
- 2.6.5 Measured noise levels should be compared with predicted noise levels by applying appropriate conversion corrections to allow for the traffic conditions at the time of measurement.

2.7 Event and Action Plan for Noise

Construction Noise

- 2.7.1 The AL Levels for construction noise are defined in *Table 2.7a*. Should non-compliance of the criteria occur, action in accordance with the Action Plan in *Table 2.7b*, shall be carried out.

Table 2.7a Action and Limit Levels for Construction Noise

Time Period	Action Required	Limit
0700-1900 hrs on normal weekdays	When one documented complaint is received	75 dB(A)
0700-2300 hrs on holidays; and 1900-2300 hrs on all other days		70 dB(A)
2300-0700 hrs of next day		55 dB(A)

Table 2.7b Event/Action Plan for Construction Noise

EVENT	ACTION				
	ET Leader	IC(E)	ER	Contractor	
Action Level	<ol style="list-style-type: none"> 1. Notify IC(E) and Contractor 2. Carry out investigation 3. Report the results of investigation to the IC(E) and Contractor 4. Discuss with the Contractor and formulate remedial measures 5. Increase monitoring frequency to check mitigation effectiveness 	<ol style="list-style-type: none"> 1. Review the analysed results submitted by the ET 2. Review the proposed remedial measures by the Contractor and advise the ER accordingly 4. Supervise the implementation of remedial measures 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Require Contractor to propose remedial measures for the analysed noise problem 4. Ensure remedial measures are properly implemented 	<ol style="list-style-type: none"> 1. Submit noise mitigation proposals to IC(E) 2. Implement noise mitigation proposals 	
Limit Level	<ol style="list-style-type: none"> 1. Notify IC(E), ER, EPD and Contractor 2. Identify source 3. Repeat measurement to confirm findings 4. Increase monitoring frequency 5. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented 6. Inform IC(E), ER and EPD the causes & actions taken for the exceedances 7. Assess effectiveness of Contractor's remedial actions and keep IC(E), EPD and ER informed of the results 8. If exceedance stops, cease additional monitoring 	<ol style="list-style-type: none"> 1. Discuss amongst ER, ET, and Contractor on the potential remedial actions 2. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly 3. Supervise the implementation of remedial measures 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of failure in writing 2. Notify Contractor 3. Require Contractor to propose remedial measures for the analysed noise problem 4. Ensure remedial measures are properly implemented 5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated 	<ol style="list-style-type: none"> 1. Take immediate action to avoid further exceedance 2. Submit proposals for remedial actions to IC(E) within 3 working days of notification 3. Implement the agreed proposals 4. Resubmit proposals if problem still not under control 5. Stop the relevant portion of works as determined by the ER until the exceedance is abated 	

2.8 Noise Mitigation Measures

Construction Noise

- 2.8.1 The EIA Report has recommended construction noise control and mitigation measures. The Contractor shall be responsible for the design and implementation of these measures.
- 2.8.2 Noise emissions from construction sites can be minimised through good site practice, selecting quiet plant, quiet working methods and through the use of temporary barriers. These methods are discussed in the following paragraphs.

Good Site Practice

- 2.8.3 Good site practice and noise management can considerably reduce the impact of construction site activities on nearby NSRs. The following package of 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 works;
 - machines and plant 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 to direct noise away from nearby NSRs;
 - silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction works;
 - mobile plant should be sited as far away from NSRs as possible; and
 - material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

Selecting Quieter Plant and Working Methods

- 2.8.4 The Contractor may be able to obtain particular models of plant that are quieter than standard types given in the GW-TM. The benefits achievable for each of the measures proposed will depend on the details of the Contractor's chosen methods of working, and it is considered too restrictive to specify items of plant that a Contractor has to use during construction activities. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total Sound Power Level (SWL) of all plant on the site, so that the

Contractor is allowed some flexibility to select plant to suit his needs.

- 2.8.5 It should be noted that various types of silenced equipment can be found in Hong Kong. However, the 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 certificate or demonstration.

Temporary Noise Barriers

- 2.8.6 In general, noise barriers located between noisy construction activities and NSRs could give up to 5 dB(A) reduction from screening (estimated in accordance with the GW-TM). It would be possible for the Contractor to provide barriers, in the form of site hoardings, to achieve this level of reduction. Certain types of PME, such as generators and compressors, can be completely enclosed giving a total noise reduction of 10 dB(A) or more. Vertical barriers that can be located close to noisy plant can also be very effective at screening NSRs from particular plant.
- 2.8.7 By considering the above methods of mitigation, it is possible to develop a mitigation package, which can be adopted to minimise potential noise impacts. Three possible mitigation options have been considered in this assessment.

Mitigation Option 1

- 2.8.8 Mitigation Option 1 utilises quiet plant, where appropriate, and movable noise barriers.
- 2.8.9 The results of the noise assessment indicate that mitigation option 1 can be successfully used to reduce the number of noise impacts generated by construction activities. However, residual impacts are likely at Wu Kwai Sha New Village, Kam Lung Court and Lee On Estate.

Mitigation Option 2

- 2.8.10 In areas where mitigation option 1 is not sufficient to protect NSRs from noise impacts further mitigation will be required. This will necessitate restricting the either the construction activities which can operate simultaneously as well as restricting the of number of plant used to carry out the specific activities. The necessary measures are:
- *Site Clearance* - reduce the number of bulldozers/rippers, compressors and lorries to one and ensure that he excavator, bulldozer, scraper and motor grader do not operate simultaneously.
 - *Pile Capping* - separate the individual tasks (i.e. ground, reinforcement, concreting and backfilling activities) and ensure that the backhoe and excavator do not operate simultaneously.

- *In-situ Superstructure* - formwork and reinforcement to be carried out separately from concreting.
 - *Paving* - ensure the asphalt paver and road roller do not operate simultaneously.
 - *Drainage* - separate all sub-tasks (i.e. excavation of trench and placement of pipes).
 - *Road Construction* - separate all sub-tasks (i.e. levelling of new road, laying base and sub-base, kerbing and laying new surface). In addition it will be necessary to avoid simultaneously operation of the following items of plant: grader and bulldozer; dumper truck and roller; asphalt paver and road roller.
 - *Fourth quarter of 2001* - reschedule construction of utilities services and road furniture to avoid this period.
 - *Fourth quarter of 2002* - reschedule construction of road furniture to avoid this period. The residual noise impacts at Lee On Estate are, in general, dominated by construction of the main alignment, footbridge and MOS Rail.
- 2.8.11 It is recommended that the construction of the alignment in the vicinity (within 40 m) of Lee Ming House (Lee On Estate) is scheduled so it will not coincide with the construction of the footbridge and the elevated section of MOS Rail (within 40 m of Lee Ming House).
- 2.8.12 If the above measures are not sufficient to restore the construction noise quality to acceptable levels upon the advice of ET Leader, the Contractor shall liaise with the ET Leader on some other mitigation measures, propose to ER for approval, and carry out the mitigation measures.

Operational Noise

- 2.8.13 The EIA Report has recommended operational noise mitigation measures. These are summarised in the following paragraphs.
- 2.8.14 To protect properties within Wu Kwai Sha and Lok Wo Sha Villages a 130 m long, 600 mm high concrete parapet wall, extending east from Kam Ying Road junction along the left hand side of Sai Kung bound carriageway will be provided. Additionally, a solid abutment below the first slope of the footbridge will be constructed. The abutment will be approximately 50 m in length increasing in height from grade at a slope of 8.3% and will be finished with an absorptive material on the side facing Lee On Estate
- 2.8.15 To protect properties within Kam Lung Court two barriers will be provided. The first will be a 100 m long, absorptive cantilever barrier, extending east from the Kam Ying Road junction, 2 m from the Sha Tin bound carriageway. The second is a 320 m long, cantilever barrier

- (absorptive on both sides) comprising of a 5 m vertical section and cantilever portion protruding 1 m vertically and 2 m horizontally. This barrier will extend east from the Kam Ying Road junction and will be located at 1 m from the right hand side of the Sai Kung bound carriageway.
- 2.8.16 To protect properties within Lee On Estate two barriers will be provided. The first is a 120 m long absorptive cantilever barrier, extending east of the proposed footbridge, 2 m from the left hand side of the Sha Tin bound carriageway will be provided. The second is 320 m long, cantilever barrier (absorptive on both sides) comprising of a 5 m vertical section and cantilever portion protruding 1 m vertically and 2 m horizontally. This barrier will extend north east from the proposed footbridge and will be located at 1 m from the right hand side of the Sai Kung bound carriageway.
- 2.8.17 To protect properties within the proposed residential development at Wu Kai Sha Village (DD206) a 100 m long, 5 m tall vertical barrier, 2 m from the northern edge of the slip road leading from Sai Sha Road to Trunk Road T7.
- 2.8.18 The operational noise mitigation is presented in *Figure 4*. Further details of the noise barriers recommended can be found in *Section 3.6* of the EIA.

3 Landscape and Visual

3.1 General

3.1.1 A competent landscape architect should be employed during the construction and maintenance periods of the contract to enforce the recommended landscape and visual impact mitigation measures. He/She will be responsible for the the following tasks:

- the tree transplanting operation will be undertaken by a competent landscape contractor;
- all existing trees and vegetation within the study area which are not directly affected by the works will be retained and protected;
- the methods of protecting existing vegetation proposed by the contractor are acceptable and enforced;
- all landscaping works are carried out in accordance with the specifications;
- the methods of transplanting the trees proposed by the contractor are feasible and being carried out under his/her supervision;
- the planting of heavy standard trees will be carried out properly and in the right season;
- the species of the new trees and vegetation to be planted are chosen correctly and in the right mix;
- the transplanted and newly planted trees are watered regularly and nourished; and
- the survival of transplanted and newly planted trees will be monitored for a 12-month establishment period.

3.2 Landscape Impact

3.3.1 The Contractor should ensure that the trees to be felled within the project site boundary have been accurately located and felling approval secured from the relevant governmental department.

3.3.2 A survey report should be submitted by the Contractor to verify the existing tree locations with their existing conditions survey, prior to commencement of site works.

3.3.3 During the inspections and the document review procedures as outlined in this Manual, the Environmental Team Leader shall pay particular attention to the issues relating to existing tree preservation, and check whether the Contractor has followed the relevant Contract Specifications.

3.3 Visual Impact

- 3.2.1 A baseline survey from key viewpoints and sensitive receivers identified in the EIA should be undertaken by the Contractor to the approval by the Environmental Team prior to starting any construction activity on-site.
- 3.2.2 Visual monitoring adopting the Field Record Sheet (Appendix A) should be completed with accompanying photographs taken from the critical viewpoint locations and submitted by the Contractor on a bi-monthly basis.

3.4 Mitigation Measures

Construction Phase

- 3.4.1 Mitigation of temporary visual and landscape impacts during the construction stage can be achieved through the implementation of the following recommended measures:
- conservation of topsoil;
 - screening of site construction works by use of hoardings;
 - surface treatment of site hoardings to enhance visual interest and harmony with surrounding landscape / townscape;
 - locating site offices and other temporary buildings in least visually prominent locations;
 - efficient programming of construction works to reduce duration of construction works;
 - staging of construction works to minimise areas requiring site hoardings which creates visual intrusion; and
 - re-routing of pedestrian routes away from the work site where possible;
 - retaining existing trees and minimising damage to vegetation where possible. Care shall be taken not to damage those trees identified in the Tree Survey Report to be retained during the construction phase; and
 - careful and efficient transplanting of existing vegetation carried out under the supervision of a professional landscape architect.

Operational Phase

- 3.4.2 The scheme proposes the upgrading of Sai Sha Road from a single lane carriageway to a dual two lane carriageway together with a major roundabout junction with proposed Trunk Road T7. Noise mitigation

measures are proposed including a mix of vertical barriers and inverted L cantilevered barriers.

3.4.3 The proximity and height of the VSRs in the Lee On Estate and Kam Lung Court restricts the level of screening to alleviate the visual impacts. However, the following mitigation measures are recommended:

- compensatory planting to be included in the landscape works such that the number of compensatory trees shall not be less than the number of trees to be felled;
- natural slopes or soil berms to be developed to facilitate soft landscape establishment during the planning and construction stage where possible;
- transplanting of good existing trees;
- regrading of any new formed slopes to tie in with adjacent levels;
- retention of existing tree and shrub planting not affected by the works;
- dense tree, or tree and shrub planting, on all new formed slopes, where possible, to form landscape buffer zones and visual screens;
- ornamental tree and shrub planting to central medians, traffic islands and the roundabout, where possible and in accordance with required sightlines, and traffic engineering requirements;
- consideration of the design of, and hard materials finishes to, pedestrian subway entrances, and retaining walls;
- use of hard materials sympathetic to the surrounding environment for pavements, cycle tracks and the road;
- noise barriers and semi-enclosure systems to be designed to create elements that are integrated within the scheme and surrounding landscape and to minimise the undesirable effects of glare;
- tree and / or shrub planting to roadside amenity strips with raised planters where possible;
- footbridges, ramps and staircases to be designed in the context of the scheme and as elements integrated with the surrounding landscape;
- consideration of the design of subway portals, ramps and staircases; and
- soft landscape treatment of the central public transport reserve, although the final design will be limited by the engineering requirements of the reserve.

4 SITE ENVIRONMENTAL AUDIT

4.1 Site Inspections

- 4.1.1 Site Inspections provide a direct means to trigger and enforce the specified environmental protection and pollution control measures. They shall be undertaken routinely by the ET Leader 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.
- 4.1.2 The ET Leader is responsible for the 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.
- 4.1.3 Regular site inspections shall be carried out at least once per week. The areas of inspection shall not be limited to the 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 ET Leader shall make reference to the following information in conducting the inspection:
- (a) the EIA recommendations on environmental protection and pollution control mitigation measures;
 - (b) works progress and programme;
 - (c) individual works methodology proposals (which shall include proposal on associated pollution control measures);
 - (d) the contract specifications on environmental protection;
 - (e) the relevant environmental protection and pollution control laws; and
 - (f) previous site inspection results.

- 4.1.4 The Contractor shall update the ET Leader 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 IC(E) 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 ET Leader to report on any remedial measures subsequent to the site inspections.
- 4.1.5 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 the Action Plan for environmental monitoring and audit.

4.2 Compliance with Legal and Contractual Requirements

- 4.2.1 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.
- 4.2.2 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 also be sent to the ET Leader for vetting to see whether sufficient environmental protection and pollution control measures have been included.
- 4.2.3 The ET Leader shall also review the progress and programme of the works to check that relevant environmental laws have not been violated, such that any foreseeable potential for violating the laws can be prevented.
- 4.2.4 The Contractor shall regularly copy relevant documents to the ET Leader 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 ET Leader's inspection upon his request.
- 4.2.5 After reviewing the document, the ET Leader 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 ET Leader'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 advise the Contractor and the ER accordingly.

- 4.2.6 Upon receipt of the advice, the Contractor shall undertake immediate action to remedy 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.

4.3 Environmental Complaints

- 4.3.1 Receipt of a complaint shall activate the actions required in the Event and Action Plans for noise by the ET, Engineer, Contractor and IC(E). A flow chart of the formal procedure for handling complaints is given in *Figure 6*. Complaints shall be referred to the ET Leader for carrying out complaint investigation procedures. The ET Leader shall liaise with the Contractor on the complaint investigation and undertake the following procedure:

- (a) log complaint and date of receipt onto the complaint database and inform the IC(E) immediately;
- (b) investigate the complaint to determine its validity, and to assess whether the source of the problem is due to works activities;
- (c) if a complaint is valid and due to works, identify mitigation measures;
- (d) if mitigation measures are required, advise the Contractor accordingly;
- (e) review the Contractor's response on the identified mitigation measures, and the updated situation;
- (f) 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;
- (g) review relevant environmental monitoring results and undertake additional monitoring if necessary to verify the situation;
- (h) report the investigation results and the subsequent actions to the complainant; and
- (i) record the complaint, investigation, the subsequent actions and the results in the monthly EM&A reports (refer to *Section 5*).

- 4.3.2 During the complaint investigation work, the Contractor and ER shall cooperate with the ET Leader 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 ER shall ensure that the measures have been carried out by the Contractor.
- 4.3.3 Details of all complaints shall form a part of the regular monthly reports (refer to *Section 5*) and shall be accompanied by a review of the circumstances including any recommendations necessary to avoid future repetitions of complaints of a similar nature. The findings of all complaints shall be sent to the complainant in writing as soon as possible.

5 REPORTING

5.1 General

5.1.1 The reporting guidelines referred to in this section are based upon a paper based system, however, the same information can be provided by an electronic medium upon agreeing the format with the ER and EPD. All the monitoring data (baseline and impact) shall also be submitted in diskettes in a format shown in *Annex A*.

5.2 Baseline Monitoring Report

5.2.1 The ET Leader shall prepare and submit a Baseline Environmental Monitoring Report within 10 working days of completion of the baseline monitoring. Copies of the Baseline Environmental Monitoring Report shall be submitted to all parties; the Contractor, the IC(E), the ER and the EPD. The format and content of the report, and the representation of the baseline monitoring data shall be in a format to the satisfaction of EPD and include, but not be limited to the following:

- (a) up to half a page executive summary;
- (b) brief project background information;
- (c) drawings showing locations of the baseline monitoring stations;
- (d) monitoring results (in both hard and diskette copies) together with the following information:
 - monitoring methodology;
 - name and types of equipment used and calibration details;
 - parameters monitored;
 - monitoring locations;
 - monitoring date, time, frequency and duration; and
 - QA/QC results and detection limits.
- (e) details on influencing factors, including:
 - major activities, if any, being carried out on the site during the period;
 - weather conditions during the period;
 - other factors which might affect the results;
- (f) determination of the AL Levels for each monitoring parameter and statistical analysis of the baseline data; the analysis shall conclude if there is any significant difference between control and impact stations for the parameters monitored, and the following information should be recorded:

- graphical plots of monitored parameters in the month annotated against;
- the major activities being carried out on site during the period;
- (g) revisions for inclusion in the EM&A Manual; and
- (h) comments and conclusions, includes:
 - submission of implementation status proforma, proactive environmental protection proforma, regulatory compliance proforma, site inspection proforma, data recovery schedule and complaint log summarising the EM&A period (see *Annex A*).

5.3 EM&A Reports

- 5.3.1 The results and findings of all EM&A work required in the Manual shall be recorded in the monthly EM&A reports prepared by the ET Leader. The EM&A report shall be prepared, endorsed by IC(E) and submitted within 10 working days of the end of each reporting month, with the first report due in the month after construction commences. Before submission of the first EM&A report, the ET Leader shall liaise with the parties on the exact number of copies and format of the monthly reports in both hard copy and electronic medium requirement. The ET Leader 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.
- 5.3.2 The report shall contain an executive summary of the project activities including locations, exceedance of AL Levels, causes of exceedance and mitigation measures being taken; all monitoring data with the information indicating the sampling / measurement locations, and other factors which might affect the results and detailed description of the findings from auditing of monitoring data.
- 5.3.3 The raw data sheets of the monitoring data shall be maintained properly and readily and easily accessible upon request by other parties. The monitoring data shall be stored in floppy disk with the format agreed with EPD. The disk shall be submitted to EPD together with the monthly report.
- 5.3.4 A report shall be made to EPD immediately by fax following exceedance of the Action Level by any parameter giving details of raw monitoring data, mitigation measures implemented and the proposed actions to ensure the reoccurrence shall be prevented.
- 5.3.5 First Monthly EM&A Report

The First Monthly EM&A Report shall include at least the following :

- (a) 1-2 pages executive summary;
- Breaches of AL levels;
 - Complaints Log;
 - Notifications of any summons and successful prosecutions;
 - Reporting Changes;
 - Future key issues.
- (b) Basic Project Information
- Project organisations including key personnel contact names and telephone numbers;
 - Programme
 - Management structure; and
 - Works undertaken during the month;
- (c) Environmental Status
- Work undertaken during the month with illustrations; and
 - Drawing showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations.
- (d) Summary of EM&A requirements
- All monitoring parameters;
 - AL Levels;
 - Event-Action Plans;
 - Environmental mitigation measures, as recommended in the project EIA Report; and
 - Environmental requirements in contract documents.
- (e) Implementation Status
- Advice on the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project EIA Report, summarised in the updated implementation schedule (in *Annex A*);
- (f) Monitoring Results
- To provide monitoring results (in both hard and diskette copies) together with the following information:
- Monitoring methodology;
 - Name of laboratory and types of equipment used and calibration details;
 - Parameters monitored;
 - Monitoring locations;
 - Monitoring date, time, frequency, and duration;

- Weather conditions during the period; and
 - Any other factors which might affect the monitoring results; and
 - QA/QC results and detection limits.
- (g) Report on Non-compliance, Complaints, Notifications of Summons and Successful Prosecutions
- Record of all non-compliances (exceedances) of the AL Levels;
 - Record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;
 - Record of all notifications of summons and successful prosecutions for breaches of the current environmental protection/pollution control legislations, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary;
 - Review of the reasons for and the implications of non-compliances, complaints, summons and prosecutions including review of pollution sources and working procedures; and
 - Description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliances;
- (h) Others
- An account of the future key issues as reviewed from the works programme and work method statements; and
 - Advice on the solid and liquid waste management status.

5.3.6 Subsequent Monthly EM&A Reports

The subsequent Monthly EM&A Reports shall include the following :

- (a) Executive Summary (1-2 pages)
- Breaches of AL levels;
 - Complaint Log;
 - Notifications of any summons and successful prosecutions;
 - Reporting changes; and
 - Future key issues.

(b) Environmental Status

- Construction programme with fine tuning of construction activities showing the inter-relationship with environmental protection/mitigation measures for the month;
- Works undertaken during the month with illustrations including key personnel contact names and telephone number; and
- Drawing showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations

(c) Implementation Status

Advice on the implementation status of environmental protection and pollution control/mitigation measures including measures for landscape and visual impacts, as recommended in the EIA Report, summarised in the updated implementation schedule (see *Annex A*).

(d) Monitoring Results

To provide monitoring results (in both hard and diskette copies) together with the following information:

- Graphical plots of the monitored parameters in the month annotated against;
- The major activities being carried out on site during the period;
- Monitoring methodology;
- Name of laboratory and types of equipment used and calibration details;
- Parameters monitored;
- Monitoring locations;
- Monitoring date, time, frequency, and duration;
- Weather conditions during the period;
- Any other factors which might affect the monitoring results; and
- QA/QC results and detection limits

(e) Report on Non-compliance, Complaints, Notifications of Summons and Successful Prosecutions

- Record of all non-compliances (exceedances) of the AL Levels;
- Record of all complaints received (written or verbal) for each media, including locations and nature of complaints investigation, liaison and consultation undertaken, actions and follow-up procedures taken, results and summary;
- Record of all notifications of summons and successful prosecutions for breaches of the current environmental

protection/pollution control legislations, including locations and nature of the breaches, investigation, follow-up actions taken, results and summary;

- Review of the reasons for and the implications of non-compliances, complaints, summons and prosecutions including review of pollution sources and working procedures; and
- a description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliance;

(f) Others

- An account of the future key issues as reviewed from the works programme and work method statements; and
- Advice on the solid and liquid waste management status.

(g) Appendix

- AL levels
- Graphical plots of trends of monitored parameters at key stations over the past four reporting periods for representative monitoring stations annotated against the following:
 - i) major activities being carried out on site during the period;
 - ii) weather conditions during the period; and
 - iii) any other factors which might affect the monitoring results.
- Monitoring schedule for the present and next reporting period
- Cumulative statistics on complaints, notifications of summons and successful prosecutions
- Outstanding issues and deficiencies

5.3.7 Quarterly EM&A Summary Reports

The Quarterly EM&A Summary Report which should generally be around 5 pages (including about 3 of text and tables and 2 of figures) should contain at least the following information. Apart from these, the first quarterly summary report should also confirm that the necessary statistical power to categorically identify or confirm the absence of impact attributable to the works.

- (a) up to half a page executive summary;
- (b) basic project information including a synopsis of the project organisation, programme, contacts of key management, and a synopsis of work undertaken during the quarter;

- (c) a brief summary of EM&A requirements including:
 - monitoring parameters;
 - AL Levels; and
 - environmental mitigation measures, as recommended in the EIA Report;
- (d) advice on the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project EIA study report, summarised in the updated implementation schedule;
- (e) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
- (f) graphical plots of the trends of monitored parameters over the past 4 months (the last month of the previous quarter and the present quarter) for representative monitoring stations annotated against:
 - the major activities being carried out on site during the period;
 - weather conditions during the period; and
 - any other factors which might affect the monitoring results;
- (g) a summary of non-compliance (exceedances) of the AL Levels;
- (h) a brief review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures;
- (i) a summary description of the actions taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;
- (j) a summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken;
- (k) comments (e.g. effectiveness and efficiency of the mitigation measures), recommendations (e.g. any improvement in the EM&A programme) and conclusions for the quarter; and
- (l) proponents' contacts and any hotline telephone number for the public to make enquiries.

5.3.8 Annual/Final EM&A Review Reports

The Annual/Final EM&A Report should contain at least the following information:

- (a) Executive Summary (1-2 pages);
- (b) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
- (c) basic project information including a synopsis of the project organisation contacts of key management, and a synopsis of work undertaken during the course of the project or past twelve months;
- (d) a brief summary of EM&A requirements including:
 - (i) environmental mitigation measures, as recommended in the project EIA Report;
 - (ii) environmental impact hypotheses tested;
 - (iii) AL Levels;
 - (iv) all monitoring parameters; and
 - (v) Event-Action Plans;
- (e) a summary of the implementation status of environmental protection and pollution control/mitigation measures as recommended in the project EIA study report summarised in the updated implementation schedule;
- (f) graphical plots and the statistical analysis of the trends of monitored parameters over the course of the project, including the post project monitoring (for the past twelve months for annual report) for all monitoring stations against:
 - the major activities being carried out on site during the period;
 - weather conditions during the period; and
 - any other factors which might affect the monitoring results.
- (g) a summary of non-compliances (exceedances) of the AL Levels;
- (h) a review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures as appropriate;
- (i) a description of the actions taken in the event of non-compliance;
- (j) a summary record of all complaints received (written or verbal) for each media liaison and consultation undertaken, action and follow-up procedures taken;

- (k) a summary record of notifications of summons and successful prosecutions for breaches of the current environmental protection pollution control legislations locations and nature of the breaches, investigation, follow-up actions taken and results;
- (l) a review of the validity of EIA Report predictions and identification of shortcomings in EIA Report recommendations; and
- (m) a review of the effectiveness and efficiency of the mitigation measures;
- (n) a review of success of the EM&A programme to cost effectively identify deterioration and to initiate prompt effective mitigatory action when necessary.

5.4 Data Keeping

5.4.1 The site document such as the monitoring field records, laboratory analysis records, site inspection forms, etc. are not required to be included in the monthly EM&A reports for submission. However, the document shall be well kept by the ET Leader and be ready for inspection upon request. All relevant information shall be clearly and systematically recorded in the document. The monitoring data shall also be recorded in magnetic media form, and the software copy can be available upon request. All the documents and data shall be kept for at least one year after completion of the construction contract.

5.5 Interim Notifications of Environmental Quality Limit Exceedances

5.5.1 With reference to Event/Action Plans in *Tables 2.7a and 2.7b*, when the environmental quality limits are exceeded, the ET Leader shall immediately notify the ER and 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 sample template for the interim notifications is shown in *Annex A*.