

1. INTRODUCTION

1.1 Purpose of the Manual

The purpose of this Environmental Monitoring and Audit (EM&A) Manual, hereafter referred to as the Manual, is to guide the setup 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 of Route 10 (NLYLH) (Southern Section). It aims to provide systematic procedures for monitoring, auditing and minimising of the environmental impacts.

Legislation

Hong Kong environmental regulations for air and water quality, noise and waste, the Hong Kong Planning Standards and Guidelines, and recommendations in the EIA study final report on Route 10 (NLYLH) (Southern Section) have served as environmental standards and guidelines in the preparation of this Manual.

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 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 for reviewing pollution sources and working procedures required in the event of non-compliance of the environmental criteria and complaints;
- k) requirements for 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.

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

The Highways Department of the SAR Government has commissioned Mott Connell Ltd to undertake the Investigation and Preliminary Design Assignment (hereafter known as the Assignment) for Route 10 (NLYLH) under Agreement No. CE 82/97. The purpose of the Assignment Study is to identify the environmental impact arising from the construction and operation of the Project.

The project site and boundary is shown in *Figure 1.1*.

The objectives of the EIA Study are as follows:

- i. to describe the Project and associated works together with the requirements and environmental benefits associated with it;
- ii. 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 it including both the natural and man-made environment and the associated environmental constraints;
- iii. to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;
- iv. to identify and quantify any potential losses or damage to flora, fauna and natural habitats;
- v. to identify any negative impacts on sites of cultural heritage and to propose measures to mitigate any such impacts;
- vi. to propose the provision of infrastructure or mitigation measures to minimize pollution, environmental disturbance and nuisance during construction and operation of the Project;

- vii. to identify existing landscape and visual quality in the study area for the purpose of evaluating the landscape and visual impact of the Project;
- viii. to investigate the feasibility, effectiveness and implications of the proposed mitigation measures;
- ix. to identify, predict and evaluate residual (ie after practicable mitigation) environmental impacts and the cumulative effects expected to arise during construction and operation of the Project in relation to sensitive receivers and potential affected uses;
- x. to identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the Project which are necessary to mitigate these residual environmental impacts and cumulative effects and reduce them to acceptable levels;
- xi. 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; and
- xii. to identify any additional studies necessary to implement the mitigation measures or monitoring and proposals recommended in the EIA report.

1.3 Environmental Monitoring and Audit Requirements

In this Section, a summary of the EIA findings is presented, and the requirements and scope of the EM&A are discussed. Details of the recommended mitigation measures and implementation schedule are described in *Annex A*.

Noise

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. It was recommended that noise monitoring be carried out as part of the EM&A programme during the construction period.

Air Quality

The construction work will inevitably lead to dust emissions, mainly from blasting, concrete batching, excavation, truck haulage and material handling. It is predicted that the dust generated will exceed the hourly and daily criteria of $500 \mu\text{gm}^{-3}$ and $260 \mu\text{g m}^{-3}$ respectively at the some ASRs. Dust control measures were recommended to be incorporated in the Contract Specification to minimise dust nuisance arising from the works.

During operation effective control of air pollution within the Tai Lam Chung Tunnel requires proper supervision of maintenance and operation of the ventilation system and monitoring equipment. Good preventive maintenance should be employed.

Water Quality

It has been recommended that water quality monitoring be carried out to ensure protection of marine waters when marine construction works are carried out at the Toll Plaza. Water quality sensitive receivers include marine life and the Ma Wan Fish Culture Zone.

Waste Management

It has been recommended that auditing of each waste stream shall be carried out periodically by the contractor to determine if the various types of waste are being managed in accordance with approved procedures and the site waste management plan. The audits shall look at all aspects of waste management including waste generation, storage, recycling, treatment, transport, and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the construction works, and to audit quarterly thereafter.

Ecology

The mitigation measures will be included in clauses in the construction contracts. The implementation of the measures shall be checked as part of the environmental monitoring and audit procedures during the construction period.

Sensitive Receivers

Representative air and noise sensitive receivers, as defined in the Technical Memorandum on Environmental Impact Assessment, have been identified in the EIA Assessment Report and are listed in *Tables 1.1-1.2*. Both the existing and planned receivers are included in the list. The locations of these sensitive receivers are shown in *Figures 1.2-1.11*.

Table 1.1 Air Sensitive Receivers

ASR	Location	Distance from alignment (m)
A1	Fa Peng	100
A2	Tso Wan	100
A3	Hong Kong Garden	250
A4	Squatter Area, Northwest to Hong Kong Garden	250
A7	Correctional Institution (Staff Quarters)	130
A8	Clinic	70
A9	Tai Lam Chung Tsuen	110
A10	Scattered Development at West of TLC Road	220
A11	CDA to the South of TLC Viaduct	130

ASR	Location	Distance from alignment (m)
A12	"V" Zone to the South of TLC Viaduct	130
A13	Psychiatric Centre	360
A14	CSD Staff Quarters at Hong Fai Road	180
A15	Village Houses at Siu Lam	250
A16	Home for the Aged at Siu Lam	180
A17	So Kwun Wat Sun Tsuen	80
A18	So Kwun Wat Tsuen	110
A19	So Kwun Wat Lee Uk Tsuen	70
A20	Lo Tsing Shen Tsuen	40
A21	So Kwun Wat Ching Uk Tsuen	110
A22	Scattered Houses to the North of Tuen Mun Road Interchange	100
A23	Scattered Houses at So Kwun Wat	30
A24	Scattered Houses to the West of Poseidon Court	190
A25	Correctional Institution	220
P1	Proposed Residential Development	65
P2	Planned G/IC Site	120
P3	Planned CDA Site	140
P4	PSPS Development in Area 56	50
P5	R (C) Site in Area 55	143
P6	Area 56 CDA Site	180
P7	Area 48 Residential Site	10

Table 1.2 Noise Sensitive Receivers

NSR	Description	Type
<i>North Lantau Section</i>		
NL - N1	Tso Wan	Residential
NL - N2	Fa Peng	Residential
<i>Tsing Lung Tau Section</i>		
TLT - N1	Hong Kong Garden	Residential
TLT - N4	Squatter Area - Northwest of Hong Kong Garden	Residential
TLT - N5	Bayside Villa	Residential
TLT - P1	R (C) Zone to the East of Hong Kong Garden	Residential
<i>Tai Lam Chung Section</i>		
TLC - N1	Correctional Institution (Staff Quarters)	Residential
TLC - N2	Correctional Institution (Clinic)	Clinic
TLC - N3	Tai Lam Chung Tsuen	Residential
TLC - N4	Scattered Village Houses - West of Tai Lam Chung Tsuen Road	Residential
TLC - P1	"V" Zone - South of Tai Lam Chung Viaduct	Residential
TLC - P2	CDA Zone - South of Tai Lam Chung Tsuen	Residential

NSR	Description	Type
Siu Lam		
SL - N1	Siu Lam Psychiatric Centre	Clinic
SL - N2	Siu Lam Hospital	Clinic
SL - N3	Correctional Institution (South Bound of the Siu Lam Interchange)	Residential
SL - N4	Correctional Institution (South Bound of the Siu Lam Interchange)	Residential
SL - N5	Police Quarters	Residential
SL - N6	Correctional Institution Staff Quarters	Residential
SL - N7	Kings Park Villa	Residential
SL - N8	The Castle Bay	Residential
SL - N9	Castle Peak Villa	Residential
SL - N10	Scattered House to the West of Siu Lam Tsuen	Residential
SL - N11	Scattered House to the South of Siu Lam Tsuen	Residential
SL - N12	Scattered House to the West of Poseidon Court	Residential
SL - N13	West of Siu Lam Tsuen	Residential
SL - N14	Poseidon Court	Residential
SL - N15	Correctional Institution Staff Quarters	Residential
SL - N16	Correctional Institution Staff Quarters	Residential
SL - N17	Scattered House to the North of CI Staff Quarters	Residential
SL - N18	Home for the Aged at Siu Lam	Residential
SL - N19	Village House Along Siu Lam Road	Residential
SL - N20	Village House Along Siu Lam Road	Residential
SL - N21	Village House Along Siu Lam Road	Residential
SL - N22	Village House Along Siu Lam Road	Residential
So Kwun Wat		
SKW - N1	So Kwun Wat Ching Uk Tsuen	Residential
SKW - N2	So Kwun Wat Tsuen	Residential
SKW - N3	So Kwun Wat Lee Uk Tsuen	Residential
SKW - N4	So Kwun Wat Govt. School	School
SKW - N5	Lo Tsing Shan Tsuen (So Kwun Wat Interchange - West Bound)	Residential
SKW - N6	Lo Tsing Shan Tsuen (So Kwun Wat Interchange - East Bound)	Residential
SKW - N7	Scattered Village House in So Kwun Wat	Residential
SKW - N8	Scattered Village House in So Kwun Wat	Residential
SKW - N9	Scattered House at So Kwun Wat	Residential
SKW - N10	Scattered House at So Kwun Wat	Residential
SKW - N11	Scattered Village House (Next to the Perowne Barracks)	Residential
SKW - N12	Scattered Village House (Next to Perowne Barracks)	Residential
SKW - N13	Scattered House Located Near Tuen Mun Road / So Kwun Wat Road Junction	Residential
SKW - N14	Scattered Village Houses in Area 56	Residential

NSR	Description	Type
SKW - P1	Area 56 - School Site	School
SKW - P2	Area 56 - PSPS Site	Residential
SKW - P3	Area 56 - CDA Site 1	Residential
SKW - P4	Area 56 - CDA Site 2	Residential
SKW - P5	Area 55 - School Site 1	School
SKW - P6	Area 55 - School Site 2	School
SKW - P7	Area 55 - Residential Site	Residential
SKW - P8	Area 55 - CDA Site	Residential
SKW - P9	Area 48 - Residential Site	Residential

For the purpose of this EM&A, only the existing receivers are considered as sensitive receivers.

Water Quality Sensitive Receivers

Water quality sensitive receivers have been identified as 'marine' life in the vicinity of the Toll Plaza between Fa Peng and Tso Wan.

1.4 Project Organisation

The project organisation and lines of communication with respect to environmental protection works are shown in *Figure 1.13*.

The Environmental Team (ET) shall be appointed by the contractor but shall not be in any way an associated body. The ET leader shall have relevant professional qualifications, or have sufficient relevant EM&A experience, and be subject to approval of the Engineer's Representative (ER) and the Environmental Protection Department (EPD).

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 the 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 contractors, the ER, and the EPD or its delegate.

Appropriate resources shall also be allocated by the contractors and the ER to fulfil their duties as specified in this Manual.

The Independent Checker (Environmental), IC(E), shall be appointed by the contractor and an independent person 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

A preliminary project programme is shown in *Figure 1.14*.

The Project will be constructed in three packages, and the construction works are expected between 2002 and 2007. The preliminary construction programme for the package is summarized in *Table 1.3* below.

Table 1.3 Preliminary Construction Programme

Work Element	Work Elements	Approx Timescale
Advance Works	Advance Works for Tsing Lung Bridge which includes the excavation at Kwai Shek:	Q2 2001 - Q1 2002
Major Contract	(i) Tsing Lung Bridge Viaducts on Lantau Toll Plaza seawalls & reclamation	Q2 2002 - Q4 2006
	(ii) Lantau Toll Plaza	Q1 2005 - Q4 2006
	(iii) Tai Lam Chung Tunnel	Q2 2003 - Q4 2006
	(iv) So Kwun Wat Interchange and Link Road	Q1 2004 - Q4 2006
	(v) Siu Lam Link road	Q1 2005 - Q4 2006

The major construction activities are reclamation, blasting, cutting and filling, anchorage and bridge tower construction, viaduct and superstructure construction, and tunnelling works.

It is expected that construction works will generally be carried out 12 hours a day. However, the bridge and tunnel construction works will require some 24 hours working.

Table 1.4 presents the cut and fill balance for the materials generated from the construction of the Project.

Table 1.4 Cut and Fill Balance for Construction of Route 10 (NLYLH) (Southern Section)

Section	Items included	Cut Volume (m3)	Fill Volume (m3)	Balance
North Lantau	<ul style="list-style-type: none"> • Fa Peng • Toll Plaza • Sam Chuen • Yi Chuen • San Po Tsui 	2,258,000	3,483,000	-1,225,000
Tsing Lung Bridge	<ul style="list-style-type: none"> • Kwai Shek • Tsing Lung Tau 	2,499,000	0	2,499,000
Tai Lam Chung	<ul style="list-style-type: none"> • Tunnel Portals • Tunnel 	2,775,000	566,000	2,209,000

Section	Items included	Cut Volume (m3)	Fill Volume (m3)	Balance
	<ul style="list-style-type: none"> • Tai Lam Chung Viaduct • Siu Lam • Siu Lam Viaduct • Siu Lam Quarry • So Kwun Wat Mainline 			
So Kwun Wat Interchange	<ul style="list-style-type: none"> • So Kwun Wat Link Road • Siu Lam Link Road 	485,000	83,000	402,000
Total (Southern Section)		8,017,000	4,132,000	3,885,000
Notes:				
1. Quantities based on measurement from Preliminary Design Drawings and MOSS program output.				
2. Negative balance shows net import of fill required.				
3. Bulking factor 1.2 NOT included on volumes.				

The majority of the excavated materials will be reused on-site as fill materials for the construction of seawalls, reclamation of the toll plaza and road embankments. The surplus excavated materials will be available for use on other projects.