

1.1

BACKGROUND

San Tin is an area of historical recurrent flooding. The need for the construction of the *Main Drainage Channels and Poldered Village Protection Scheme for San Tin, North West New Territories* (the Project) was established in the *Territorial Land Drainage and Flood Control Strategy Study, Phase 2* (TELADFLOCOSS-2 Study) completed by the Drainage Services Department (DSD) in 1993, to alleviate the recurrent floods in the San Tin basin.

ERM-Hong Kong Limited (ERM), in association with Ecosystems Limited, Shankland Cox Limited and Maunsell Consultants Asia Limited, have been commissioned by the Territory Development Department (TDD) to undertake an Environmental Impact Assessment (EIA) Study for the Project.

The proposed Project comprise:

- *Public Works Programme (PWP) Item No. 35CD covering the village flood protection works for the San Tin villages and Chau Tau Tsuen* - Due to the urgent need to protect the San Tin villages and Chau Tau Tsuen from risk of flooding, the village flood protection works under 35CD commenced in 1996 and will be completed in 1999. The environmental control and monitoring requirements for 35CD, similar to that previously used for the 71CD work for Sha Po Tsuen, were reviewed and considered to be adequate to achieve established Government environmental standards.
- *Non-itemized work for the Western Main Drainage Channel (MDC) for San Tin* - The ongoing DSD's *Drainage Master Plan Study in Northern New Territories* will include a comprehensive review of the need for further flood control works in San Tin. The need of the Western MDC will be reviewed and should the Western MDC be recommended for implementation in the drainage master plan study, an EIA Study will be required for the proposed work, a Designated Project, to fulfill the requirements of the Environmental Impact Assessment Ordinance.
- *PWP Item No. 73CD consisting of the Eastern MDC for San Tin* - Supported by the San Tin Rural Committee and the Yuen Long Provisional District Board, this MDC work is tentatively scheduled for construction from mid-2001 to end-2003.

This EIA Study focuses on the Eastern MDC works providing a detailed assessment of the potential environmental impacts during construction and operation, and identifying mitigation measures and environmental monitoring requirements for incorporation into the engineering design and construction of the drainage channel. Environmental issues assessed include ecology, water quality, solid waste management, land contamination, noise, air quality, visual and landscape and socio-economic. The information will contribute to decisions on the acceptability of any adverse residual environmental impacts. The Antiquities and Monuments Office has confirmed that there is no requirement for heritage impact assessment for the Eastern MDC.

In accordance with the EIA Ordinance, the proposed drainage work for the Eastern MDC is considered a Designated Project under Schedule 2, Part 1 of the Ordinance due to its close proximity to Conservation Area, and therefore the present EIA Study has been undertaken in accordance with the approach and requirements of the Ordinance.

This Environmental Monitoring and Audit (EM&A) Manual provides a summary of the key findings of the EIA Study and details the environmental monitoring and audit requirements of the Eastern MDC works, based on the findings presented in the EIA Report.

1.2

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 for the San Tin Eastern MDC, 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 operation of the Project. It aims to provide systematic procedures for monitoring, auditing and minimising of the environmental impacts associated with the Project.

Hong Kong environmental regulations for air, water quality, noise and waste, the Hong Kong Planning Standards and Guidelines, and recommendations in the EIA study final report on the Project 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) Leader 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.

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.

1.3 *PROJECT DESCRIPTION*

The alignment of the Eastern MDC as given in the Brief has been finalised and committed in the San Tin Outline Zoning Plan (OZP, No. S/YL-ST/1, 1994, see *Figure 1.1b*), following the recommendations in the TELADFLOCOSS-2 Study and consultations with local residents. The Eastern MDC, running parallel and next to the San Sham Road is farthest possible from the ecologically sensitive Ramsar site and, minimises fragmentation of the existing San Tin fish pond areas.

1.3.1 *Preliminary Channel Design*

The proposed channel are constructed for the purpose of flood protection, approximately 2.2km long and 45m wide. The design of the channel basically follows the DSD Stormwater Design Manual. The channel will be designed to have adequate capacity to cater for a 1 in 50 years storm combined with a 1 in 10 years tide with 300 mm freeboard, and the 1 in 200 years event should also be retained within the channel.

Figure 1.3a shows the preliminary design layout of the Eastern MDC. The connection to the existing trapezoidal channel upstream at Castle Peak Road is at 180 degrees (which is hydraulically preferable). The connection at the Shenzhen River is streamlined at about 60 degrees to minimize head loss. The proposed channel consists of two river embankments at about 4.9 mPD, with channel bed varying from 0.65 mPD to 1.5 mPD. The side slopes of the channel are 1 in 2, both internal and external. The proposed trapezoidal channel is about 30 m wide (river bed) and will hold about 4.5 m depth of water.

The following design features have been specifically adopted for the Eastern MDC, providing ecologically and aesthetically friendly solution, and taking into account hydraulic performance and operational requirements of the channel:

- The inner lining of the channel will all be grasscreted with perennial vegetation, except the dry weather flow interceptor.
- The external slope of the channel will be general fill slope with planting of suitable vegetation.
- There will only be one maintenance access roads on top of the western channel embankment, approximately 3.5 m wide.

In addition to the channel, there will be one inflatable dam, one air blower house and pumping station as shown in *Figure 1.3a*, for the purpose of preventing backflow of sediment rich waters from Shenzhen River during high tide, as well as removing water to Shenzhen River during low flow condition.

1.4 CONSTRUCTION

For the 73CD Eastern MDC works, the construction is tentatively scheduled to commence in June 2001 for a period of 30 months up to December 2003 with provision of extension of time. The construction programme is planned as follows:

- first 4 months - setting up of site office, environmental monitoring baseline exercise, application of permits such as Noise Control Permit and Close Area Permit and forming haul road;
- next 24 months - construction of pumping station, inflation dam, bridge, box culverts, embankment, landscaping and constructed wetland; and
- last 2 months - connection of channel to Shenzhen River and tidying up the site, outstanding landscape and constructed wetland.

The main construction activities will include excavation and filling, followed by grasscreting of channel linings and the access road construction. The plant used for the construction of the channels will be common types used for civil engineering works in Hong Kong, for example, dump trucks, excavators, loaders, etc. The major plant used will be the earth moving plant for the construction of the earth embankment. Construction will be carried out by land plant.

1.5 OPERATION

Maintenance is required for the channel, mainly involving the desilting of the channel to keep the channel under a free flow condition. Maintenance dredging of Eastern MDC will be carried out by a land-based dredger on a need basis, in dry condition during low tide or when the inflatable dam constructed at downstream of the channel is inflated to exclude the effect of tide. Disposal of the excavated materials will be by land transport to public fill area or landfill depending on the quality of the materials.

1.6 SENSITIVE RECEIVERS

1.6.1 Air Sensitive Receivers

Representative Air Sensitive Receivers (ASRs) have been identified according to the criteria set out in the TM and through site inspections and review of landuse plans of the Study Area. Domestic premises, school and recreation areas are classified as ASRs.

The identified ASRs and their horizontal separation between the eastern channels associated with the MDC are given in *Table 1.6a* below and the locations are shown in *Figure 1.6a*.

Table 1.6a *Identified ASRs and Separations to the Channels*

ASRs	Location	Distance to Main Drainage Channel (73 CD) (m)
1	Lok Ma Chau Control Point	80
2	Ha Wan Tsuen	280
3	Ki Lun Tsuen	500
4	Yan Shau Wai	500
5	Tung Chan Wai	270
10	Wing Ping Tsuen	370

1.6.2 Noise Sensitive Receivers

Noise Sensitive Receivers, as defined by HKPSG and the NCO, have been identified by site survey and reference to survey sheets. The identified NSRs are low-rise residential (2 to 3 storeys high) and their approximate distances from the nearest channels (locations shown in *Figure 1.6b*) associated with the MDCs are given in *Table 1.6b* below.

All NSRs are considered to be village type developments and therefore an Area Sensitivity Rating of "A" has been assigned to those distant from NTCR, and an Area Sensitivity Rating of "B" has been assigned to those considered to be indirectly affected.

Table 1.6b *Identified NSRs and their Area Sensitivity Rating*

NSRs		Distance to Eastern MDC (73CD)	Distance to Pumping Station	Area Sensitivity Rating
1	Ha Wan Tsuen	280	340	A
2	Pun Uk Tsuen	570	N/A	A
3	Chau Tau Tsuen	540	N/A	A
4	Ki Lun Tsuen	500	N/A	A
5	Yan Shau Wai	320	N/A	A
6	Tung Chan Wai	270	N/A	A

NSRs		Distance to Eastern MDC (73CD)	Distance to Pumping Station	Area Sensitivity Rating
7	On Lung Tsuen	530	N/A	A
8	Fan Tin Tsuen	580	N/A	A
9	Wing Ping Tsuen	370	N/A	B
10	San Lung Tsuen	680	N/A	A
11	Tsing Lung Tsuen	830	N/A	B

All distances to NSRs have been calculated in accordance with *Clause 2.7* of IND-TM.

1.6.3 *Water Quality and Ecological Sensitive Receivers*

Around the Eastern MDC, there are fish ponds towards the west and the stream channel towards south, although stream water does not directly drain through the fish ponds. Streams which drain the San Tin area discharge into Shenzhen River and eventually into Inner Deep Bay approximately 2 km downstream.

As shown in *Figure 1.6c*, Water Quality Sensitive Receivers (WSRs) during construction include the surrounding water bodies along the Eastern MDC, either in direct contact (existing stream channel and Shenzhen River) or indirect contact (adjacent fishponds). During the operation phase, the WSR will be the discharge water body which is the Shenzhen River.

1.6.4 *Land Contamination*

Potential sensitive receivers who may come into contact with contaminated soils excavated during the construction and operational programme are construction workers and surrounding land users such as local villagers. However, no major impacts are expected as long as standard mitigation measures are employed during the earth works programme.

In addition, excavation of potentially contaminated areas could potentially lead indirectly to increased soil disturbance and migration of any contaminants present on the sites into the surrounding fish ponds and channels. However, this is considered unlikely to be significant, due to the localised nature of contamination, and provided that standard mitigation measures are employed.

1.7 *SUMMARY OF THE EIA STUDY*

The primary objective of the EIA Study is to provide information on the nature and extent of the potential environmental impacts associated with the proposed development of the Project, focussing on the Eastern MDC. This information will contribute to decisions on the acceptability of any adverse environmental impacts likely to result from the construction and subsequent operation of the Project, and the conditions for the design and construction of the Project. Issues assessed include ecology, water quality, solid waste management, land contamination, noise, air quality, visual and landscape and socio economic.

The EIA has been undertaken in accordance with the scope of work and methodology set out in the Inception Report. The following provides a summary of the key findings of the EIA Study.

1.7.1 *Air Quality*

Construction Phase

This assessment indicated that the dust criteria will be complied at all the air sensitive receivers during construction of the Eastern MDC. Mitigation measures as good construction practice should follow the *Air Quality (Construction Dust) Regulation* to ensure the dust level is within the criteria. As the sensitive receivers are located more than 80 m away from the channel, potential odour nuisance is not expected. Mitigation measures and EM&A requirements have been recommended to minimise potential nuisance from the work.

Operational Phase

There will be no pollutant sources during the operational phase, but it is expected that the impacts from infrequent ad hoc maintenance excavation will be similar to the excavation during the construction phase but to a smaller scale. Mitigation measures recommended for the construction phase will generally apply to maintenance excavation.

1.7.2 *Noise*

Construction Phase

The main noisy activities during the construction of the Eastern MDC are expected to include excavation, pond drainage operations, embankment formation, access road construction, river bed and pumping station construction. The assessment concludes that the construction can be carried out without exceeding the daytime noise criterion with respect to established criteria. Good construction practices such as use of quiet plant and working methods are recommended to minimise any potential impact.

Operational Phase

Operational noise emissions from the Eastern MDC pumping station can comply with the HKPSG standards through appropriate design of the pumping station. It is expected that potential impact from the infrequent maintenance excavation will be small.

1.7.3 *Water Quality*

Construction Phase

The key issue in terms of water quality will be related to the excavation for the Eastern MDC channel along the existing stream course. This activity, if uncontrolled, is likely to lead to the release of suspended solids and pollutants from the disturbed existing stream sediments and reduction of dissolved oxygen within the local water bodies, affecting potential water sensitive receivers

downstream. However, the impact is expected to be small as the excavation will be conducted mostly along filled fishponds and earth bunds.

A range of mitigation measures and working method controls has been recommended, such as use of sediment traps and excavation at the existing stream course in the dry season, to ensure that potential to water quality impact is minimised to within acceptable levels.

Operation Phase

The proposed Eastern MDC Project will introduce drainage improvements at San Tin, and will improve water quality through enhanced transportation of pollutants and increased flow rate of the water column. The installation of the inflatable dam at the proposed Eastern MDC will also eliminate the potential impact of pollutants from Shenzhen River due to tidal intrusion. Potential impact from ad hoc maintenance excavation is expected to be limited and will be controlled by appropriate measures.

1.7.4 Waste management

Construction Phase

Excavation and disposal of river and fish pond sediment will be the key sources of impact during the construction phase. The total amount of excavated materials from the San Tin Eastern MDC works will be about 115,000 m³, of which less than 10,000 m³ could be classified as seriously contaminated sediment in accordance with Environmental Protection Department's (EPD) guidelines. Some soft excavated materials such as pond sediment (if uncontaminated) can be re-used on site for the constructed wetland and landscaping works. It is recommended that a sediment quality investigation should be carried out prior to the commencement of the construction works to confirm quantity of the contaminated sediment, and presented in a Sediment Quality Report to EPD and Fill Management Committee. Special excavation and disposal procedures as recommended in the report will be required to minimise potential environmental impacts. Together with other mitigation measures such as proper handling and disposal of construction and chemical waste, and recycling of construction and demolition materials on site, it is anticipated that the potential environmental impacts associated with the handling, storage, transport and disposal of wastes arising from the work will meet the established guidelines.

Operational Phase

It is expected that impacts from the ad hoc maintenance excavation will be similar to the excavation during the construction phase but on a smaller scale. Hence, mitigation measures for the handling and disposal of solid waste generated from the operational phase will be similar to that recommended for the construction phase.

1.7.5 *Ecology*

Construction Phase

Loss of wetland habitats of ecological value, particularly to waterbirds and their prey, was identified as the impact of primary concern. Impacts of habitat loss have been addressed through a package of mitigation measures that includes impact avoidance and reduction, wetland restoration and wetland creation. Construction phase impacts to aquatic ecology in local watercourses, the Shenzhen River and Inner Deep Bay could occur due to water quality degradation during channel excavation; these impacts would be addressed by controls on excavation methods, timing and spoil disposal. The potential impact of disturbance to sensitive wildlife during construction works would be addressed by the mitigation measures proposed for noise control. Overall, the mitigation measures proposed would limit predicted impacts to acceptable levels.

Operational Phase

Channel maintenance (excavation and vegetation cutting) could affect ecology in the in-channel compensatory wetland area. These impacts can be mitigated by keeping the frequency of maintenance works to the lowest level commensurate with maintaining flood capacity. Other ecological impacts arising during the operational phase would be related to disturbance from human and vehicle traffic along the channel embankment road. These will be mitigated through the habitat mitigation measures adopted for construction phase impacts. Overall, the mitigation measures proposed would limit impacts to acceptable levels.

1.7.6 *Landscape and Visual*

The landscape and visual assessment has identified that the main impact from the Eastern MDC occurs through the use of elevated embankment along the channel sides leading to visual impact particular to residents in close proximity of the channel. Specific design and landscaping mitigation measures have been recommended to minimise impact, such as appropriate screen planting, grasscrete lining (vegetation cover) of channel and sensitive design of pumping station to relate to other building structures in the surrounding.

1.8 *ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS*

1.8.1 *Air Quality*

Dust monitoring is recommended during construction to ensure compliance with the target limits for air quality. The monitoring locations should be at the site boundary or such locations close to the major dust emission source, close to the sensitive receptors, taking into account the prevailing meteorological conditions.

1.8.2 *Noise*

Noise monitoring is recommended during construction to ensure compliance with the target limits for noise specified in the EIA Ordinance and Deep Bay Guidelines. It is recommended that noise monitoring be carried out during the construction period of the MDCs works at Sam Po Shue, Tung Chan Wai and surrounding area of the pumping station.

1.8.3 *Water Quality*

Based on the EIA Report of water quality impacts, it is recommended that during the construction of the MDC, a water quality monitoring and audit programme should be conducted to detect any deterioration of water quality. Monitoring location will be carried out at the ultimate discharge point of the Eastern Channel.

1.8.4 *Waste*

During the construction phase, auditing of different waste generation, storage, recycling, treatment, transport and disposal arrangements/procedures should be carried out periodically to determine if waste is being managed in accordance with approved procedures and the site waste management plan.

1.8.5 *Ecology*

Ecological monitoring and audit is recommended during the first three years of operational phase to detect any unpredicted ecological impacts and to monitor the effectiveness of the mitigation measures. Monitoring of bird use, fish and invertebrates of San Tin villages flood storage ponds and Eastern Channel area should be carried out, including operational management regime and planting monitoring and audit.

1.9 *PROJECT ORGANISATION*

The San Tin Eastern MDC project organisation and lines of communication with respect to environmental monitoring and audit works is shown in *Figure 1.9a*.

The Environmental Team (ET) Leader shall have relevant professional qualifications, or have sufficient relevant EM&A experience subject to approval of the Engineer or Engineer's Representative (ER) and the Environmental Protection Department (EPD)

The responsibility of respective parties are:

The Project Proponent (Works Agent):

- Ensure the full implementation of environmental mitigation measures to comply with Environmental Permit conditions under the Environmental Impact Assessment Ordinance.

The Contractor:

- Employ an Environmental Team (ET) to undertake monitoring and audit, laboratory analysis and reporting of environmental monitoring and audit;
- Provide assistance to ET in carrying out regular environmental monitoring and audit and ensuring environmental mitigation measures recommended in the EIA study and in the Contract Specifications are enforced.
- Submit proposals on mitigation measures in case of exceedances of Action and Limit levels in accordance with the Event and Action Plans;
- Implement measures to reduce impact where Action and Limit levels are exceeded.
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 7.3*.

The Engineer or Engineer's Representative:

- Supervise the Contractor's activities and ensure that the requirements in the EM&A Manual and pollution control clauses in the Contract Specification are fully complied with;
- Inform the Contractor when action is required to reduce impacts in accordance with the Event and Action Plans;
- Employ an Independent Environmental Checker (IC(E)) to audit the results of the EM&A works carried out by the ET; and
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 4.3*.

The Environmental Team Leader:

- Monitor the various environmental parameters as required in the EM&A Manual;
- Analyse the environmental monitoring and audit data and review the success of EM&A programme to cost effectively confirm the adequacy of mitigatory measures implemented and the validity of the EIA predictions and to identify any adverse environmental impact arising;
- Carry out site inspection to investigate and audit the Contractor's site practice, equipment and work methodologies with respect to pollution control and environmental mitigation, and anticipate environmental issues for proactive action before problems arise;
- Audit and prepare audit reports on the environmental monitoring data and the site environmental conditions;
- Report on the environmental monitoring and audit results to the IC(E), Contractor, the ER, and the EPD;

- Recommend suitable mitigation measures to the Contractor in the case of exceedance of Action and Limit levels in accordance with the Event and Action Plans; and
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 7.3*.

Independent Environmental Checker:

- Review the EM&A works performed by the ET Leader;
- Audit the monitoring activities and results;
- Report the audit results to the ER and EPD in parallel;
- Review the EM&A reports submitted by the ET;
- Review the proposal on mitigation measures submitted by the Contractor in accordance with the Event and Action Plans;
- Adhere to the procedures for carrying out complaint investigation in accordance with *Section 4.3*.

Sufficient and suitably qualified professional and technical staff shall be employed by the respective parties to ensure full compliance with their duties and responsibility, as required under the EM&A programme for the duration of the project.

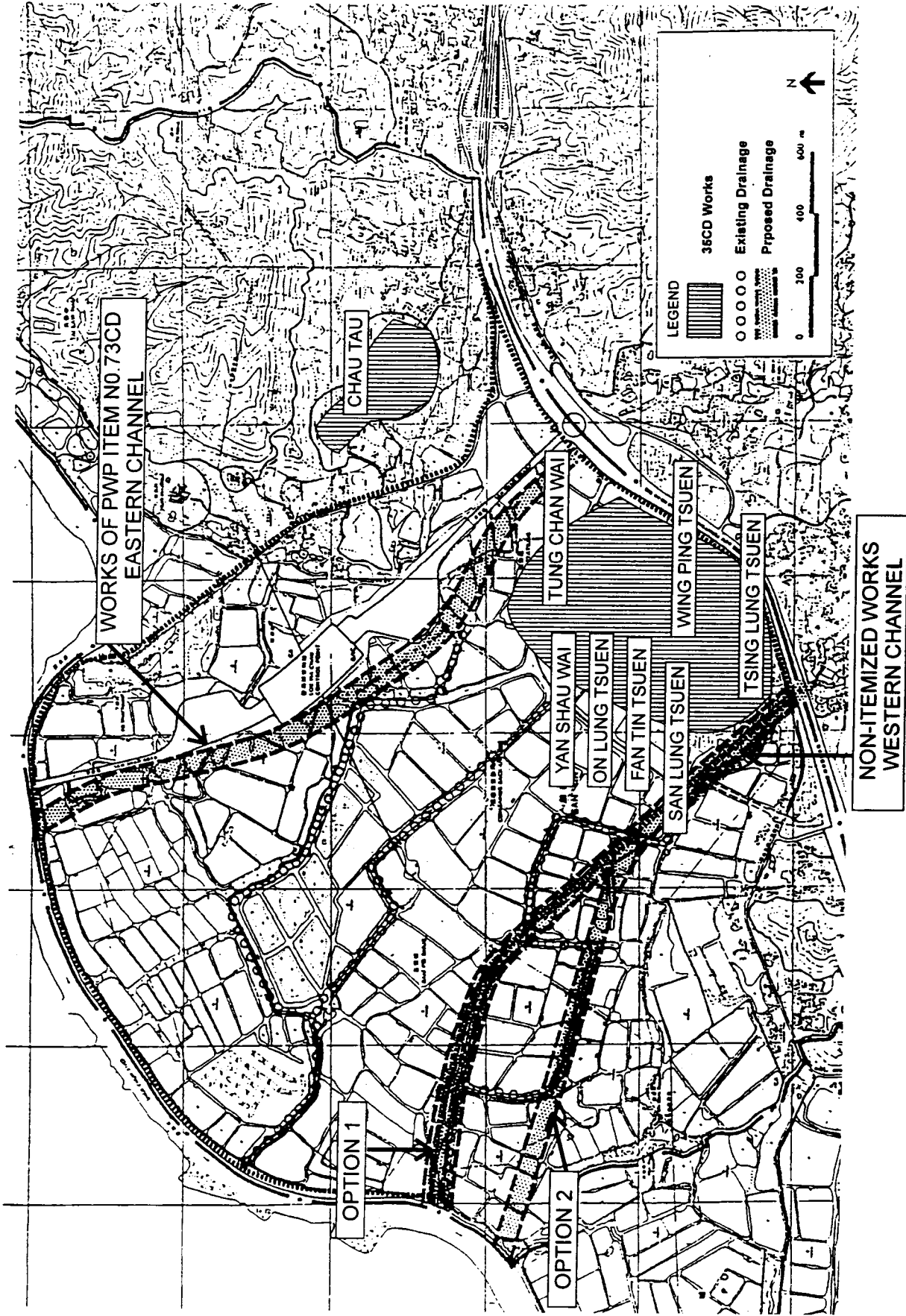


FIGURE 1.1a
LOCATION OF SAN TIN MAIN DRAINAGE CHANNELS AND POLDERED VILLAGE PROTECTION SCHEME WORKS



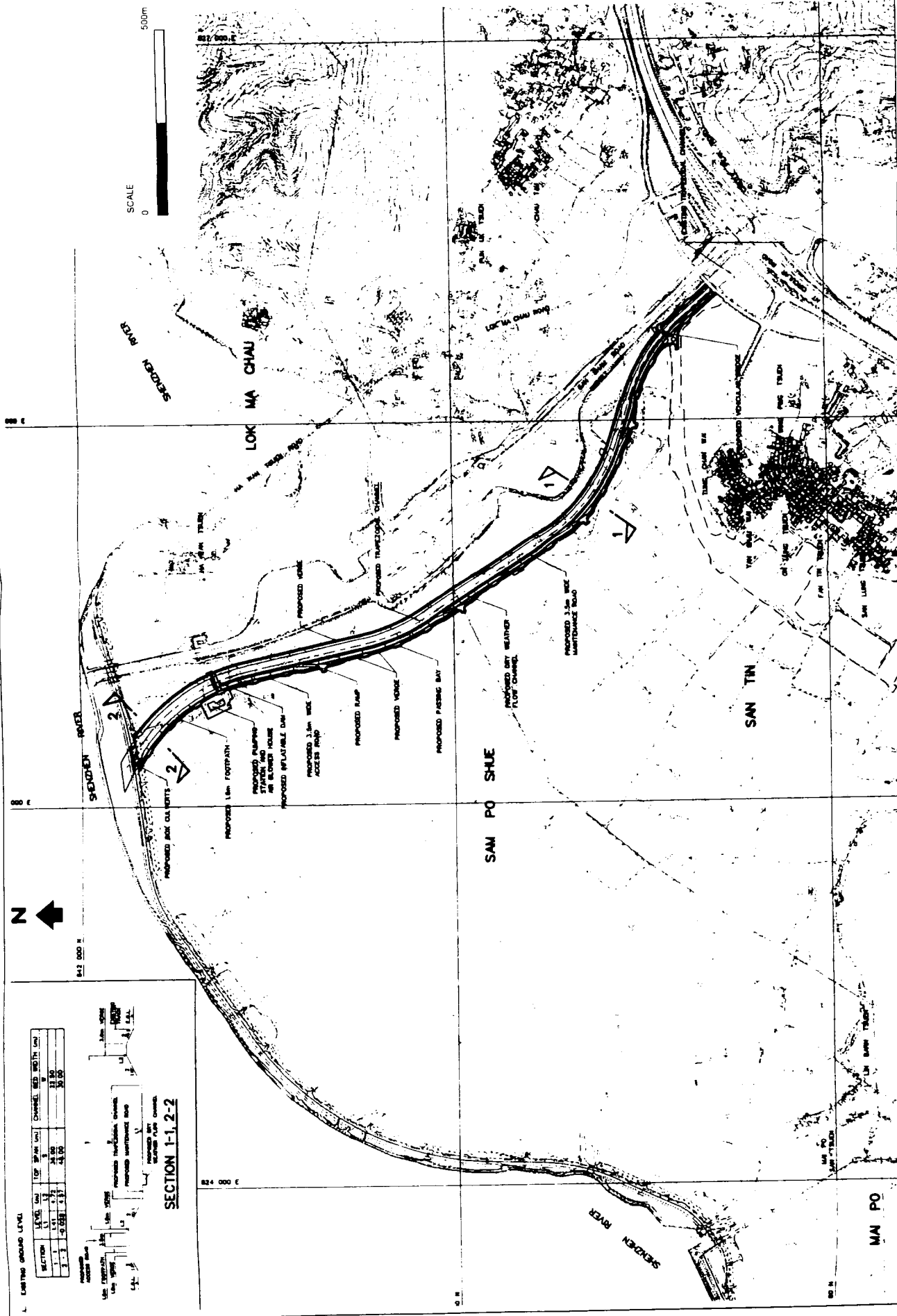
FIGURE 1.1b

SAN TIN OUTLINE ZONING PLAN
(NO.S/YL-ST/1, 1994)

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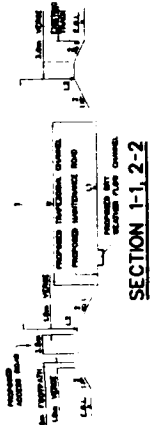


PRELIMINARY LAYOUT OF EASTERN MDC

FIGURE 1.3a

1. EXISTING GROUND LEVEL

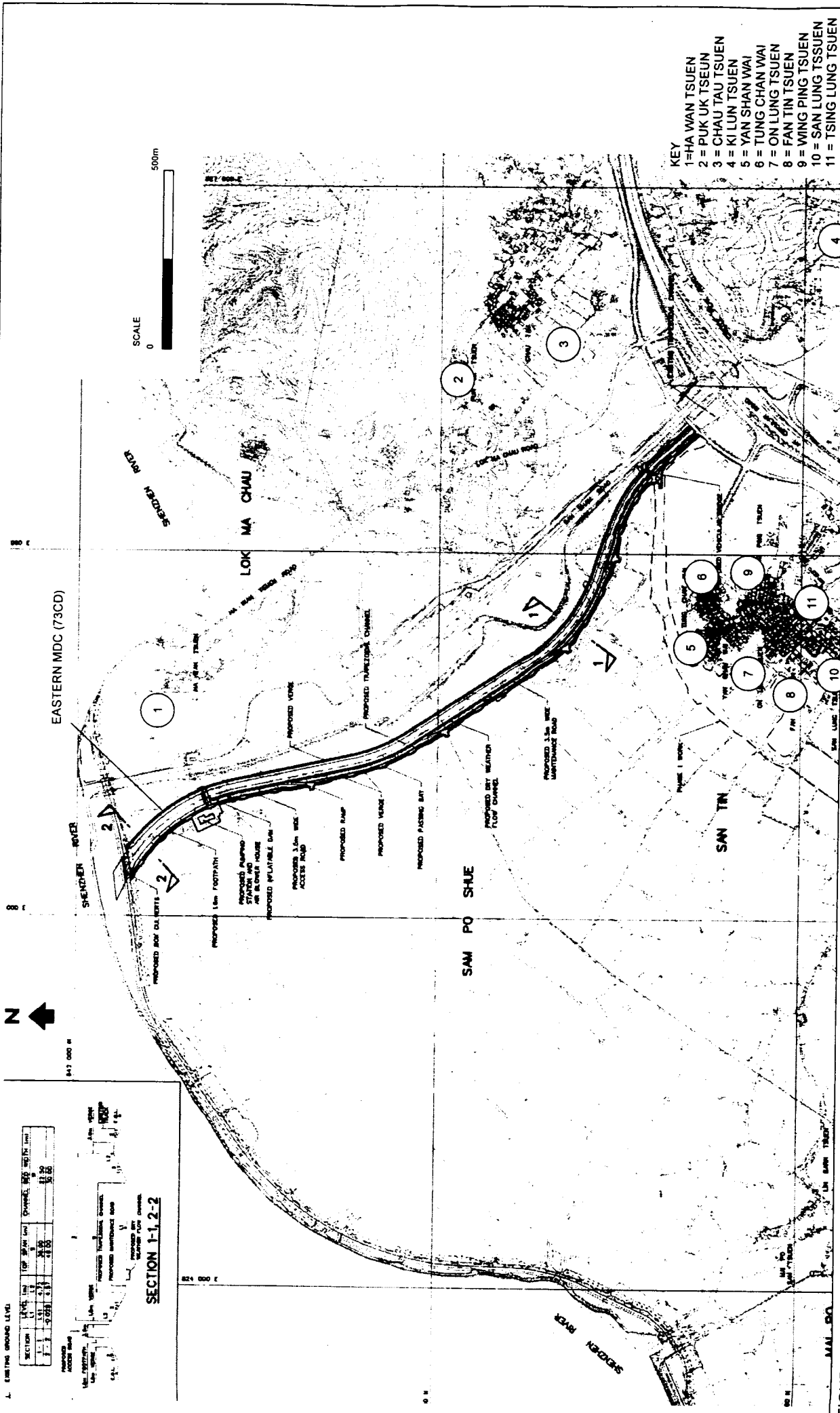
SECTION	LEVEL (m)	TOP OF DAM (m)	CHANNEL BED WIDTH (m)
1-1	1.1	3.80	11.80
2-2	1.1	4.80	11.80
3-3	1.1	4.80	11.80



4. EXISTING GROUND LEVEL

SECTION	LEVEL	DATE	BY	CHKD	APP'D
1-1	1.00	11/99
2-2	2.00	11/99

SECTION 1-1, 2-2









- KEY
- 1=HA WAN TSUEN
 - 2= PUK UK TSEUN
 - 3= CHAU TAU TSUEN
 - 4= KIL LUN TSUEN
 - 5= YAN SHAN WAI
 - 6= TUNG CHAN WAI
 - 7= ON LUNG TSUEN
 - 8= FAN TIN TSUEN
 - 9= WING PING TSUEN
 - 10= SAN LUNG TSSUEN
 - 11= TSING LUNG TSUEN

LOCATION OF REPRESENTATIVE NSRS

FIGURE 1.6b



- KEY
-  PWP ITEM NO.73CD (EASTERN MDC)
 -  TEMPORARY CONTAINER VEHICLE PARK AND CONTAINER STORAGE UP TO NOVEMBER 2000
 -  EXISTING STREAM CHANNEL
 -  FISHPONDS ADJACENT TO EASTERN CHANNEL
 -  SHENZHEN RIVER
 -  SHENZHEN RIVER WATER QUALITY MONITORING STATIONS
- WSRs —



SCALE 1 : 20500

FIGURE 1.6c WATER QUALITY SENSITIVE RECEIVERS AND LOCATIONS OF SHAM CHUN RIVER WATER QUALITY MONITORING STATIONS

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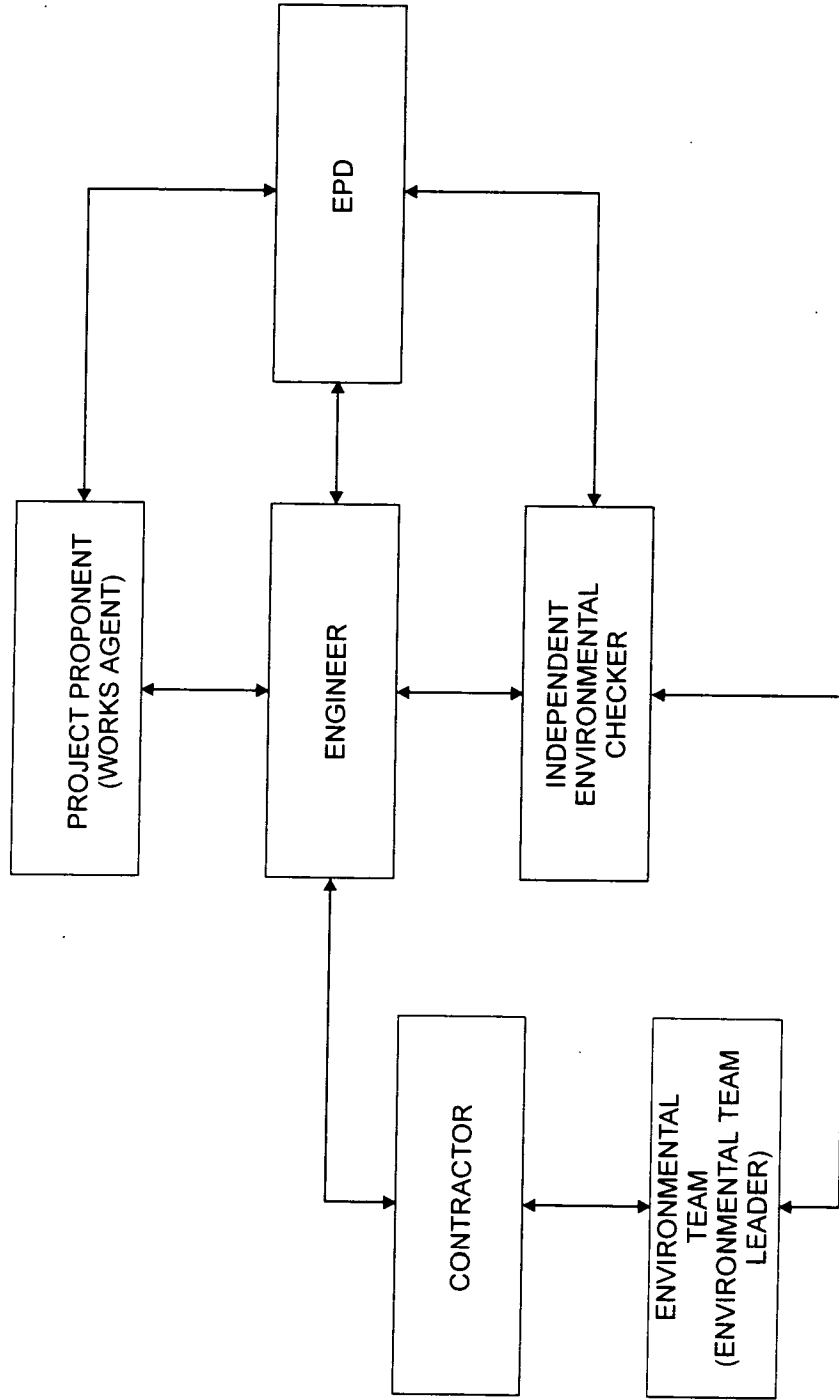


FIGURE 1.9a

PROJECT ORGANISATION AND LINES OF COMMUNICATION WITH RESPECT TO THE EM&A PROGRAMME

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