

Removal of Sediment in Sham Wan and Kau Sai Fish Culture Zones

Project Profile

December 1998

Agriculture & Fisheries Department

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1. Introduction

Bottom sediment under the Sham Wan and Kau Sai fish culture zones (FCZs) contain a large amount of organic matter accumulated over the years. This is largely the result of the traditional practice of using trash fish as fish feed in the past decades. The organic sediment would adversely affect the surrounding marine habitats, the associated marine life and the productivity of the FCZs.

To reduce the problem of bottom sedimentation, Agriculture and Fisheries Department (AFD) introduced in 1994 a new pellet feed formulation in place of trash fish. Better fish growth and good environmental benefits of less water pollution and a cleaner sea bottom were observed in some farms in Lo Tik Wan FCZ. The improvement of sea bottom conditions through the promotion of the environmental-friendly pellet feed alone could likely be a slow process. To achieve quick improvements in the marine environment, the Director of Agriculture and Fisheries hence proposes the removal of bottom sediment at FCZs by dredging. There are several localized benefits in this project in both fisheries and ecological views. They include:

- Improvement of the local water quality and sediment condition to be more suitable for fish culture and for benthic colonization;
- Removal of the anoxic sediments to enable fast recovery of the bottom environment within weeks rather than years through decomposition by natural process;
- Removal of the bulk of nutrient trapped in the sediment in the FCZs can help to reduce the risks of local red tide;
- Minimising fish kills due to the upwelling of anoxic and toxic gas; and,
- Removal of trapped nutrient which may be released gradually, affecting the water quality at fish culture zones and the surrounding environment.

The Federation of Hong Kong Aquaculture Associations (comprising representatives of various fish culture zones) has requested Government assistance in the removal of sediment under fish culture zones in April and May 1998. The Federation is also supportive of the proposal to conduct a pilot project in the selected fish culture zones. Some members of the Provisional Legislative Council also supported Government action to remove sediment in fish culture zones. The Federation and the fish farmers in the two fish culture zones concerned will be closely

liaised with, to exchange views and to ensure the smooth progress of the dredging process.

Despite the obvious benefits of removing bottom sediment in fish culture zones, there is a lack of experience in sediment dredging in fish culture zones. The practical way forward is to conduct dredging in a few fish culture zones on a trial basis in order to gain experience in such dredging operations and to monitor its effectiveness.

In the last application (Project Profile ref # DIR-003/ 1998, submitted on 14 August 1998), sediment dredging works was proposed for Lo Tik Wan, Sok Kwu Wan and Cheung Sha Wan FCZs. Sediment dredging has now been started at Cheung Sha Wan FCZ since 26 November 1998, but not the other two zones because a large number of mariculturists of these two zones did not agree to the dredging. On 8 December 1998, Hon. Wong Yung-kun, Chairman of the Federation of Hong Kong Aquaculture Associations suggested to use the remainder of the funds for removing sediment in Sham Wan and Kau Sai FCZs.

This sediment removal exercise at the FCZs is a pilot study in Hong Kong and will provide valuable experience and information on the technical feasibility and environmental acceptability for future dredging in other FCZs.

2. Basic Information

2.1 Project Title

Removal of Sediment in Sham Wan and Kau Sai Fish Culture Zones.

2.2 Purpose and Nature of the Project

To remove the enriched sediment at the seabed of the two selected Fish Culture Zones by grab dredging so as to improve the environmental conditions.

2.3 Name of the Project Proponent

Agriculture & Fisheries Department.

2.4 Location & Scale of Project

The proposed areas are beneath the gazetted zone areas of the two FCZs, Sham Wan (Figure 2.4a) and Kau Sai (Figure 2.4b). Depths of sediment to be dredged range from 0.5-1m and in no circumstances, greater than 1 m depth, referenced from the dredging operation at Cheung Sha Wan. The exact depth of sediment to be dredged will be finalised pending the sediment testing results. The gazetted zone areas and maximum sediment volume (estimated on the dredging depth to be 1 m) of the two FCZs are summarized in Table 2.4a. Approximately 226,800 m³ of in situ sediment will be removed in the Project. The corresponding coordinates of the two FCZs are shown in Table 2.4b.

Table 2.4a The proposed sediment volume to be dredged and the zone area of the two subjected Fish Culture Zones (Assuming the maximum dredging depth to be 1m)

Fish Culture Zone	Zone Area (m ²)	Proposed Sediment Volume (m ³)
Sham Wan	180,600	180,600
Kau Sai	46,200	46,200

Table 2.4b The coordinates of the two Fish Culture Zones

	Northing	Easting
Sham Wan		
SW 1	833895.876	854323.847
SW 2	833960.330	854.611.720
SW 3	833892.645	854654.370
SW 4	833747.805	854557.945
SW 5	833440.784	854521.947
SW 6	833133.763	854485.950
SW 7	833138.000	854306.000
SW 8	833516.938	854314.923
Kau Sai		
KS1	822546	850635
KS2	822546	851096
KS3	822426	850944
KS4	822426	850635

2.5 Number and Type of Designated Projects

Dredging of sediment in the gazetted zone areas of the two FCZs is an operation which is less than 500m from the nearest boundary of an existing fish culture zone and is classified as a designated project under C.12 of Schedule 2 of the Environmental Impact Assessment Ordinance.

2.6 Name & Telephone number(s) of Contact Person(s)

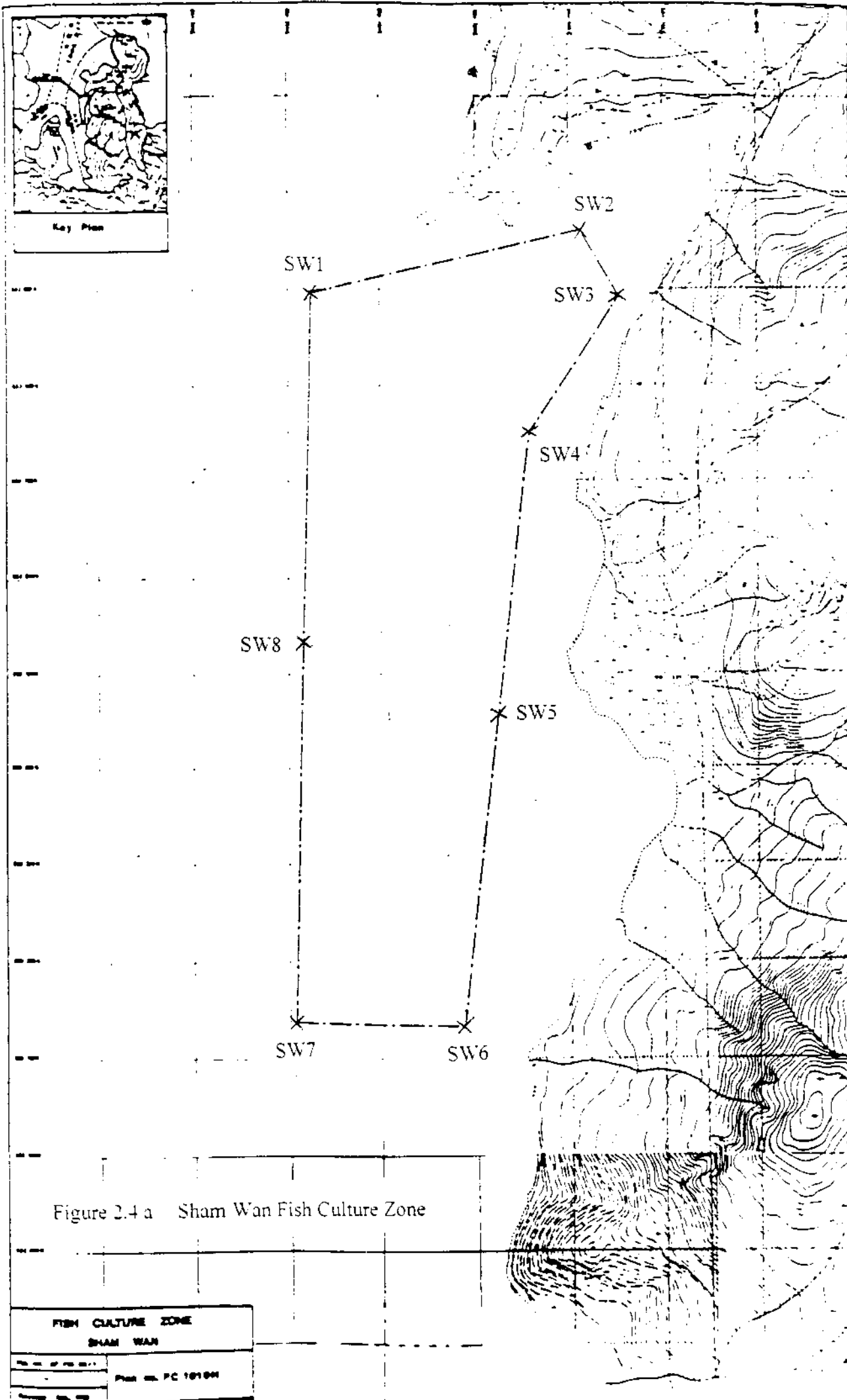
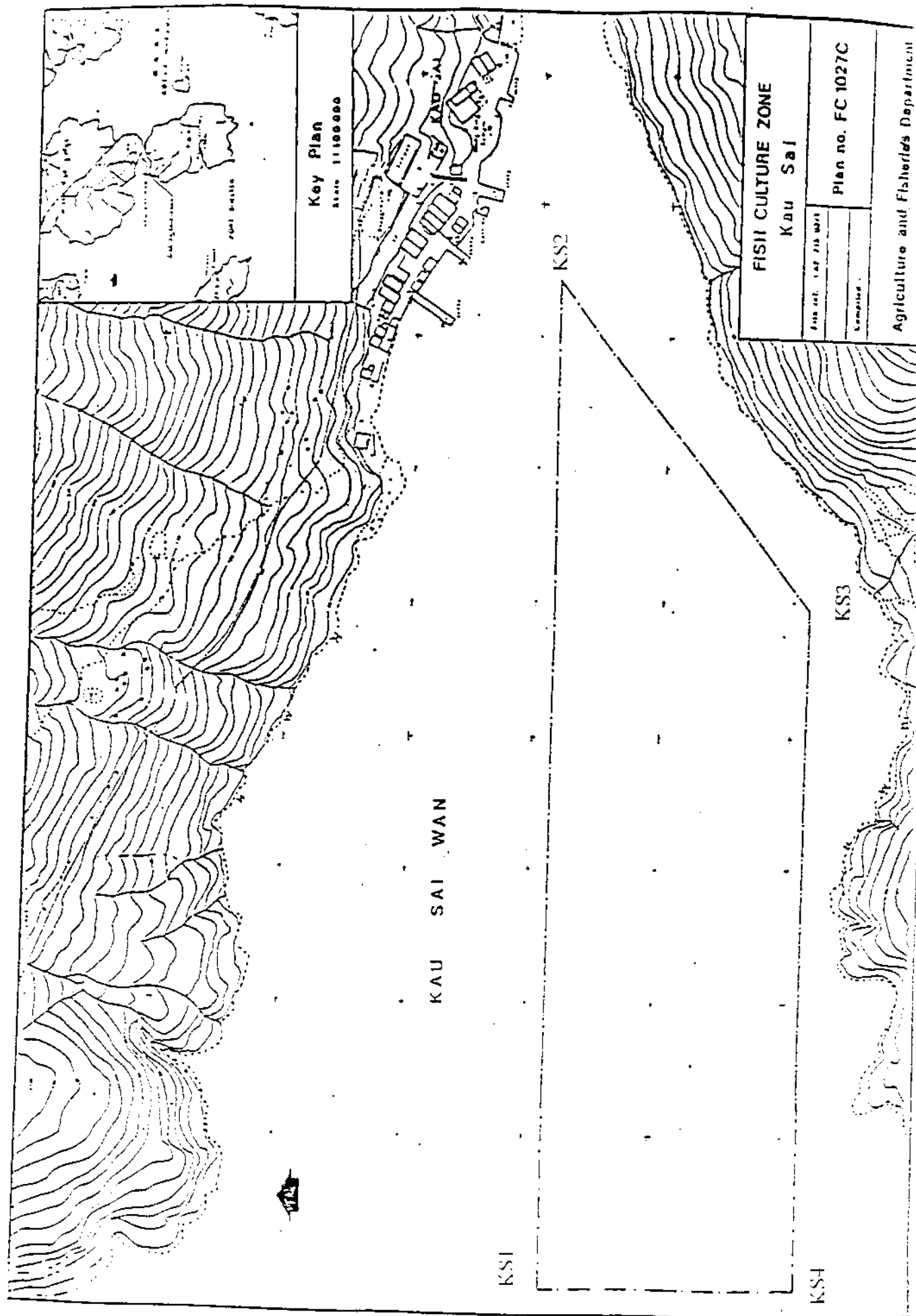


Figure 2.4 a Sham Wan Fish Culture Zone

FISH CULTURE ZONE SHAM WAN	
Scale 1:50,000	Photo No. PC 101004
Scale 1:10,000	

Figure 2.4 b Kau Sai Fish Culture Zone



3. Planning and Implementation Programme

3.1 Planning and Implementation

The whole project will be planned and implemented by Agriculture and Fisheries Department (AFD) in collaboration with Civil Engineering Department (CED). Dredging will be carried out by contractors appointed by CED.

3.2 Project Programme

The project programme includes

- i. Temporary Relocation of Mariculture Rafts,
- ii. Dredging Operation and
- iii. Water and Sediment Quality Monitoring.

The work is scheduled to start in March 1999 and be finished by June 1999.

i. Temporary Relocation of Mariculture Rafts

Mariculture rafts are required to relocate temporarily to areas which will not interfere with the dredging operation. Relocation of rafts will start at least two weeks before the dredging operation. Only rafts with fish will be moved to the relocation site while the vacant rafts will be relocated to the nearby shores. The number of rafts, total area of rafts, area of waters occupied and maximum duration of the relocation for the two FCZs are estimated in Table 3.2a.

Table 3.2a Estimate of number of rafts, total area of rafts, area of waters occupied and maximum duration of relocation for temporary relocation of mariculture rafts of the two FCZs

FCZs	No. of rafts	Total raft area (m ²)	Area of waters occupied (m ²)	Duration (weeks)
Sham Wan	80	8,200	54,000	16
Kau Sai	70	8,400	28,000	8

The proposed relocation sites for Sham Wan and Kau Sai FCZs are shown respectively on Figs 3.2 a & b. As shown in Fig 3.2a, two relocation sites, near Ko Tang Hau and Nam Fung Wan are considered for the present relocation of Sham Wan FCZ. Mariculturists prefer the site at Ko Tang Hau, and Nam Fung Wan will be treated as the emergency site. The location of the final relocation site is subject to approval of Environmental Protection Department (EPD), Marine Department (MD) and agreement from the Jockey Club Wong Shek Water Sports Centre. For Kau Sai FCZ, it has been agreed by EPD and MD that the rafts can be temporarily relocated to the site at Kau Sai Wan (Fig 3.2b). The other site near Tai Wong Wan is only reserved for emergency purpose.

ii. Dredging Operation

To shorten the period of disturbance to the FCZs and the environment during dredging, it is important that the dredging operation should be carried out within shortest possible time. Hence, 2 grab dredgers will be deployed by CED's contractor. Working sequence and the average dredging rate in each FCZ are presented in Figs 3.2 c & d for Sham Wan and Kau Sai respectively.

The whole dredging process will be finished within 12 weeks for the two FCZs (Table 3.2b). The timing may vary slightly depending on the zone areas and the weather condition during dredging. The programme is prepared based on the assumption that the dredging will proceed between 0700-2300 everyday, including general holidays and Sunday. In Sham Wan, two dredgers will be deployed from 1st to 8th weeks. By the end of the 8th week, one of the dredgers at Sham Wan will move to Kau Sai. From the 8th week onwards, there will be one dredger operate in each FCZs and the works will be completed by the end of the 12th weeks.

iii. Water and Sediment Quality Monitoring.

Prior to and after the dredging procedure, a period of 4 weeks will be assigned for the baseline and post-project water quality monitoring (WQM, Table 3.2b). Impact WQM will also be assigned for the whole dredging period. Sediment testing for the relocation sites will also be carried out before and after the relocation process. For details, please refer to Appendix II. the Environmental Monitoring & Auditing (EM & A) Manual.

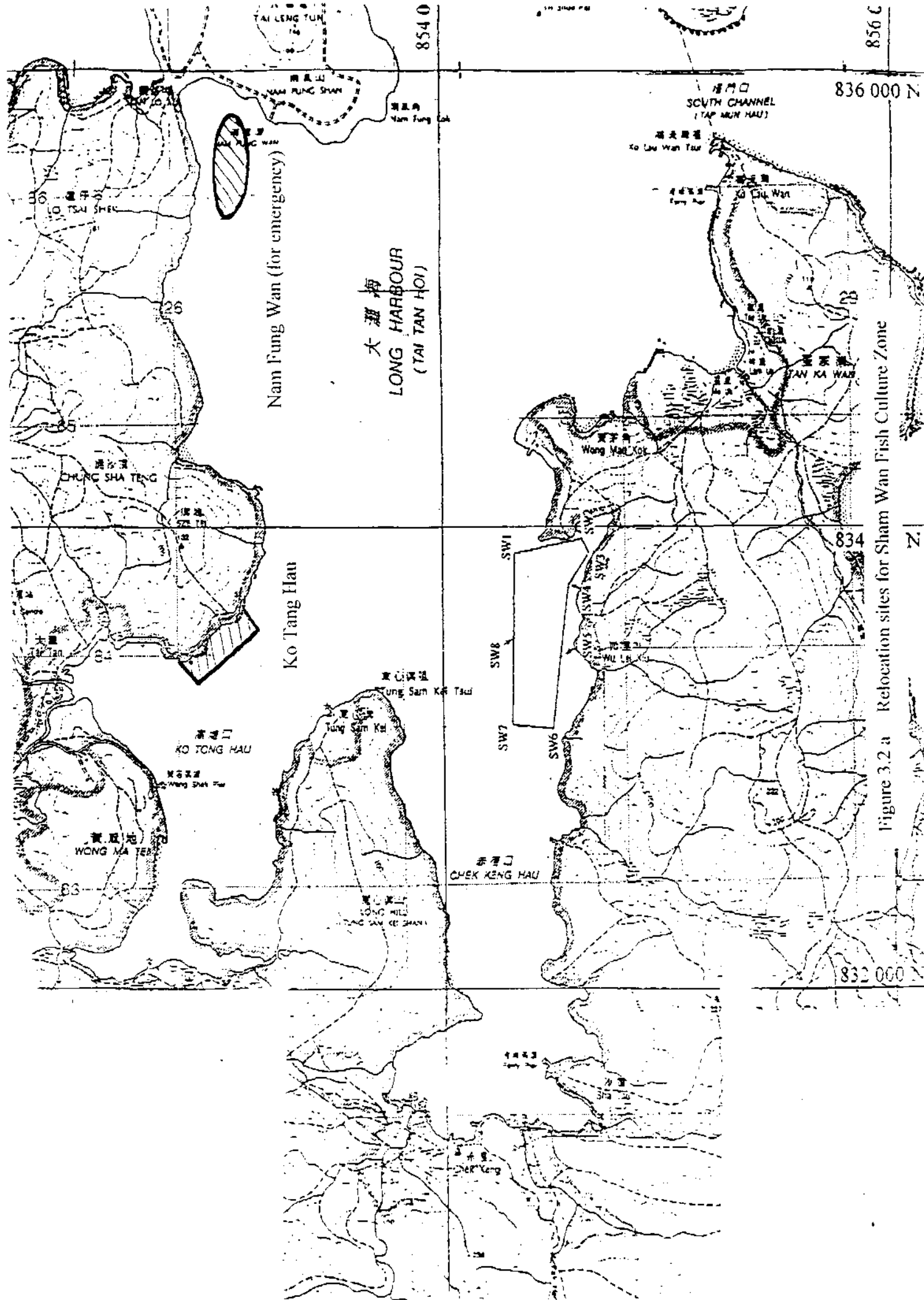
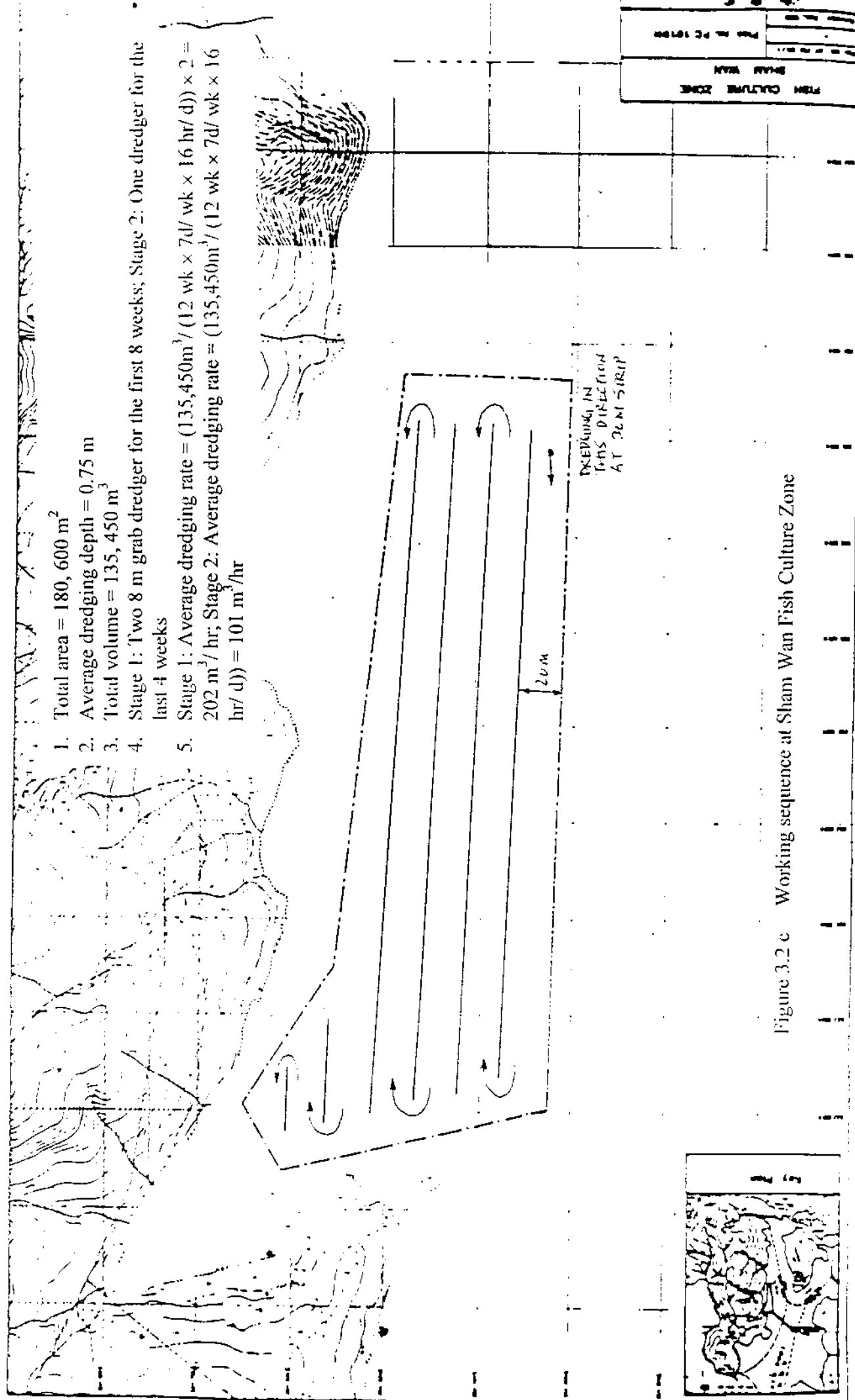


Figure 3.2 a Relocation sites for Sham Wan Fish Culture Zone



1. Total area = 180, 600 m²
2. Average dredging depth = 0.75 m
3. Total volume = 135, 450 m³
4. Stage 1: Two 8 m grab dredger for the first 8 weeks; Stage 2: One dredger for the last 4 weeks
5. Stage 1: Average dredging rate = $(135,450\text{m}^3 / (12\text{ wk} \times 7\text{d/ wk} \times 16\text{ hr/ d})) \times 2 = 202\text{ m}^3/\text{hr}$; Stage 2: Average dredging rate = $(135,450\text{m}^3 / (12\text{ wk} \times 7\text{d/ wk} \times 16\text{ hr/ d})) = 101\text{ m}^3/\text{hr}$

Figure 3.2 c Working sequence at Sham Wan Fish Culture Zone

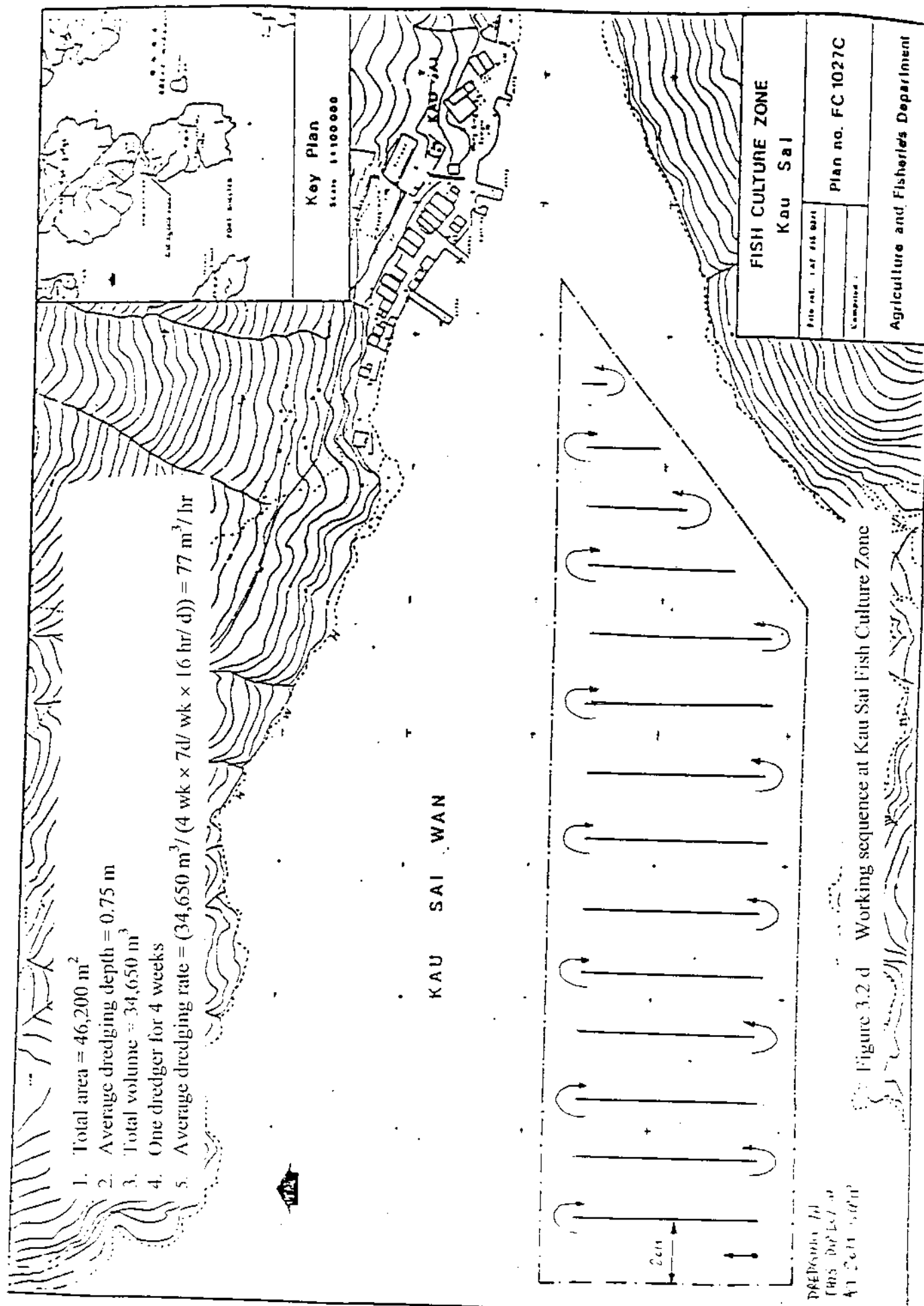


Table 3.2b Provisional project and water quality monitoring (WQM) program

Location	Activities	1st Month	2nd Month	3rd Month	4th Month	5th Month
Sham	WQM (Baseline)					
Wan	WQM (Impact)					
	WQM (Post-project)					
	Execution of Works		2 dredgers		1 dredger	
Kau Sai	WQM (Baseline)					
	WQM (Impact)					
	WQM (Post-project)					
	Execution of Works				1 dredger	

4. Possible Impact on the Environment

4.1 Sediment Condition

Wu et al (1994) showed that mariculture activities in four FCZs in Hong Kong (Ma Wan, Sok Kwu Wan, Yung Shue Au & Tap Mun) using trash fish for feeding generated a very high organic and nutrient loading and caused severe but localised organic pollution to the marine environment. High organic enrichment of the bottom sediment was indicated by the relative high value of sediment oxygen demand, hydrogen sulphide concentration, total organic matter and total organic nitrogen compared with the control areas. The diversity of benthic animals areas which serves as a good indicator for organic pollution is also reduced in the study.

A sediment quality study will be performed in the project

- i. to classify the sediment grade for disposal purpose;
- ii. to determine the sediment depth to be dredged; and
- iii. to identify the appropriate water quality parameters to be monitored in the environmental monitoring and audit (EM & A) programme.

The concentration in mg/kg (dry weight) of cadmium, chromium, copper, mercury, nickel, lead and zinc will be determined to satisfy the requirements specified by EPD under the Dumping at Sea Ordinance. The necessity to test for heavy metal will be finalised, subject to the negotiation of CED with EPD since the sediments of the two FCZs are unlikely to contain heavy metal.

Analysis for total inorganic nitrogen (TIN, $\mu\text{g-N/L}$), total Kjeldahl nitrogen (TKN, $\mu\text{g-N/L}$), ammoniacal nitrogen ($\text{NH}_3\text{-N}$, $\mu\text{g-N/L}$), sediment oxygen demand (SOD, $\text{mgO}_2/\text{hr/m}^2$), electrochemical potential (mV), total phosphate (TP, $\mu\text{g-P/L}$), total sulphide (TS, $\mu\text{g-S/L}$), total organic carbon (% w/w) and particle size distribution will also be determined for the bottom sediment. For details, please refer to Appendix I Sediment Quality Test.

4.2 Dredging and Disposal Procedure

4.2.1 Water Quality

During the dredging process, the main environmental impact will be the resuspension of the organic enriched sediment. The anoxic gas hydrogen sulphide may occasionally be released from the bottom sediment. There will also be a short-term drop of dissolved oxygen within the dredged area. The impacts will be transient.

Similar to the present dredging operation in Cheung Sha Wan FCZ, the cumulative water quality impact of two dredgers will be maintained below the action limit. Such prediction is based on the suspended solid concentration results of the first two weeks during the Impact WQM. Hence, two dredgers are proposed for the dredging in the first 8 weeks at Sham Wan FCZ.

4.2.2 Ecological & Fisheries Impact

The cultured fish and benthic organisms are vulnerable to the possible deterioration in water quality, e.g. decrease in ambient dissolved oxygen and increase in suspended solid.

4.2.3 Noise Impact

Noise impact during the dredging process will, if any, be minimal. Assessment in accordance with the Technical Memorandum on 'Noise from Construction Work other than Percussive Piling' revealed that noise levels at sensitive receivers during unrestricted hours (0700-1900 hours on any day not being a general holiday) would not exceed the guidelines contained in the Technical memorandum on 'Environmental Impact Assessment Process'.

4.3 Other Impact

No operational and decommissioning impacts are identified.

5. Surrounding Environment

5.1 Existing and Planned Sensitive Receivers

5.1.1 Fish Culture Zones

The dredged areas will be located beneath the zone areas of the two FCZs. The main sensitive receivers in this project are those fishes reared in the stated FCZs. Mariculturists have been consulted and they agreed that they would take into account of the dredging operation including relocating their rafts to areas with minimal impacts and within reasonable reach. No fish culture activities will be allowed within the FCZs during dredging.

5.1.2 Benthic Communities

Due to the highly organic-enriched sediment in the FCZs, the diversity of benthic animals is very low. By removing the anoxic sediment, it will provide the opportunity for the benthic organisms to recolonize the defaunated seabed.

6. Environmental Protection Measures and Further Environmental Implications

6.1 Water Quality Impact

To minimize the short term impacts on the surrounding environment during dredging and disposal of removed sediment at appropriate dumping grounds directed by Environmental Protection Department, standard pollution control clauses will be incorporated in the work contracts. Water quality monitoring and audit program during dredging will be conducted to ensure compliance with the relevant Water Quality Objectives.

A detailed Environmental Monitoring & Auditing (EM & A) Manual is presented in Appendix II. Action/ event plans are proposed in the EM & A Manual to confirm compliance with the Water Quality Objectives and acceptability of the impacts.

The Contractor shall prevent adverse impacts from operations on water quality. To achieve these requirements the Contractor shall design and implement methods of work that:

- Minimise disturbance to the seabed while dredging;
- Minimise leakage of dredged material during lifting;
- Minimise loss of material during transportation of dredged materials;
- Prevent unacceptable reduction, due to the work, of the dissolved oxygen content of the waters adjacent to the work;
- Prevent excess suspended solids from being present in the water within and adjacent to the work; and,
- Prevent avoidable deterioration in water quality that may cause adverse effects on the marine life in the FCZs.

Pollution avoidance measures during the dredging process shall include but not be limited to the following:

- Mechanical grabs shall be designed and maintained to avoid spillage and to seal tightly while being lifted;

- All vessels shall be sized such that adequate clearance is maintained between vessels and the seabed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
- Marine works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the waters within the Site or dumping grounds;
- Barges and grab dredgers shall be fitted with tight-fitting seals to their bottom openings to prevent leakage of material;
- Excess materials shall be cleaned from the decks and exposed fittings of barges and grab dredgers before the vessel departs;
- Loading of barges and grabs shall be controlled to prevent splashing of dredged materials into the surrounding waters, and barges or grabs shall not be filled to a level that will cause overflowing of materials or polluted water during loading or transportation; and,
- Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action.
- Silt curtains are to be installed where necessary to protect sensitive receivers identified at the dredging sites.

Seabed surveys will be carried out in the sediment quality study. Reference to the sediment testing result in Cheung Sha Wan, only garbages like fish bones, scales and shell fragments were obtained and these will not interfere with the closure of the grab.

6.2 Ecological and Fisheries Impact

No fish culture will be allowed in the FCZs during the dredging operation. The main sensitive receiver, the cultured fishes, will not be impacted by the work. Impacts to the benthic fauna will be minimal as the diversity and abundance of the benthos are already low in the FCZs. Silt curtains will be installed to minimise the impact to the relocated mariculture rafts. Installation of the silt curtains for the 2 dredging operations are indicated in Appendix II EM & A Manual (Locations: Figs 1.2 a & b and Details: Figs 2.8 a-c).

6.3 Noise Impact

No noise sensitive receivers are identified nearby the two subject sites. Reference to the present dredging operation in Cheung sha wan FCZ, a Construction Noise Permit (CNP) for working between 0700-2300 hours on weekdays and at any time on general holidays including Sundays will be applied. To allow 24-hours working, site measurement of noise levels for two weeks after the commencement of works will be conducted for further CNP application. If necessary, noise abatement measures such as erecting acoustic barriers on board of the dredgers will be implemented.

6.4 Possible Severity, Distribution and Duration of Environmental Effects

Environmental impacts would be transient and minimal. No fish culture activities will be allowed within the FCZs during dredging. Since the dredging areas are only within the FCZs with small dredged volume and the work will be finished within 12 weeks, the environmental impacts caused by the project should be short-termed and localized.

By removal of the bottom sediment, water quality and benthic habitat will be improved. This will consequently improve the mariculture environment and enhance the re-establishment of the benthic communities.

6.5 Further Implication

The study will provide valuable information for assessment of proposals for sediment removal in other FCZs in future.

7. Reference

Binnie Consultants Limited (1995). Report on Underwater Dive Surveys (Oct 1991-Nov 1994). Fill Management Study. Phase IV. Investigation and Development of Marine Borrow Areas for Civil Engineering Department, Geotechnical Engineering Office.

Wu, R.S.S., K.S. Lam, D. W. MacKay, T. C. Lau, V. Yam (1994). Impact of Marine Fish Farming on Water Quality and Bottom Sediment: A Case Study in the Sub-tropical Environment. *Marine Environmental Research* 38:115-145.

Appendix I Sediment Quality Test

1. Introduction

Marine bottom sediment to be dredged will adversely affect the water quality of the surrounding water bodies. Assessment of the sediment quality has therefore been considered necessary in order to determine the existing conditions in the vicinity of the FCZs and the potential sensitivity of each FCZ.

The main aims of the sediment test are:

- a) Classifying of the bottom sediment such that appropriate disposal procedure will be established;
- b) Determining the depth of sediment to be dredged with the FCZs and
- c) Selecting relevant water quality parameters for the environmental monitoring and audit programme.

2. Sampling Information

The locations and coordinates of the sampling stations for Sham Wan and Kau Sai FCZs are shown in Figures 2.1-2.2 respectively. The sampling is scheduled to be commenced in early January 1999 and the results will be presented for approval within 45 days after the application for permission to apply directly for Environmental Permit.

Samples will be confined to surface sediment (0m) and at 0.5m depth only and collected by divers using specially made sampling tubes of 65 mm in diameter. The locations of sampling stations were determined by DGPS. Approximately 1 kg of sediment sample will be collected at each station, and immediately stored in plastic bag. Each bag will be labelled to indicate the respective sample location. The samples will then be transported to MaterialLab on the same day after collection. After arrival, the samples will be divided, stored, composed and chilled if necessary, according to the test requirements.

3. Testing Information

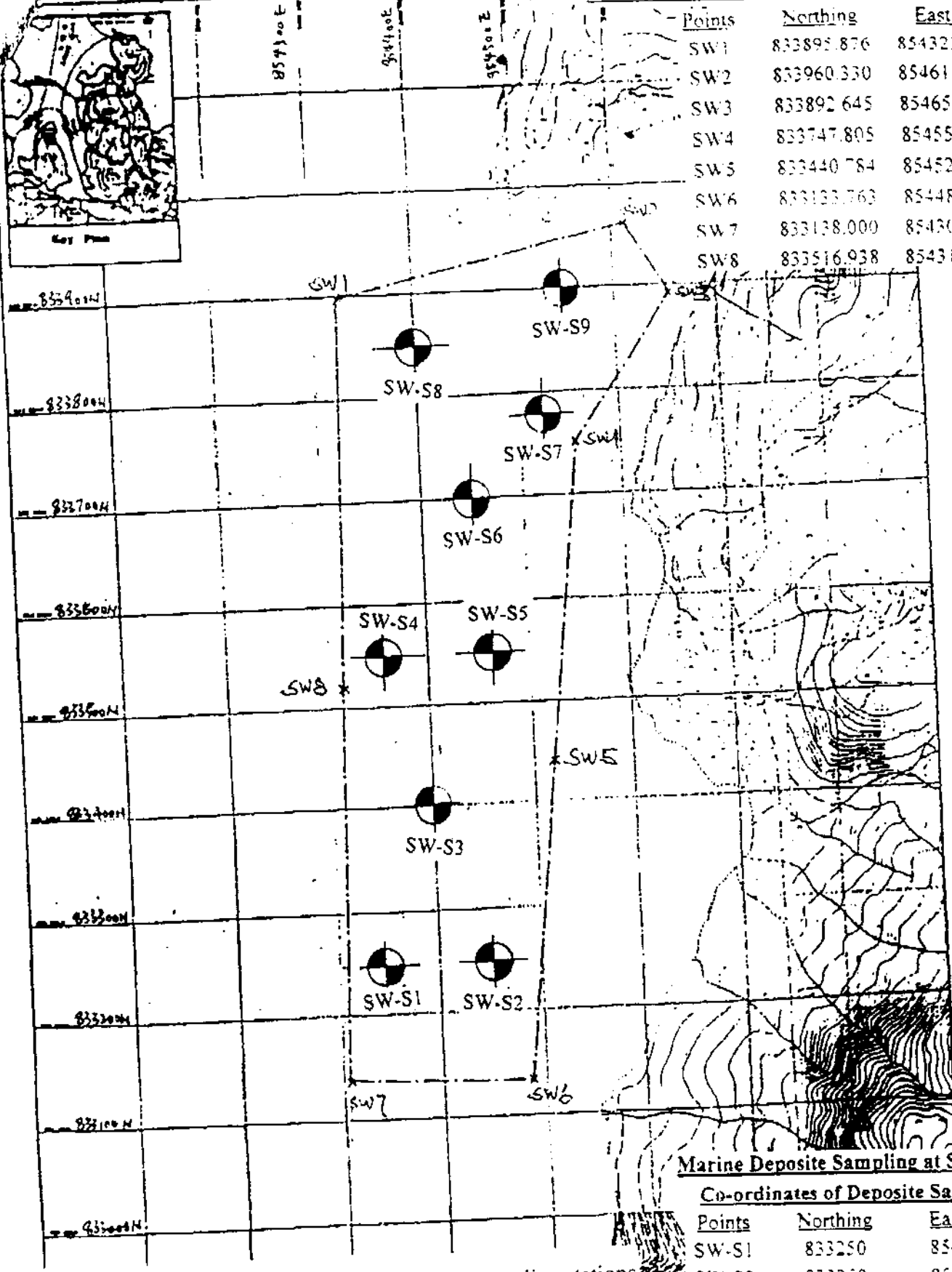
Parameters will be tested are listed in Table 3.1.

Table 3.1 Parameters to be tested

Testing Items	Sampling Depth	
	0m	0.5m
Chromium (mg/ kg)	✓	
Cadium (mg/ kg)	✓	
Copper (mg/ kg)	✓	
Lead (mg/ kg)	✓	
Zinc (mg/ kg)	✓	
Nickel (mg/ kg)	✓	
Mercury (mg/ kg)	✓	
Total Inorganic Nitrogen (mg N/ kg)	✓	✓
Total P (mg P/ kg)	✓	✓
Total TKN (mg N/ kg)	✓	
Sediment Oxygen Demand ₁₂₆₀ (mg O ₂ / L)	✓	✓
Electrochemical Potential (mV)	✓	
NH ₃ -N (mg N/ kg)	✓	
Sulphide (mg S ²⁻ / kg)	✓	
Particle Size Distribution (PSD)	Samples of 0.5 m only were mixed to form one composite sample	
Chemical Oxygen Demand (mg O ₂ / kg)	✓	
Total Organic Carbon (mg C /kg)	✓	

Testing methodologies and quality control measures of the above parameters will be identical to that for Cheung Sha Wan dredging project and have been approved by EPD.

Points	Northing	Easting
SW1	833895.876	854323.847
SW2	833960.330	854611.720
SW3	833892.645	854654.370
SW4	833747.805	854557.945
SW5	833440.784	854521.947
SW6	833133.763	854485.950
SW7	833138.000	854306.000
SW8	833516.938	854314.923



Marine Deposit Sampling at Sham Wan

Co-ordinates of Deposit Sample

Points	Northing	Easting
SW-S1	833250	854350
SW-S2	833250	854450
SW-S3	833400	854400
SW-S4	833550	854360
SW-S5	833550	854460
SW-S6	833700	854450
SW-S7	833780	854520
SW-S8	833850	854400
SW-S9	833900	854550

Figure 2.1 Locations and coordinates of the sampling stations at Sham Wan Fish Culture Zone

FISH CULTURE ZONE SHAM WAN	
By (1) of the (2)	Plan No. FC 101/99
Scale 1:500	

Boundary of Fish Culture Zone at Kau Sai

Points	Northing	Easting
KS1	822546	850635
KS2	822546	851096
KS3	822426	850944
KS4	822426	850635

Marine Deposit Sampling at Kai Sai

Co-ordinates of Deposit Sample

Points	Northing	Easting
KS-S1	822486	850705
KS-S2	822486	850805
KS-S3	822486	850905
KS-S4	822506	850994

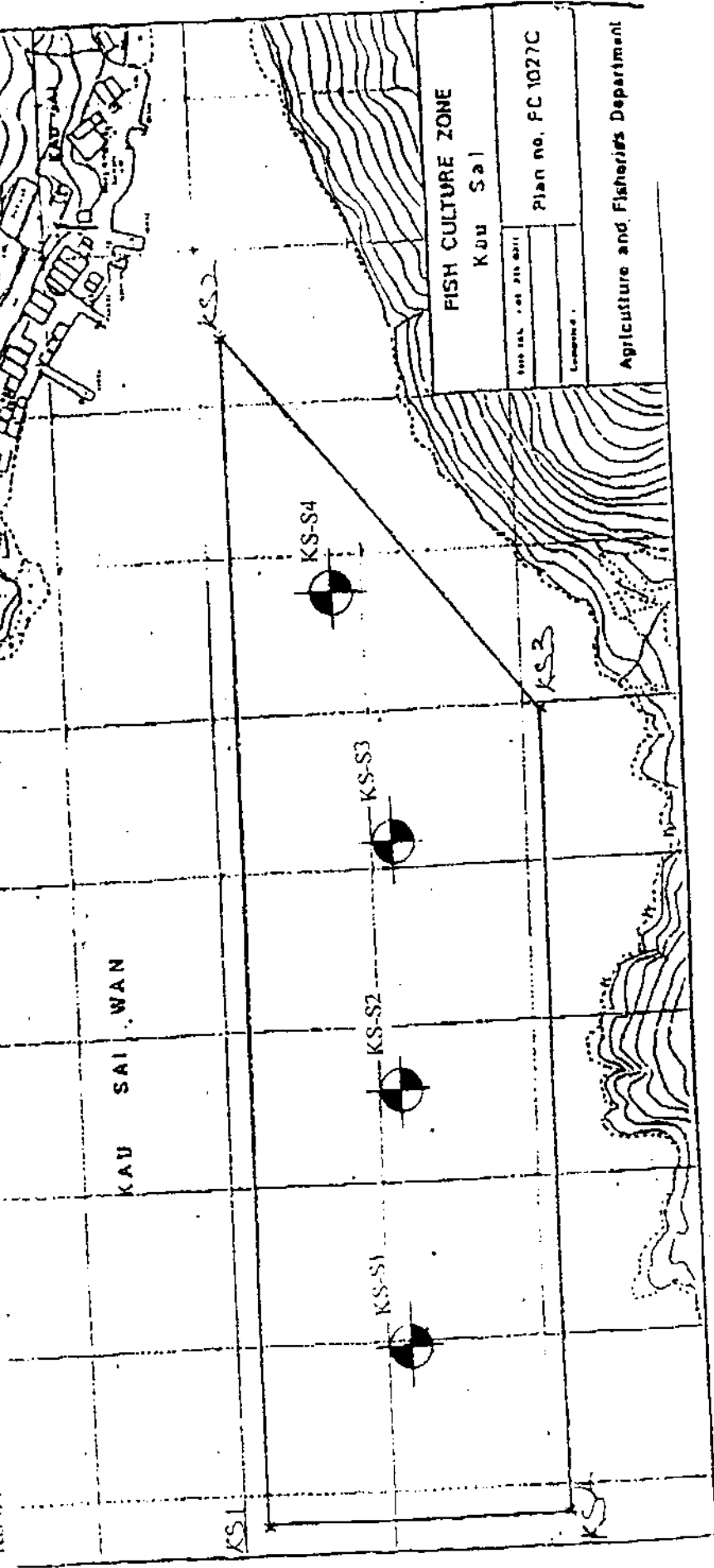


Figure 2.2 Locations and coordinates of the sampling stations at Kau Sai Fish Culture Zone

Appendix II Environmental Monitoring & Audit Manual

1. Introduction

1.1 Purpose of the Manual

The purpose of this Environmental Monitoring and Audit (EM&A) Manual is guide the setup of an EM&A programme to monitor the water quality, to assess the effectiveness of the recommended mitigation measures and to identify the further need for additional mitigation measures or remedial actions. This manual outlines the monitoring and audit programme to be undertaken for the dredging of bottom sediment at two Fish Culture Zones (FCZs): Sham Wan and Kau Sai. It aims to provide systematic procedures for monitoring, auditing and minimising the environmental impacts associated with the dredging and disposing off works.

It is envisaged that the EM & A Manual will be reviewed during the final detailed design and periodically throughout the project implementation to ensure that it remains relevant and effective in respect of changing site conditions.

1.2 Background

The Contractor, Nishimatsu Construction Company Limited has been awarded a contract by the Government of Hong Kong Special Administrative Region, Civil Engineering Department (CED), Contract No. CV/97/05, for the Maintenance Dredging during the period of 1998-1999.

Under this term contract, the contractor is designated to carry out a maintenance dredging for the Fish Culture Zones at Sham Wan and Kau Sai as shown in Fig 1.2 a & b respectively.

The works mainly include dredging of designated amount of marine sediment from the two Fish Culture Zones by Grab Dredgers. The dredged sediment will be carried by Hopper Barges and transported via Tug Boats for disposal at approved area.

Before commencement of dredging, there will be a relocation of fish rafts from the gazetted FCZs to temporary relocation sites. The rafts at Sham Wan will move to areas near to Ko Tang Hau (Fig 1.2 a) while that of Kau Sai will move to Kau Sai Wan (Fig 1.2 b).

In order to ensure the aquatic condition of the relocation sites not be affected by the temporary fish culture practice, tests on sediment quality of the relocation sites are to be taken. Samples of the bottom sediment will be taken from two monitoring stations at each relocation

site soon after the relocation and before the anchors of fish rafts are lifted for back relocation to the gazetted FCZs. Water quality monitoring at the two stations in each relocation site is to be conducted as well during the course of dredging operation.

In addition, based on the results of the study on bottom sediment quality of the Cheung Sha Wan FCZ and the sediment quality testing to be carried out at Sham Wan and Kau Sai FCZs, parameters for water quality monitoring will be recommended in this manual to be undertaken near the dredging site prior to, during and after dredging at the two mentioned FCZs. The same parameters will also be monitored within the two relocation sites during the dredging works.

1.3 Environmental Monitoring and Audit Requirements

The monitoring work is to ensure that any deteriorating water quality could be readily detected and timely action be taken to rectify the situation.

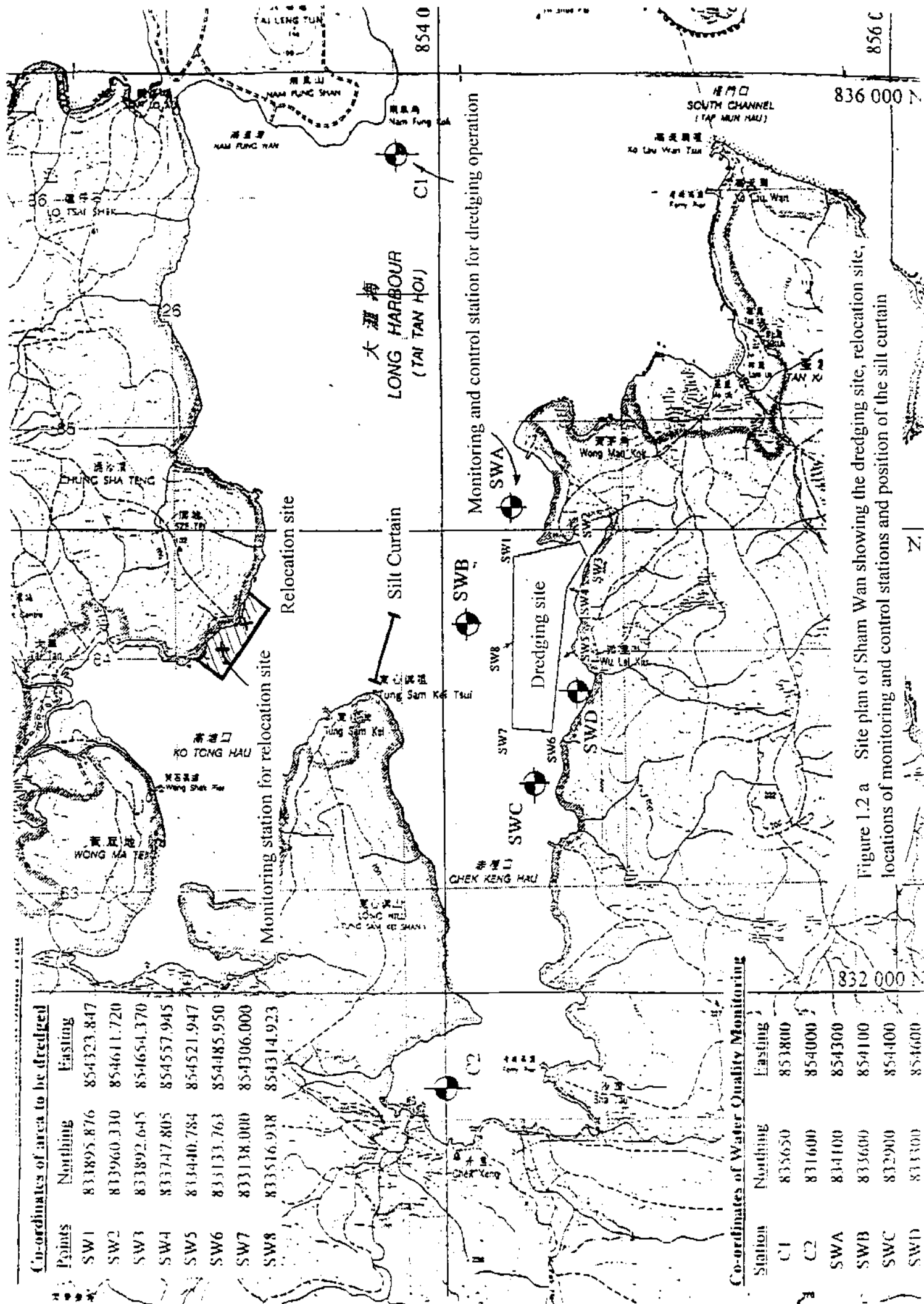
It is recommended that the environmental monitoring of water quality at designated monitoring stations and control stations be undertaken around the dredging site prior to, during and after the dredging operation.

For the relocation sites at Ko Tang Hau and Kau Sai Wan, water quality monitoring is to be carried out at 2 designated monitoring stations during the dredging operation. Moreover, total phosphorus, ammoniacal nitrogen, total Kjeldahl nitrogen and chemical oxygen demand are to be determined on sediment samples taken from the same designated stations at the relocation site soon after the relocation and before the anchors of fish rafts are lifted for back relocation to the Sham Wan and Kau Sai FCZs.

Environmental auditing on the monitoring data will be undertaken, via the establishment of Action/Limit (AL) levels for the representative water quality monitoring parameters to check against any non-compliance. Should the monitoring results indicate any non-compliance of AL levels, actions according to the action plan shall be followed and appropriate environmental mitigation measures shall be implemented to rectify the situation.

1.4 Environmental Team

MaterialLab Limited has been commissioned by the client as the Environmental Team which comprises the monitoring staff and the environmental auditor to undertake the environmental monitoring and audit work for this contract.



Dredging of Fish Culture Zone at Kau Sai

Co-ordinates of area to be dredged

Points	Northing	Easting
KS1	822546	850635
KS2	822546	851096
KS3	822426	850944
KS4	822426	850635

Co-ordinates of Water Quality Monitoring

Station	Northing	Easting
C1	823000	851246
C2	821000	850720
KSA	822546	850435
KS2	822660	849000
KSC	822426	849300

牛尾海
SHELTER
GAU MEI HOI

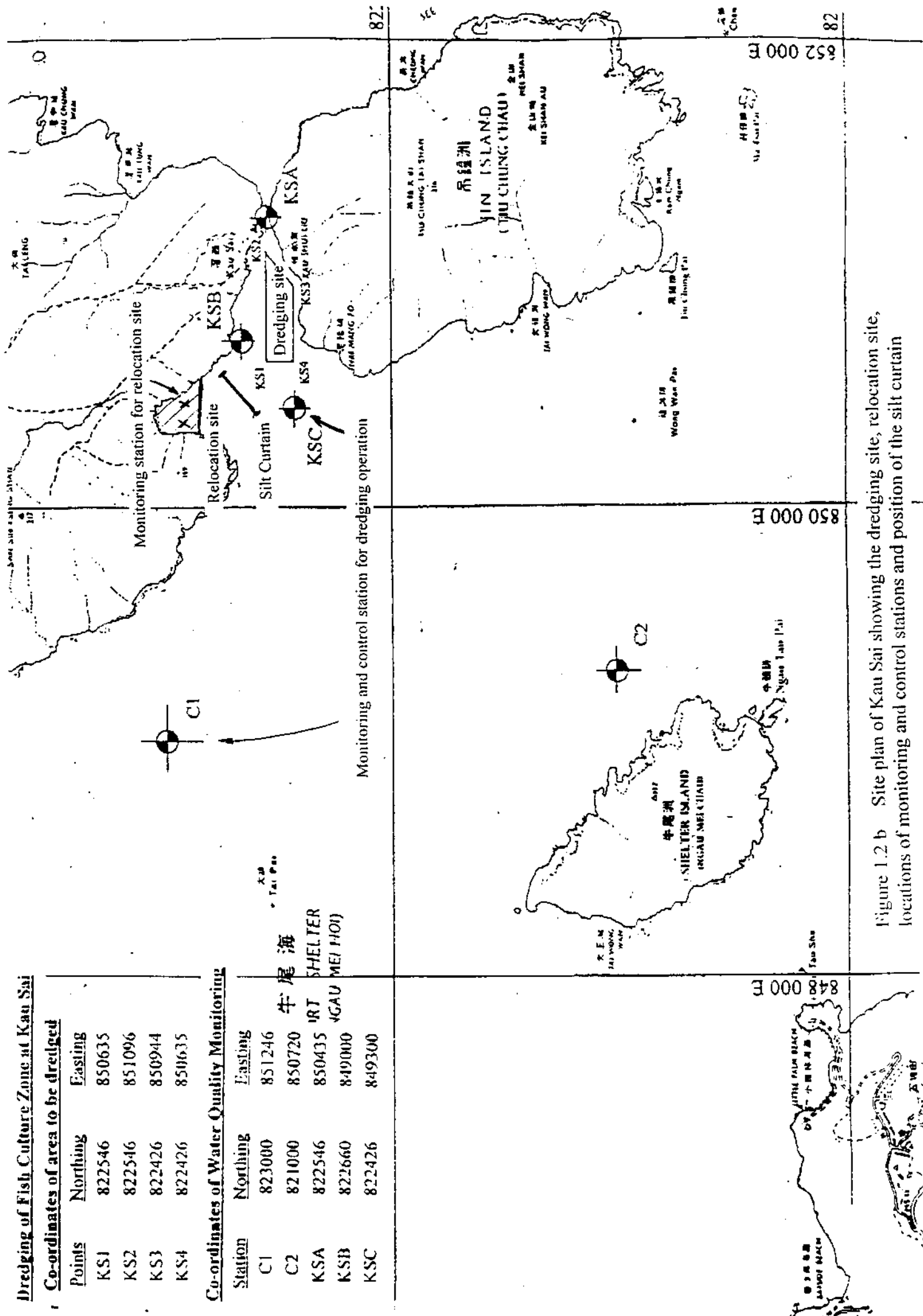


Figure 1.2 b Site plan of Kau Sai showing the dredging site, relocation site, locations of monitoring and control stations and position of the silt curtain

The organisation chart of the Environmental team is shown in Figure 1.4a.

The monitoring staff will carry out the field monitoring work and laboratory analysis as necessary.

The auditor will audit all the monitoring data and describe the findings in the monthly reports which will be submitted to the Director of Environmental Protection (DEP) through the Engineer for comments on a monthly basis. The auditor will also advise the Contractor and the Engineer regarding necessary mitigatory measures and assess the effectiveness of these measures.

2. Water Quality

2.1 Water Quality Parameter

The Environmental Team will carry out in-situ measurements of turbidity in NTU, dissolved oxygen (DO) in mg/L, DO saturation in %, salinity in g/L, water temperature in °C and water depth in metre around the dredging sites and at the relocation sites. Water samples from these sites will also be taken to laboratory for analysis of suspended solids (SS), Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), Ammoniacal Nitrogen (NH₃-N), Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD).

In association with the water quality parameters, some relevant data shall also be noted, such as tidal state, time, weather conditions, sea condition and any special phenomena and work underway at the construction site etc.

2.2 Monitoring Equipment

2.2.1 Dissolved Oxygen and Temperature Measuring Equipment

a) The instrument should be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and use a DC power source. It should be capable of measuring:

- a dissolved oxygen level in the range of 0-20mg/L and 0-200% saturation; and,
- a temperature of 0-45 °C

b) It should have a membrane electrode with automatic temperature compensation complete with a cable. Sufficient stocks of spare electrodes and cables should be available for replacement where necessary.

2.2.2 Turbidity Measurement Instrument

The instrument should be a portable, weatherproof turbidity-measuring instrument complete with comprehensive operation manual. The equipment should use a DC power source. It should have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU and be complete with a cable.

Environmental Team Organisation Chart

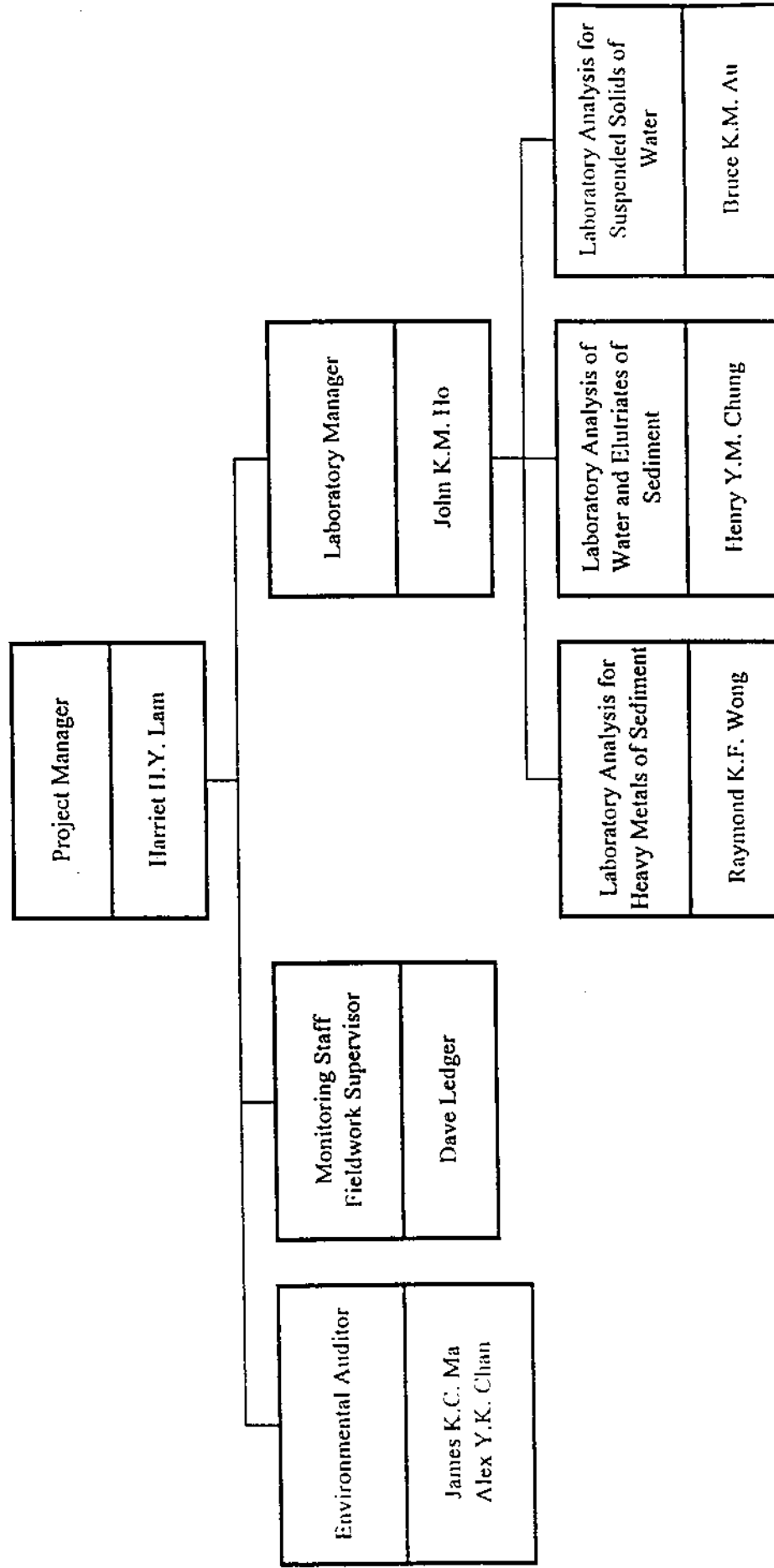


Figure 1.4a Organization Chart of the Environmental Team

2.2.3 Suspended Solids

- a) A water sampler should have a transparent PVC cylinder, with a capacity of not less than 2 L, and can be effectively sealed with latex cups at both ends. The sampler should be a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth.
- b) Water samples for suspended solids measurement should be collected in high density polythene bottles, packed in ice and delivered to the laboratory as soon as possible after collection.

2.2.4 Salinity

A portable salinometer capable of measuring salinity in the range of 0-40 g/L should be used for measuring salinity of the water at each monitoring location.

2.2.5 Water Depth Detector

A portable, battery-operated echo sounder should be used for the determination of water depth at each designated monitoring station. This unit can either be handheld or affixed to the bottom of the work boat, if the same vessel is to be used throughout the monitoring program.

2.2.6 Location of Monitoring Site

A hand-held or boat-fixed type digital Global Positioning System (GPS) or other equivalent instrument of similar accuracy shall be provided and used during monitoring to ensure the monitoring vessel is at the correct location before taking measurements. After the positions are set out, locationing of boat can be by use of buoys or with reference to landmarks.

2.2.7 Ambient Temperature

A standard calibrated thermometer should be used for ambient temperature measurement. This thermometer is to be calibrated at 6 months intervals.

All in-situ monitoring instrument should be checked, calibrated and certified by HOKLAS accredited laboratory before use and subsequently re-calibrated at 3 months intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use. Wet bulb calibration for a DO meter should be carried out before measurement at each monitoring location.

The water quality monitoring equipments used for the project are listed in Table 2.2.

Table 2.2 Water Quality Monitoring Equipments

Equipment	Model	Parameters Measured	Calibration Frequency
Turbidity meter	HACH 2100P	Turbidity	3 months
Dissolved oxygen meter	YSI 58 with stirrer	Dissolved oxygen, Dissolved oxygen saturation and Water temperature	3 months
Echo sounder	Eagle Magna 3	Water depth	-
Water sampler	Kahlsico 3 litre with messenger	Water sampling	-
GPS receiver	Magellan 5000	Locating the monitoring boat	-
Buoys	-	Locating the monitoring boat	-
Thermometer	Standard calibrated thermometer	Ambient temperature	6 months
Salinity meter	YSI 30/33	Salinity	3 months
pH meter	Hanna	pH	Calibration before use

2.3 Monitoring Methodology

2.3.1 Fieldwork

Measurements are to be taken at 3 water depths, namely 1 m below water surface, mid-water and 1 m above seabed at both mid-flood and mid-ebb tides, except where the water depth is less than 6 m, the mid-depth station may be omitted. Should the water depth be less than 3 m, only mid-depth will be monitored. The Environmental Team should agree with the Engineer on all the monitoring stations.

Two measurements of turbidity, DO, DOS, salinity and water temperature at each depth of each station are to be taken. The probes must be removed from water after the first measurement and then redeployed for the second measurement. If there is a difference in value between the first and second readings of each set is more than 25% of the value of the first reading, the readings should be discarded and further measurements should be made. Duplicate samples of suspended solids measurement should be taken at each depth and at each water quality monitoring/control station. The samples should be kept in chilled condition during delivery to laboratory and before commencement of the analysis. For the purpose of evaluating the water quality, all values for SS and turbidity should be depth-averaged.

2.3.2 Laboratory Measurement/ Analysis

Suspended solids (SS)

Analysis of suspended solids should be carried out in a HOKLAS accredited laboratory. Water samples of about 1 litre should be collected at the monitoring stations for the laboratory SS determination. The SS determination work should start within 24 hours after collection of water samples.

Samples should be well mixed and filtered (with a vacuum of less than 381 mm of Hg) through pre-weighed Millipore matched pair filters (at < 5 mg/L) or pre-weighed Whatman GF/C filters (at > 5 mg/L). A Millipore or equivalent filtration assembly (with vacuum of less than 381 mm of Hg) should be used to filter the water samples. Particulates collected on the filter papers should be dried in a drying oven at 103°C until a constant weight is reached and cooled to room temperature in a dessicator prior to weighing. An accurate electronic balance should be used to attain a precision level of 0.1 mg.

Total Phosphorus

Total phosphorus in sample is determined colorimetrically by ascorbic acid method.

Total Kjeldahl Nitrogen (TKN)

Sample is digested with mercuric sulphate and sulphuric acid mixture followed by distillation. Ammonia is trapped and determined by colorimetric method using salicylate reagent.

Ammoniacal Nitrogen (NH₃-N)

Ammonia in sample reacts with reagent added. Color complex formed is determined colorimetrically by spectrophotometer.

Biochemical Oxygen Demand (BOD₅)

The biochemical oxygen demand of a water sample is determined through measurement by dissolved oxygen meter (YSI model 58) before and after sample incubation at 20°C for five days.

Chemical Oxygen Demand (COD)

Sample is subject to open dichromate reflux followed by titrimetric determined.

2.4 Monitoring Locations

Four monitoring stations and two control stations near the dredging sites are designated for the water quality monitoring at Sham Wan (Fig 1.2a) and three monitoring with two control stations are sited for Kau Sai (Fig 1.2b). Two monitoring stations, for both water and sediment quality monitoring, are designated at the two relocation sites as well (Figs 1.2 a & b). The exact locations are to be determined on site after the completion of the relocation and upon agreement with the RE.

Coordinates of the monitoring stations and control stations are shown in Table 2.4.

Table 2.4 Coordinates of Monitoring and Control Stations

Station No	Coordinates	
	Northing	Easting
Sham Wan		
Monitoring Stations		
SWA	834100	854300
SWB	833600	854100
SWC	832900	854400
SWD	833300	854600
Control Stations		
C1	835650	853800
C2	831600	854000
Kau Sai		
Monitoring Stations		
KSA	822546	850435
KSB	822660	849000
KSC	822426	849300
Control Stations		
C1	823000	851246
C2	821000	850720

2.5 Monitoring Regime

2.5.1 Baseline Monitoring

Baseline conditions for the various water quality parameters are to be established by measuring the parameters specified as 'Water Quality Parameters' at all designated stations for the dredging sites, 3 days per week, at mid-flood and mid-ebb tides, for four consecutive weeks prior to the commencement of marine works at the two FCZs. Baseline monitoring are not going to carried out at the two stations at each relocation site. By using the results from baseline monitoring, the AL levels are to be formulated and submitted to DEP through the Engineer for approval prior to commencement of marine works.

2.5.2 Impact Monitoring

During the course of the works, monitoring is to be taken three times a week, during mid-ebb and mid-flood, with sampling/ measurement at all designated monitoring stations for the two dredging sites and at the stations of relocation sites. The water monitoring at the two stations within the two relocation sites will be carried out once a week during mid-ebb and mid-flood tides. The interval between two each series (mid-ebb and mid-flood) of sampling/ measurement should normally be not less than 36 hours except there are exceedances of Action and/or Limit levels in which the monitoring frequency will be increased according to the Action/ Event Plan.

Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the AL levels are not complied with, immediate actions should be taken in accordance with the Action/ Event Plan.

2.5.3 Post Project Monitoring

Upon completion of all the maintenance dredging, the post project monitoring for all general parameters is to be conducted for a continuous period of four weeks in the same manner as described in Impact Monitoring at all designated stations for the two dredging sites. Post-project water quality monitoring is not required for the two stations at the relocation sites.

2.5.4 Monitoring for Total Phosphorus, Total Kjeldahl Nitrogen, Ammoniacal Nitrogen, Chemical Oxygen Demand and Biochemical Oxygen Demand in water samples

The sampling of marine water for determination of total phosphorus, total Kjeldahl nitrogen, ammoniacal nitrogen, chemical oxygen demand and biochemical oxygen demand is to be carried out once per week at both mid-ebb and mid-flood tides at all designated stations for the dredging sites during baseline, impact and post-project monitoring. The same parameters are to be measured at the designated stations within the two relocation sites during the course of dredging operation. *Duplicate** water samples are to be taken at three water depths of each monitoring location. Measurement of total phosphorus, total Kjeldahl nitrogen, ammoniacal nitrogen, chemical oxygen demand and biochemical oxygen demand will be conducted on the acquired samples.

** Practically manageable volumes of water samples within each depth are taken for consolidation. A measurement for total phosphorus, total Kjeldahl nitrogen, ammoniacal nitrogen and chemical oxygen demand is to be conducted for each depth of each station.*

2.5.5 Monitoring for Total Phosphorus, Total Kjeldahl Nitrogen, Ammoniacal Nitrogen and Chemical Oxygen Demand in sediment samples

Duplicate sediment samples from each designated station within the two relocation sites at Ko Tang Hau and Kau Sai Wan are to be tested for total phosphorus, total Kjeldahl nitrogen, ammoniacal nitrogen and chemical oxygen demand. Samples are to be taken from the surface seabed materials soon after the relocation and before the anchors of fish rafts are lifted for back relocation to the Sham Wan and Kau Sai FCZs.

For the sake of clarity, the parameters to be monitored at different stages of monitoring are summarised in Table 2.5.

Table 2.5 Summary of typical monitored parameters for the two FCZs

Sample Nature	Monitored Parameters	Location	Type of Monitoring		
			Baseline	Impact	Post-project
Water	Dissolved Oxygen (mg/L)	D	+	+	+
	Dissolved oxygen saturation (%)	D	+	+	+
	Turbidity (NTU)	D	+	+	+
	Suspended solid (mg/L)	D	+	+	+
	Total phosphorus (mgP/L)	D	+	+	+
	Total Kjeldahl nitrogen (mgN/L)	D	+	+	+
	Ammoniacal nitrogen (mgN/L)	D	+	+	+
	Chemical oxygen demand (mg/L)	D	+	+	+
	Biochemical oxygen demand (mg/L)	D	+	+	+
	Dissolved Oxygen (mg/L)	R	-	+	-
	Dissolved oxygen saturation (%)	R	-	+	-
	Turbidity (NTU)	R	-	+	-
	Suspended solid (mg/L)	R	-	+	-
	Total phosphorus (mgP/L)	R	-	+	-
	Total Kjeldahl nitrogen (mgN/L)	R	-	+	-
	Ammoniacal nitrogen (mgN/L)	R	-	+	-
	Chemical oxygen demand (mg/L)	R	-	+	-
	Biochemical oxygen demand (mg/L)	R	-	+	-
Sediment	Total phosphorus (mgP/L)	Samples are to be taken from two stations within the two relocation sites at Ko Tang Hau and Kau Sai Wan soon after the relocation and before the anchors of fish rafts are lifted for back relocation to the Sham Wan and Kau Sai FCZs.			
	Total Kjeldahl nitrogen (mgN/L)				
	Ammoniacal nitrogen (mgN/L)				
	Chemical oxygen demand (mg/L)				

Remarks: +: Required
 -: Not required
 D: 4 monitoring and 2 control stations near the Sham Wan FCZ dredging site & 3 monitoring and 2 control stations near the Kau Sai FCZ dredging sites
 R: 2 stations within the relocation site, Ko Tang Hau, for Sham Wan & 2 stations within the relocation site, Kau Sai Wan, for Kau Sai

2.6 Action and Limit Levels for Water Quality Monitoring

The Action and Limit (AL) levels are to be formulated based on the baseline monitoring data. A framework of AL levels is illustrated in Table 2.6.

Table 2.6 Action and Limit Levels (Baseline and Control Stations Approach)

Parameters	Action	Limit
DO in mg/L (Depth-average of Surface and Middle)	<u>Depth-average of Surface and Middle</u> <5%-ile of baseline data for surface and middle layer.	<u>Depth-average of Surface and Middle</u> <4mg/L except 5mg/L for FCZ or <1%-ile of baseline data for surface and middle layer
DO in mg/L (Bottom)	<u>Bottom</u> <5%-ile of baseline data for bottom layer.	<u>Bottom</u> <2mg/L or <1%-ile of baseline data for bottom layer
SS in mg/L (Depth-averaged)	>95%-ile of baseline data and >120% of upstream control station's SS at the same tide of the same day.	>99%-ile of baseline and >130% of upstream control station's SS at the same tide of the same day
Turbidity (Tby) in NTU (Depth-averaged)	>95%-ile of baseline data and >120% of upstream control station's Tby at the same tide of the same day.	>99%-ile of baseline and >130% of upstream control station's Tby at the same tide of the same day

2.7 Action/ Event Plan

Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the water quality criteria are not complied with, the actions in accordance with the Action Plan in Table 2.7 are to be carried out. The Environmental Team shall inform EPD by fax whenever there is any exceedance in action and limit levels.

During the dredging operation, if signs of archeological/ culture important features are detected, the dredging works shall be suspended temporarily. In addition, a diving inspection will be carried out accordingly.

Table 2.7 Action/Event Plan

Event	Environmental Team (ET)	Engineer (ER)	Contractor
Action level being exceeded by one sampling day	<ul style="list-style-type: none"> Repeat in-situ measurement to confirm findings; Identify source(s) of impact; Inform EPD and Contractor; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with ER and Contractor; Repeat measurement on next day of exceedance. 	<ul style="list-style-type: none"> Discuss with ET and Contractor on the proposed mitigation; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures. 	<ul style="list-style-type: none"> Inform the ER and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Discuss with ET and ER and propose mitigation measures to ER; Implement the agreed mitigation measures.
Action level being exceeded by more than one consecutive sampling days	<ul style="list-style-type: none"> Repeat in-situ measurement to confirm findings; Identify source(s) of impact; Inform EPD and Contractor; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with ER and Contractor; Ensure mitigation measures are implemented; Prepare to increase the monitoring frequency to daily; Repeat measurement on next day of exceedance. 	<ul style="list-style-type: none"> Discuss with ET and Contractor on the proposed mitigation; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures. 	<ul style="list-style-type: none"> Inform the ER and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Discuss with ET and ER and propose mitigation measures to ER within 3 working days; Implement the agreed mitigation measures.
Limit level being exceeded by one sampling day	<ul style="list-style-type: none"> Repeat in-situ measurement to confirm findings; Identify source(s) of impact; Inform EPD and Contractor; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with ER and Contractor; Ensure mitigation measures are implemented; Increase the monitoring frequency to daily until no exceedance of Limit level. 	<ul style="list-style-type: none"> Discuss with ET and Contractor on the proposed mitigation; Request Contractor to critically review the working methods; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures. 	<ul style="list-style-type: none"> Inform the ER and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Discuss with ET and ER and propose mitigation measures to ER within 3 working days; Implement the agreed mitigation measures.
Limit level being exceeded by more than one consecutive sampling days	<ul style="list-style-type: none"> Repeat in-situ measurement to confirm findings; Identify source(s) of impact; Inform EPD and Contractor; Check monitoring data, all plant, equipment and Contractor's working methods; Discuss mitigation measures with ER and Contractor; Ensure mitigation measures are implemented; Increase the monitoring frequency to daily until no exceedance of Limit level. for two consecutive days. 	<ul style="list-style-type: none"> Discuss with ET and Contractor on the proposed mitigation; Request Contractor to critically review the working methods; Make agreement on the mitigation measures to be implemented; Assess the effectiveness of the implemented mitigation measures; Consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the marine work until no exceedance of Limit level. 	<ul style="list-style-type: none"> Inform the ER and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Check all plant and equipment; Consider changes of working methods; Discuss with ET and ER and propose mitigation measures to ER within 3 working days; Implement the agreed mitigation measures; As directed by the Engineer, to slow down or to stop all or part of the marine work or construction activities.

2.8 Mitigation Measures

Water quality control and mitigation measures are recommended for dredging at the two FCZs. The Contractor is to be responsible for the design and implementation of these measures.

2.8.1 Water Quality

The Contractor should minimize the risk of sediments or other pollutants being released into the water column and deposited in the seabed other than designated locations.

Pollution avoidance measures shall include but not be limited to the followings:

- Mechanical grabs shall be designed and maintained to avoid spillage and innovatively seal tightly while being lifted;
- All vessels shall be sized such that adequate clearance is maintained between vessels and the seabed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
- All pipe leakages are to be repaired promptly and plant is not to be operated with leaking pipes;
- Marine works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds;
- Barges and grab dredgers shall be fitted with thigh-fitting seals to their bottom openings to prevent leakage of material;
- Excess material shall be cleaned from the decks and exposed fittings of barges and grab dredgers before the vessel is moved;
- Loading of barges and grabs shall be controlled to prevent splashing of dredged material into the surrounding water, and barges or grabs shall not be filled to a level that will cause overflowing of material or polluted water during loading or transportation; and,
- Adequate freeboard shall be maintained on barges to ensure that decks are not washed by wave action.
- Silt curtains are to be installed where necessary to protect sensitive receivers identified at the dredging sites.

Following are the mitigation measures for the implementation of the dredging project at the two FCZs:

- Erect a 150 m floating silt curtain between the dredging and relocation site for the 2 dredging operations (Figs. 1.2 a & b). The 150 m silt curtain is made up of 5 sections of 30 m silt curtain. Each section is fixed between two 1 tonne sinkers on the seabed and 1 m in diameter buoy markers. The silt curtain will be tied up on the wires connecting the buoy marker and the sinker. Totally, there will be six sinkers and buoy markers, holding 5 pieces of silt curtain. The design of the silt curtain is shown in Figs 2.8 a-c. For the installation and removal of the silt curtain, the sinkers will be installed and removed by means of a Derrick Barge. Divers will also be involved in tying up and removing the silt curtains from the connecting wires. The silt curtain will also be inspected regularly as necessary to ensure it is functioning properly during process;
- Establish additional water quality monitoring stations at the relocation sites where necessary;
- Check sediment quality at relocation sites before and after the relocation where necessary;
- Encourage the use of pellet feed at the relocation sites; and
- Adopt normal standard good dredging practices.

If the above measures are not sufficient to restore the water quality to acceptable levels, upon the advice of the Environmental Team, the Contractor, after liaison with the Environmental Team, is to propose other mitigation measures to the Engineer for approval, and carry out the mitigation measures.

3. Reporting

The Environmental Team is to prepare and submit Baseline Monitoring Report, First Monthly EM & A Report, Subsequent Monthly EM & A Report and Final EM & A Summary Report to DEP for comment via the Engineer.

The ET Leader will prepare and submit a Baseline Environmental Monitoring Report with 10 days of completion of the baseline monitoring. Copies of the Baseline Environmental Monitoring Report will be submitted to each of the three parties: the Contractor, the ER and The EPD. The ET Leader shall liaise with the relevant parties on the exact number of copies they want. The form and content of the report, and the representation of baseline monitoring data will 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) an updated construction programme with milestones of environmental protection/mitigation activities annotated;
- e) 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 (and depth);
 - monitoring date, time, frequency and duration;
 - QA/QC results and detection limits.
- f) 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.
- g) determination of the Action and Limit Levels (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 parameters monitored;
- h) revisions for inclusion in the EM&A Manual; and
- i) comments and conclusions.

Elevation of Proposed Simple Silt Curtain

Figure 2.8 a

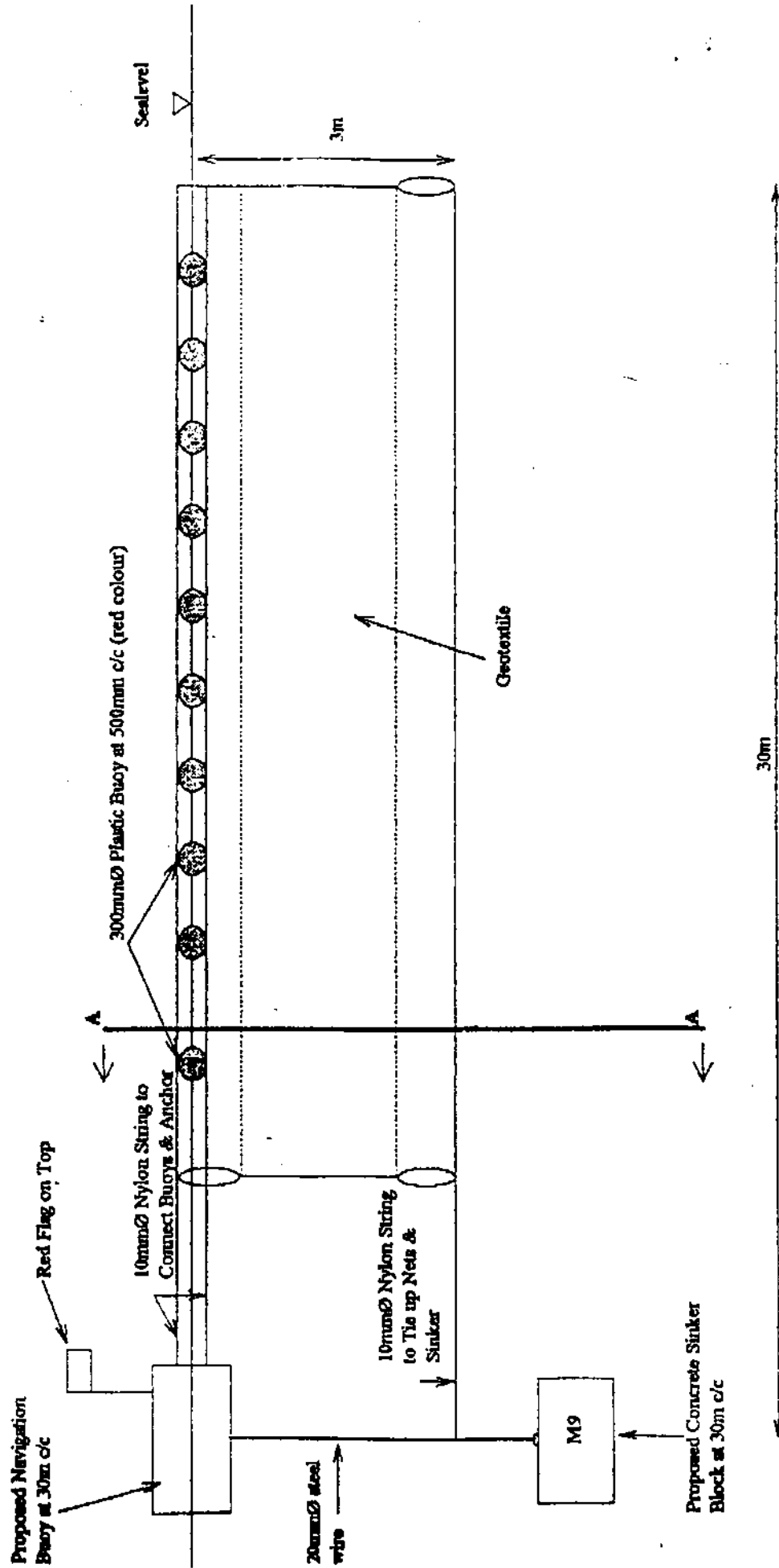


Figure 2.8 b

Section A - A

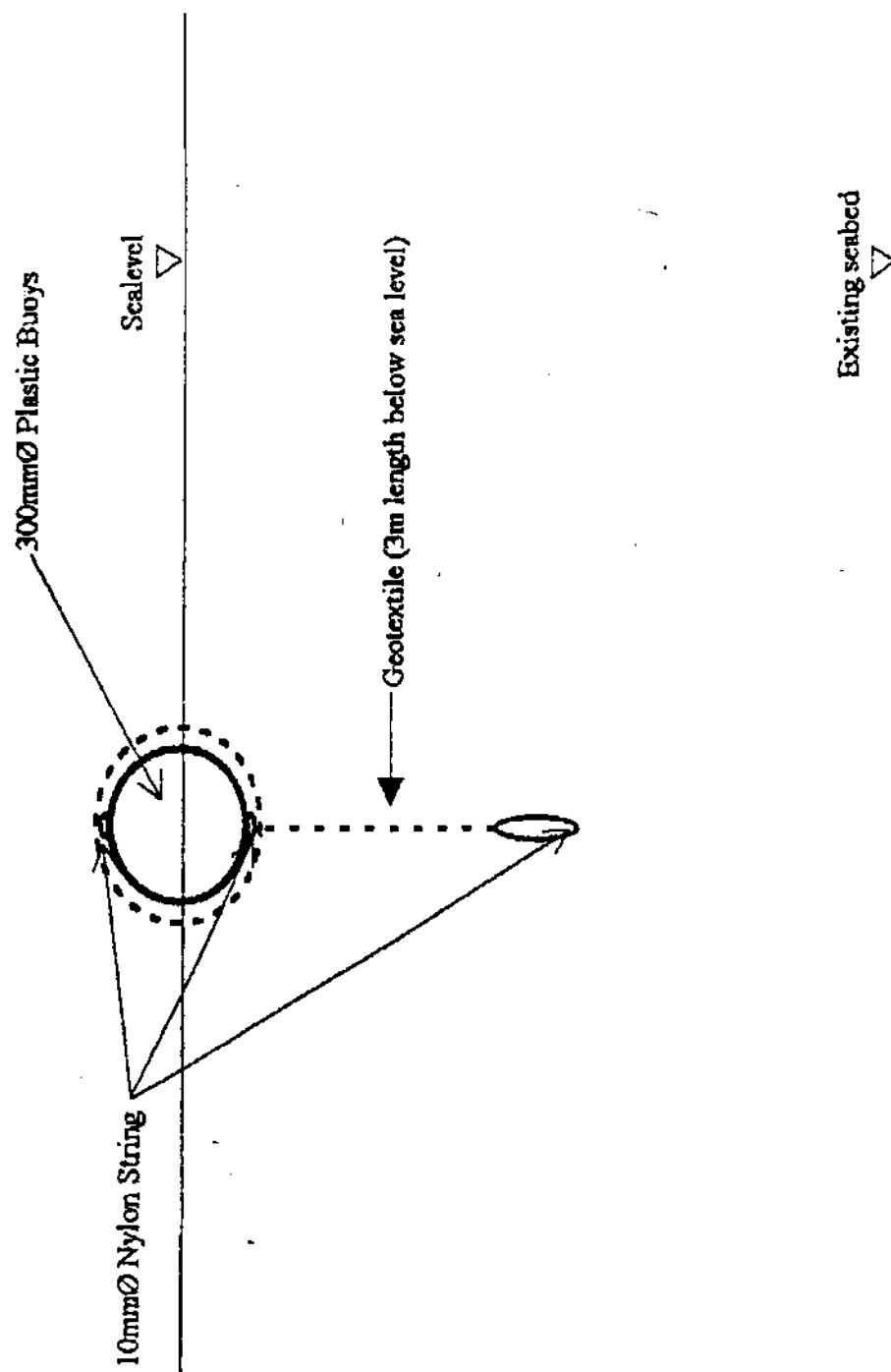


Figure 2.8 c

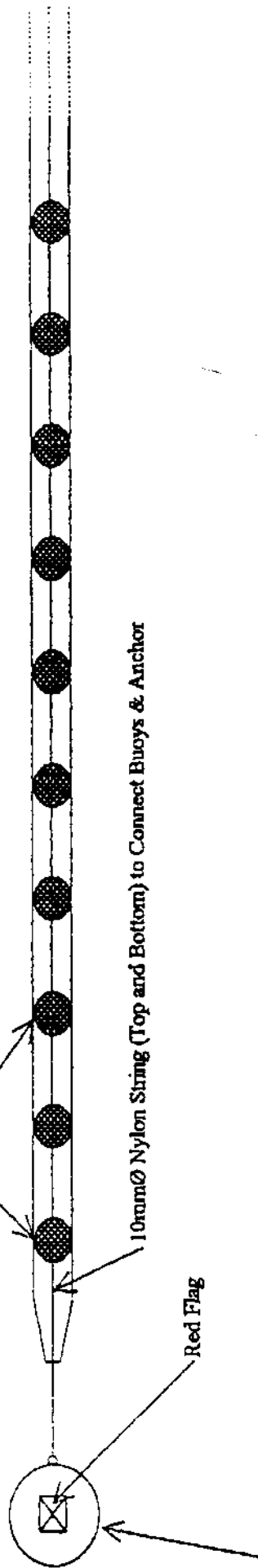
Plan of Proposed Simple Silt Curtain

300mmØ Plastic Buoy at 500mm c/c (red colour)

10mmØ Nylon String (Top and Bottom) to Connect Buoys & Anchor

Red Flag

Proposed 1m to 1.2mØ Anchor Buoys at 30m c/c



EM&A Reports

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 by A/ER and submitted within 10 working days of the end of each reporting months, with the first report due in the month after construction commences. A maximum of 4 copies of each monthly EM&A report shall be submitted to each of the three parties: the Contractor, the ER and the EPD. 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.

First Monthly EM&A Report

The first monthly EM&A report shall include at least but not be limited to the following:

- a) Executive Summary (1-2 pages)
 - Breaches of AL levels;
 - Complaint Log
 - Notifications of any summons and successful prosecution;
 - Reporting Changes;
 - Future key issues.
- b) Basic Project Information
 - Project organisation including key personnel contact names and telephone numbers;
 - Construction Programme with fine tuning of construction activities showing the interrelationship with environmental protection/mitigation measures for the month;
 - Management structure; and
 - Works undertaken during the month.
- c) Environmental Status
 - Works undertaking during the month with illustrations (such as location of works, daily dredging rates); 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;
 - Environmental quality performance limits (Action and Limit levels);
 - Event-Action Plans;
 - Environmental mitigation measures, as recommended in the project EIA study final report;

- Environmental requirements in contract documents.

e) Implication Status

Advice on the implementation status of environmental protection and pollution control/mitigation measures including measures for ecological and visual impacts, as recommended in the project profile, summarized in the implementation schedule.

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 (and depth);
- monitoring date, time, frequency and duration;
- Weather conditions during the period;
- graphical plots of the monitoring parameters in the month annotated against;
- the major activities being carried out on site during the period;
- weather conditions that may affect the results;
- 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-compliance (exceedances) of the environmental quality performance limits (Action and Limit 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 procedure 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-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and
- description of the actions taken in the event of noncompliance and deficiency reporting and any follow-up procedures related to earlier noncompliance.

h) Others

- an account of the future key issues as reviewed from the works programme and work method statements;
- advice on the solid and liquid waste management status; and
- submission of implementation status proforma, proactive environmental protection proforma, regulatory compliance proforma, site inspection proforma, data recovery schedule and complaint log summarizing the EM&A of the period.

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 prosecution;
- Reporting Changes;
- Future key issues.

b) Environmental Status

- Construction Programme with the 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 numbers; 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 ecological and visual impacts, as recommended in the project profile, summarized in the implementation schedule.

d) 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 (and depth);
- monitoring date, time, frequency and duration;
- Weather conditions during the period;
- graphical plots of the monitoring parameters in the month annotated against;
- the major activities being carried out on site during the period;
- weather conditions that may affect the results;
- 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-compliance (exceedances) of the environmental quality performance limits (Action and Limit 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 procedure 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-compliance, complaints, summons and prosecutions including review of pollution sources and working procedures; and
- description of the actions taken in the event of noncompliance and deficiency reporting and any follow-up procedures related to earlier noncompliance.

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

Final EM&A Summary Report

The termination of EM&A programme shall be determined on the following basis:

- a) completion of construction activities and insignificant environmental impacts of the remaining outstanding construction works;
- b) trends analysis to demonstrate the narrow down of monitoring exceedances due to construction activities and the return of ambient environmental conditions in comparison with baseline data; and
- c) no environmental complaint and prosecution involved.

The proposed termination may be required to consult related local community such as village representative/committee and/or District Board and the proposal should be endorsed by the A/ER and the project proponent prior to final approval from the Director of Environmental Protection.

The final EM&A summary report shall include, inter alia, the following:

- a) an 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 entire construction period;
- c) a brief summary of EM&A requirements including:
 - monitoring parameters;
 - environmental quality performance limits (Action and Limit levels); and
 - environmental mitigation measures, as recommended in the project profile.
- d) advice on the implementation status of environmental protection and pollution control/mitigation measures, as recommended in the project profile, summarised in the updated implementation status proformas;
- 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 construction period for representative monitoring stations annotated against:
 - the major activities being carried out on Site during the period;

- weather conditions during the period;
 - any other factors which might affect the monitoring results; and
 - the return of ambient environmental conditions in comparison with baseline data.
- g) compare and contrast the EM&A data with the project profile predictions and annotate with explanation for any discrepancies;
 - h) provide clear-cut decisions on the environmental acceptability of the project with reference to the specific impact hypothesis;
 - i) a summary of noncompliance (exceedances) of the environmental quality performance limits (Action and Limit levels);
 - j) a brief review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures;
 - k) a summary description of the actions taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;
 - l) a summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken;
 - m) review the monitoring methodology adopted and with the benefit of hindsight, comment on its effectiveness (including cost effectiveness);
 - n) 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;
 - o) review the practicality and effectiveness of the dredging process and EM&A programme (e.g. effectiveness and efficiency of the mitigation measures), recommend and improvement in the EM&A programme; and
 - p) a conclusion to state the return of ambient and/or the predicted scenario as per the project profile.