Annex F

Area 131 Study Final Laboratory Testing Report and Western Coast Road Dredging of Contaminated Material Report

Full results of the field investigation are included in the report "Contract No CE/95/08 W.O. No. GE/95/08.30, *Feasibility study for TKO Port Development at Area 131, Marine Ground Investigation, Factual Fieldwork Report*" dated June 1997 prepared by Bachy Soletanche Group.

7.2.3 Results

The field investigations revealed that the site is underlain by the following deposits and formations:

i) fill (about 2 m thick, coarse gravel and coarse to fine sand)
ii) marine deposits (ranging from 0 m to 14m, very soft to soft marine clay).
iii) alluvial deposit
iv) completely decomposed rock formation
v) bedrock.

Results of the laboratory testing for heavy metals as classified by the EPD Technical Circular 1-1-92 are presented in Table 7.2. Metal concentrations which exceeded Class C were found at Vibrocores VB3, VB5, VB6, VB7 and VB8 mostly found in surface deposits (0 to 2.4 m deep). Sediment copper, lead and mercury levels were found to be the main cause of the exceedance of Class C limits.

Table No 7.2 : Classification of Sediment According to the Technical Circular

Sampling Depth (m)	Classification of Sediment								
	VB1	VB2	VB3	VB4	VB5	VB6	VB7	VB8	VB9
0.0 - 0.4	n/a	B	n/a	A	C*	C	n/a	C	n/a
1.0 - 1.4	A	A	C	A	A	C	A	C	A
2.0 - 2.4	A	B	A	A	C	A	C	A	A
3.0 - 3.4	A	A	A	A	A	A	A	A	A
6.0 - 6.4	A	A	C	A	A	A	B	A	B

Note * sediment sample obtained at 0.4 - 0.5m
n/a sediment samples could not be obtained in field
for VB10, no sediment testing results were available

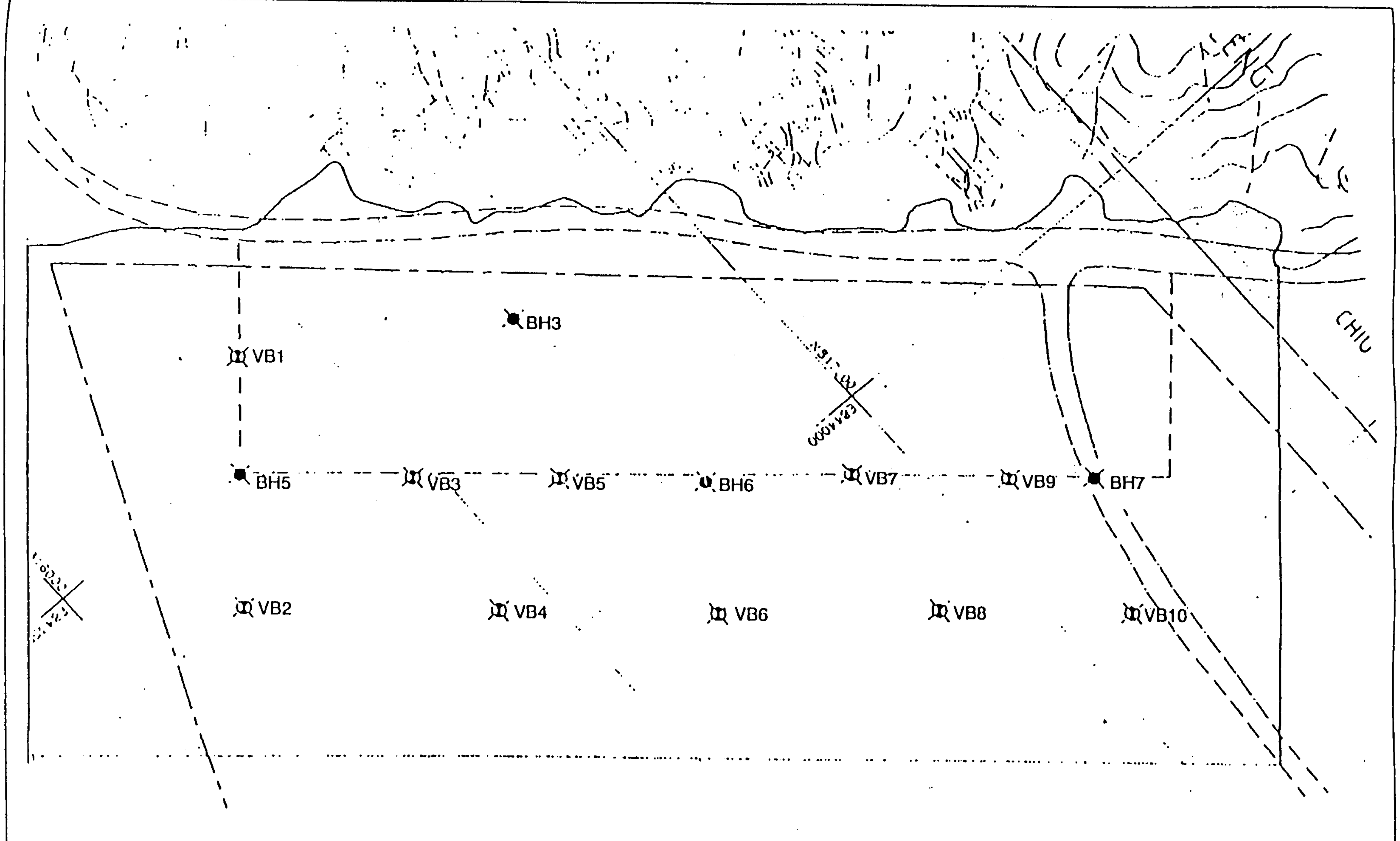
7.2.4 Impact Assessment

It is recognised that some areas may require dredging of marine sediments prior to the reclamation. Therefore, the contamination status of such material should be determined in order that disposal/ containment methods can be recommended.

The findings of the marine site investigation and sediment testing indicated that some samples can be categorized as Class C contamination. These contaminated sediments must be dredged and transported with great care, and must be permanently isolated from the environment. Ways to minimize the need for disposal through appropriate reclamation options, environmentally acceptable disposal methods and areas should be considered.

7.2.5 Conclusion

Marine site investigation indicated that surface sediments at some locations were classified as Class C Contaminated Sediment under the EPD Technical Circular 1-1-92. As discussed in the *Working Paper No. WP8 Engineering Proposal* completed in October 1997, the reclamation for Area 131 was proposed to be reclaimed by the drained method without dredging. For this method, a layer of



環科 CES	TITLE: Site Investigation Locations	CES (ASIA) LIMITED	
		PROJECT NO: B110	DATE: May 1998
		DESIGNED: Maggie Wong	DRAWING NO: Figure 7.1

MATERIALAB LIMITED
5 Lok Yi Street,
17 M.S. Castle Peak Road,
Tai Lam, Tuen Mun,
N.T., Hong Kong.
Tel : (852) 2450 8233
Fax : (852) 2450 6138

MateriaLab

HOKLAS

Report No. : 952399EN70664

Sample Identification	Copper Content mg/kg	Cadmium Content mg/kg	Chromium Content mg/kg	Lead Content mg/kg	Nickel Content mg/kg	Zinc Content mg/kg	Mercury Content mg/kg	Classification of contamination level (*)
VB8 0.0-0.4m	90	<0.2	33	36	12	200	0.10	C
VB8 1.0-1.4m	130	<0.2	78	62	19	160	0.56	C
VB8 2.0-2.4m	9.5	<0.2	31	20	18	69	<0.05	A
VB8 3.0-3.4m	7.8	<0.2	29	15	17	62	<0.05	A
VB8 6.0-6.4m	9.4	<0.2	29	22	17	58	<0.05	A
VB9 1.0-1.4m	18	<0.2	32	39	17	72	<0.05	A
VB9 2.0-2.4m	13	<0.2	25	35	14	73	0.23	A
VB9 3.0-3.4m	7.7	<0.2	31	15	17	65	<0.05	A
VB9 6.0-6.4m	19	<0.2	63	20	21	73	<0.05	B

Remarks :
1. Results are based on mass of sample dried at 103-105°C.
2. Analytical data are attached in the Appendix.
3. Testings of the seven heavy metals contents of sediment are accredited by HOKLAS.

* The classification of contamination level of sediment is an opinion of the laboratory, based on the following table issued by EPD and is not covered under the HOKLAS accreditation

Table 1 - Classification of Sediments by Metal Content (mg/kg dry weight)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Class A	0.0-0.9	0-49	0-54	0.0-0.7	0-34	0-64	0-140
Class B	1.0-1.4	50-79	55-64	0.8-0.9	35-39	65-74	150-190
Class C	1.5 or more	80 or more	65 or more	1.0 or more	40 or more	75 or more	200 or more

Supervised by : K.F. Wong

Certified by : [signature]
Approved Signatory : K.M. Ho

Date : 25/8/99

MATERIALAB LIMITED
5 Lok Yi Street,
17 M.S. Castle Peak Road,
Tai Lam, Tuen Mun,
N.T., Hong Kong.

Tel : (852) 2450 8233
Fax : (852) 2450 6138

MateriaLab

Report No. : 952399EN70664

HOKLAS

Sample Identification	Copper Content mg/kg	Cadmium Content mg/kg	Chromium Content mg/kg	Lead Content mg/kg	Nickel Content mg/kg	Zinc Content mg/kg	Mercury Content mg/kg	Classification of contamination level (*)
VB5 0.4-0.5m	120	<0.2	36	34	12	110	0.17	C
VB5 1.0-1.4m	9.2	<0.2	25	18	14	52	<0.05	A
VB5 2.0-2.4m	280	1.1	51	380	15	750	2.6	C
VB5 3.0-3.4m	6.7	<0.2	24	13	13	50	<0.05	A
VB5 6.0-6.4m	14	<0.2	25	25	13	56	0.07	A
VB6 0.0-0.4m	140	<0.2	55	52	17	140	0.24	C
VB6 1.0-1.4m	110	<0.2	80	64	22	160	0.54	C
VB6 2.0-2.4m	30	<0.2	45	57	19	120	0.62	A
VB6 3.0-3.4m	8.7	<0.2	36	16	19	70	<0.05	A
VB6 6.0-6.4m	28	<0.2	36	38	15	80	<0.05	A
VB7 1.0-1.4m	13	<0.2	36	55	14	47	<0.05	A
VB7 2.0-2.4m	54	<0.2	39	84	13	160	0.81	C
VB7 3.0-3.4m	11	<0.2	28	24	17	70	<0.05	A
VB7 6.0-6.4m	16	<0.2	36	67	13	53	<0.05	B

MATERIALAB LIMITED
5 Lok Yi Street,
17 M.S. Castle Peak Road,
Tai Lam, Tuen Mun,
N.T., Hong Kong.
Tel : (852) 2450 8233
Fax : (852) 2450 6138

MateriaLab

Report No. : 952399EN70664

HOKLAS

Copy 2 of 4

Results :

Sample Identification	Copper Content mg/kg	Cadmium Content mg/kg	Chromium Content mg/kg	Lead Content mg/kg	Nickel Content mg/kg	Zinc Content mg/kg	Mercury Content mg/kg	Classification of contamination level (*)
VB1 1.0-1.4m	15	<0.2	25	27	13	69	0.07	A
VB1 2.0-2.4m	17	<0.2	9.3	33	4.9	42	0.06	A
VB1 3.0-3.4m	32	<0.2	27	48	13	94	0.11	A
VB1 6.0-6.4m	14	<0.2	29	18	15	70	<0.05	A
VB2 0.0-0.4m	44	<0.2	38	27	17	78	0.91	B
VB2 1.0-1.4m	8.5	<0.2	20	11	11	46	<0.05	A
VB2 2.0-2.4m	49	<0.2	54	67	20	160	0.75	B
VB2 3.0-3.4m	8.4	<0.2	20	13	12	46	<0.05	A
VB2 6.0-6.4m	36	<0.2	42	31	21	89	0.06	A
VB3 1.0-1.4m	53	0.21	32	98	11	170	0.48	C
VB3 2.0-2.4m	34	<0.2	27	45	11	110	0.47	A
VB3 3.0-3.4m	19	<0.2	13	30	6.2	70	0.05	A
VB3 6.0-6.4m	32	<0.2	10	31	4.5	56	1.2	C
VB4 0.0-0.4m	11	<0.2	27	22	15	57	<0.05	A
VB4 1.0-1.4m	8.7	<0.2	16	12	9.0	39	<0.05	A
VB4 2.0-2.4m	35	<0.2	46	57	19	130	0.58	A
VB4 3.0-3.4m	7.9	<0.2	29	15	16	56	<0.05	A
VB4 6.0-6.4m	8.6	<0.2	3.7	9.8	1.0	9.4	<0.05	A

FEASIBILITY STUDY ON
THE ALTERNATIVE ALIGNMENT
FOR THE WESTERN COAST ROAD
TSEUNG KWAN O
CONTAMINATED MATERIALS REPORT

MAUNSELL GEOTECHNICAL SERVICE LTD.

CONTENTS

1. INTRODUCTION

1.1 A seawall reclamation and a submerged reef are proposed to be constructed at Yau Tong waterfront for the Western Coast Road project. The submerged reef is basically a submerged sloping breakwater designed for the protection of Western Coast Road against ship collision. Preliminary ground investigation has been carried out in this Feasibility Study to provide indicative data for the site conditions, including level of contamination of seabed material in the vicinity of the proposed seawall reclamation and submerged reef. A location plan of the site is included as Figure 1 of this report.

1.2 The purpose of this report is to examine the level of contamination of dredged marine mud from the proposed submerged reef and reclamation along the existing Yau Tong shoreline according to laboratory test results and geological assessment. The report will also form the basis for the preparation of the scope of detailed ground investigation included in the detailed design stage of the Western Coast Road project.

1.3 The objectives taken into consideration in preparing the report are summarized as follows:

- Minimize marine sand fill requirement and potential contamination to sea water by minimizing dredging.
- Where dredging is unavoidable, dredged materials are to be disposed off to potential dump sites.

1.4 This report consists of three chapters. Chapter 2 presents the results from heavy metal analysis on marine mud samples. The conclusions of this report are presented in Chapter 3.

2. CONTAMINATION OF MARINE MUD AT RECLAMATION SITE

2.1 Heavy Metal Analysis

2.1.1 The results of the heavy metal analysis are summarized in Table 2.1 and the laboratory data is presented in Appendix A. The table indicates that seriously contaminated samples (Class C) were obtained from vibrocores no. WCVC2 and WCVC3 (abbreviated as VC2 and VC3 respectively). Closer examination of the table reviews that the contamination is most serious within the first 4 metres of the seabed. The contamination also increases significantly from VC2 to VC3, which suggests that the contamination may be more serious towards the Lei Yue Mun side of the proposed reclamation. However, due to the limited number of sampling locations, this suggested variation in contamination will need to be verified in the detailed design stage of the project, when a detailed ground investigation is carried out.

2.1.2 Therefore, special measures and care need to be exercised while dredging the top layer of marine mud when preparing the dredged trench for the seawall and the submerged reef.

2. CONTAMINATION OF MARINE MUD AT RECLAMATION SITE (CONT'D)

Table 2.1: Contamination of Marine Mud

Vibro Core Location	Depth of Sampling below seabed (m)	Sample Identification Letter	Contamination Classification Based on Heavy Metal Analysis							
			Cd	Cr	Cu	Ni	Po	Zn	Hg	Overall Classification
VC2	0.0-0.1	A1	A	A	C	A	C	A	A	C
VC2	0.9-1.0	B1	A	A	A	A	A	A	A	A
VC2	3.3-3.4	D1	A	B	C	A	A	A	A	C
VC3	1.1-1.2	B1	A	B	C	A	C	A	A	C
VC3	1.9-2.0	C1	A	C	C	A	C	C	C	C
VC3	6.2-6.3	E1	A	A	A	A	A	A	A	A

2.2 Disposal of Surplus Material

2.2.1 The marine mud is required to dispose off at Government approved mud disposal pit. The EPD regulations would require this mud to be disposed of either in a contained lagoon, or on land with or without some form of chemical treatment. Class C contamination is only limited to the top 4m layer of marine mud. Based on the preliminary design of the submerged reef and seawall, the volumes of the contaminated dredged material are estimated in Table 2.2.

Table 2.2 Estimated Volumes of Contaminated Dredged Mud for Construction of Seawall and Submerged Reef

Class of Contamination	Depth Under Seabed (m)	(m^3)
A	0.5 - 1.0	28381
C	0 - 0.5, 1.0 - 4.0	198669
Total		227050

An average dredged depth of 4m has been assumed in the estimation of dredging volumes. This will be reviewed in the detailed design stage when a detailed ground investigation is carried out to provide a clearer picture of the site conditions.

2.2.2 There is a number of different mud disposal sites within Hong Kong. The Fill Management Committee (FMC) shall be consulted in the detailed design stage of the Western Coast Road project to identify the potential mud disposal sites in Hong Kong.

2.2.3 Dredging of marine mud is minimized by avoiding any dredging activities in the reclamation area behind the seawall, so that dredging is required only for the construction of submerged reef and seawall. The settlement of marine mud in the reclamation area behind the seawall will be controlled by the installation of preloading mound and vertical drains. The design of preloading mound and vertical drains are included in a separate report under the captioned Feasibility Study.

2.2.4 Discussions concerning the handling and disposal of contaminated marine mud shall be included in the EIA - Final Assessment Report of the Study.

3. CONCLUSIONS

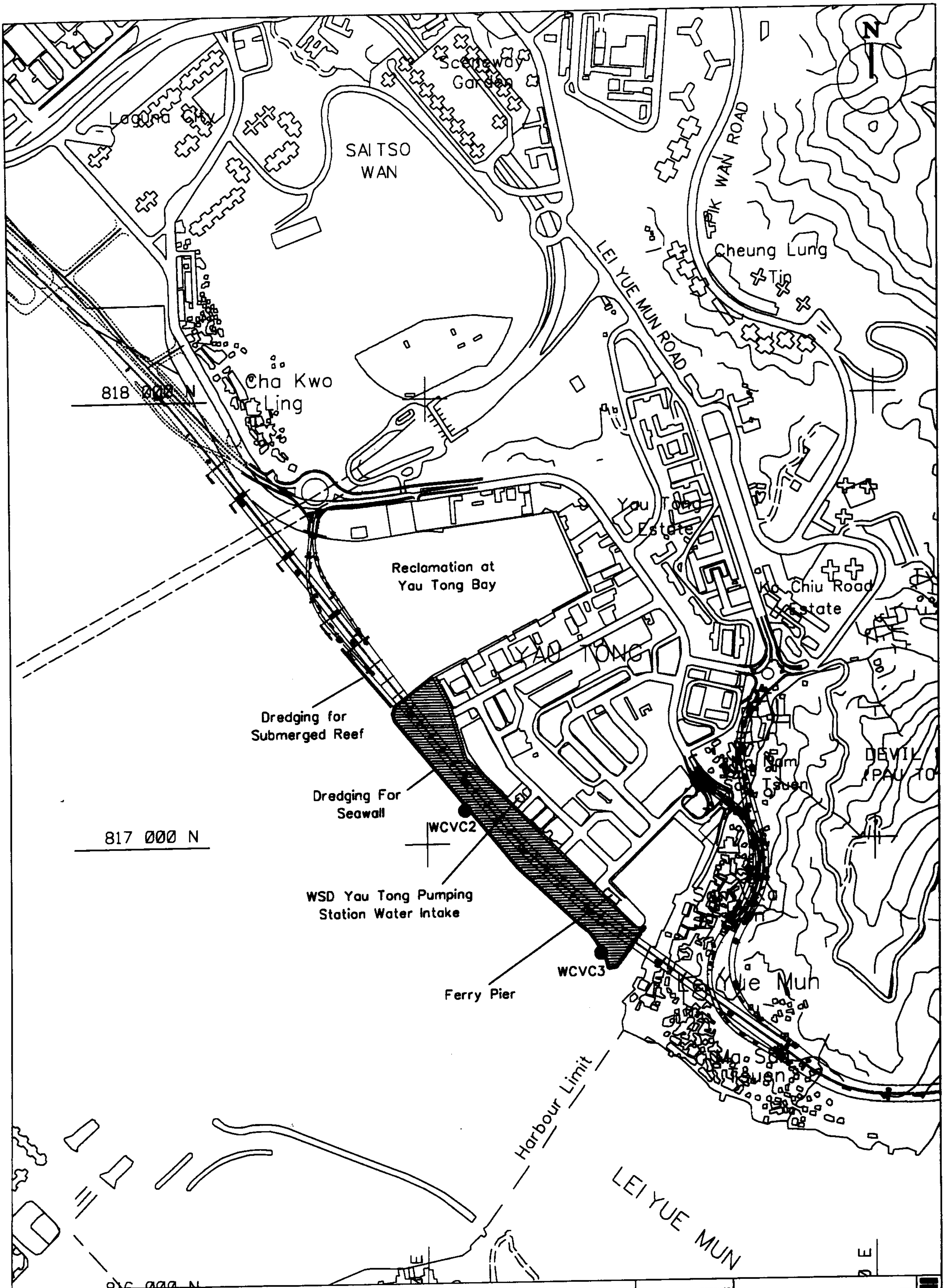
3.1 Reclamation along Yau Tong shoreline is proposed for the construction of Western Coast Road. Seawall is proposed to be built in a dredged trench surrounding the reclamation. To minimise dredging, the reclamation area behind the proposed seawall shall generally be formed without any dredging; the residual consolidation of the reclamation area shall be controlled by the use of preloading mounds and vertical drains.

3.2 Chemical analyses carried out in the recovered vibrocore samples indicate zones of serious contaminations extending between depth of 1m to 4m below the seabed at the western site boundary (vibrocores VC2 & VC3). The estimated volumes of contaminated mud from the proposed dredging are summarised in Table 2.2.

3.3 Due to the high level of marine mud contamination detected from the preliminary ground investigation, a more thorough ground investigation at the locations of the proposed dredging should be carried out in the detailed design stage in accordance with Works Branch Technical Circular No. 22/92.

FIGURE 1

LOCATION PLAN



© COPYRIGHT RESERVED

MAUNSELL CONSULTANTS ASIA LTD

VIBRO CORE (WCVC2 AND WCVC3) SAMPLING LOCATIONS DURING SITE INVESTIGATIONS OF WESTERN COAST ROAD

DATE:	FEB 98	FIGURE No.
SCALE:	1 : 1100	1

Maunsell

APPENDIX A

LABORATORY TEST RESULT OF MARINE MUD

**PROJ

*PROJ_ID	*PROJ_NAME	*PROJ_LOC	*PROJ_CLNT	*PROJ_CONT	*PROJ_ENG	*PROJ_MEMO	*PROJ_DATE	*PROJ_AGS
GE/97/11 45	Feasibility Study	LOCATION	NTE/TDD	GAMMON CONSTRUCTION	MAUNSELL	GE/97/11	19/01/1998	07/94

**CNMT

*HOLE_ID	*SAMP_TOP	*SAMP_REF	*SAMP_TYPE	*SPEC_REF	*SPEC_DPTH	*CNMT_TYPE	*CNMT_RESL	*CNMT_UNIT	*CNMT_METH	*CNMT_REM	*CNMT_LIM
WCVC2		A1	CATS			B	0 34	mg/kg	APHA		0 2
WCVC2		A1	CHRTS			B	43	mg/kg	APHA		1
WCVC2		A1	CUTS			B	130	mg/kg	APHA		1
WCVC2		A1	PBTS			B	83	mg/kg	APHA		1
WCVC2		A1	HGTS			B	<0 1	mg/kg	APHA		0 1
WCVC2		A1	NITS			B	10	mg/kg	APHA		1
WCVC2		A1	ZNTS			B	92	mg/kg	APHA		1
WCVC2		B1	CATS			B	<0 2	mg/kg	APHA		0 2
WCVC2		B1	CHRTS			B	13	mg/kg	APHA		1
WCVC2		B1	CUTS			B	4.5	mg/kg	APHA		1
WCVC2		B1	PBTS			B	15	mg/kg	APHA		1
WCVC2		B1	HGTS			B	<0 1	mg/kg	APHA		0 1
WCVC2		B1	NITS			B	7.5	mg/kg	APHA		1
WCVC2		B1	ZNTS			B	37	mg/kg	APHA		1
WCVC2		D1	CATS			B	0.2	mg/kg	APHA		0 2
WCVC2		D1	CHRTS			B	71	mg/kg	APHA		1
WCVC2		D1	CUTS			B	89	mg/kg	APHA		1
WCVC2		D1	PBTS			B	55	mg/kg	APHA		1
WCVC2		D1	HGTS			B	0.17	mg/kg	APHA		0 1
WCVC2		D1	NITS			B	21	mg/kg	APHA		1
WCVC2		D1	ZNTS			B	94	mg/kg	APHA		1
WCVC3		B1	CATS			B	0.54	mg/kg	APHA		0 2
WCVC3		B1	CHRTS			B	656	mg/kg	APHA		1
WCVC3		B1	CUTS			B	190	mg/kg	APHA		1
WCVC3		B1	PBTS			B	88	mg/kg	APHA		1
WCVC3		B1	HGTS			B	0.57	mg/kg	APHA		0 1
WCVC3		B1	NITS			B	12	mg/kg	APHA		1
WCVC3		B1	ZNTS			B	130	mg/kg	APHA		1
WCVC3		C1	CATS			B	0.46	mg/kg	APHA		0 2
WCVC3		C1	CHRTS			B	85	mg/kg	APHA		1
WCVC3		C1	CUTS			B	180	mg/kg	APHA		1
WCVC3		C1	PBTS			B	100	mg/kg	APHA		1
WCVC3		C1	HGTS			B	1.1	mg/kg	APHA		0 1
WCVC3		C1	NITS			B	17	mg/kg	APHA		1
WCVC3		C1	ZNTS			B	250	mg/kg	APHA		1
WCVC3		E1	CATS			B	<0 2	mg/kg	APHA		0 2
WCVC3		E1	CHRTS			B	4 6	mg/kg	APHA		1
WCVC3		E1	CUTS			B	4	mg/kg	APHA		1
WCVC3		E1	PBTS			B	56	mg/kg	APHA		1
WCVC3		E1	HGTS			B	<0 1	mg/kg	APHA		0 1
WCVC3		E1	NITS			B	2 1	mg/kg	APHA		1
WCVC3		E1	ZNTS			B	19	mg/kg	APHA		1

APPENDIX B

RESPONSES TO COMMENTS

Comments received:		**Responses:**
(1)	**From PM/Kowloon, TDD** **Ref. (21) in UA4/5/42 Pt.4** **Date 1/4/98**	
	No Comment.	Noted.
(2)	**From PM/NTE, TDD** **Ref. (68) in NTE-JB2/584 TH/41 IX** **Date 14/4/98**	
	Para 2.2.2	
	FMC should be consulted to identify the potential mud disposal sites available at 2002 and 2003 for the WCR project.	Noted.
(3)	**From Director of Marine** **Ref. (11) in PA/S 492/73(14)** **Date 15/4/98**	
	No Comment.	Noted.
(4)	**From PGGE/GEO, CED** **Ref. GCP 1/10/407 XXIV** **Date 15/4/98**	
(i)	Table 2.1	
	Sample VC2 at 3.3-3.4m should be classified as Class C (not Class B) in accordance with EPD TC No. 1-1-92.	Noted. Table 2.1 is amended accordingly, and hence Table 2.2
(ii)	Table 2.2	
	The differentiation of disposal volumes between Class A and B is unnecessary because both classes of dredged sediments are destined for open sea-floor disposal sites or empty marine sand borrow pits.	Noted. There is no Class B materials after amending Table 2.1
(iii)	Para 2.2.2	
	Delete the following test "although it is .... of Western Coast Road" because the statement does not reflect the forward planning undertaken by the Fill Management Committee	Noted. Para 2.2. in amended accordingly
(5)	**From CE/PD of CEO, CED** **Ref. (22) in PD 5/2/24** **Date 20/4/98**	
	No Comment.	Noted.