

## 6 SEDIMENT CONTAMINATION

### 6.1 INTRODUCTION

6.1.1 Marine sediment dredging would occur from laying of submarine and emergency overflow outfalls. The water quality impact from dredging has been evaluated in Chapter 5. This section documents the baseline conditions of sediment in the vicinity of Peng Chau and Tai Lei Island and the sediment sampling and analysis results at the proposed dredging site.

### 6.2 ENVIRONMENTAL LEGISLATION, STANDARDS AND GUIDELINES

6.2.1 Environment, Transport and Works Bureau Technical Circular (Works) (ETWB TCW) No. 34/2002 on the Management of Dredge/Excavated Sediment sets out the procedure to be followed in assessing and classifying the sediment and explains the marine disposal arrangement for the classified material. A Sediment Quality Report is required to be completed and submitted to EPD at least three months prior to tendering of the dredging contract being tendered. Dumping permit from EPD would be required for marine disposal of dredged materials if dredged volume is less than 50,000m<sup>3</sup>.

6.2.2 Marine sediment is classified into three (3) categories, L, M and H, in ETWB TCW No. 34/2002 based on its contamination levels:

Category L- Sediment with all contaminant levels not exceeding the Lower Chemical Exceedance Level (LCEL). The material must be dredged, transported and disposed of in a manner that minimises the loss of contaminants either into solution or by resuspension.

Category M- Sediment with any one or more contaminant levels exceeding the LCEL and none exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with care, and must be effectively isolated from the environment upon final disposal unless appropriate biological tests demonstrate that the material will not adversely affect the marine environment.

Category H- Sediment with any one or more contaminant levels exceeding the UCEL. The material must be dredged and transported with great care, and must be effectively isolated from the environment upon final disposal.

6.2.3 The classification of Sediment Quality is provided in **Table 6-1**.

**Table 6-1 Sediment Quality Criteria for the Classification of Sediment**

Contaminants	Lower Chemical Exceedance Level (LCEL)	Upper Chemical Exceedance Level (LCEL)
Metals (mg/kg dry weight)		
Cadmium (Cd)	1.5	4
Chromium (Cr)	80	160
Copper (Cu)	65	110
Mercury (Hg)	0.5	1
Nickel (Ni)	40	40
Lead (Pb)	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
Metalloid (mg/kg dry weight)		
Arsenic (As)	12	42
Organic - PAH (µg/kg dry weight)		
Lower Molecular Weight PAHs	550	3160
High Molecular Weight PAHs	1700	9600
Organic-non- PAH (µg/kg dry weight)		
Total PCBs	23	180
Organometallics (µg /TBTL in interstitial water)		
Tributyltin (TBT)	0.15	0.15

6.2.4 According to ETWB TCW No. 34/2002, Category L sediment can be disposed of at a gazetted open sea disposal site. Category M sediment can be disposed of at a dedicated marine disposal site if the biological screening test is passed. If the biological screening test is failed, the dredged Category M sediment needs to be disposed of at a confined marine disposal facility (e.g. East Sha Chau contaminated mud disposal pits). For Category H sediment, if none of the contaminant levels exceed 10 times of the LCEL, or one or more contaminant levels exceed 10 times of the LCEL but with the biological screening test passed, the sediment would be disposed of at confined marine disposal facility. In case the biological screening test is failed, the sediment would need special treatment and disposal. **Figure 6-1** shows various disposal routes for the three categories of sediment.

## 6.3 BASELINE CONDITIONS

6.3.1 No record of dredging or excavation has been found in the area around the proposed dredging boundary. The water body around Peng Chau is within the secondary contact recreation zone and has been the water receiving body for treated effluent of the existing STW.

6.3.2 Review of the available baseline information on the sediment quality was conducted and a summary is provided as follow.

a) EIA Report on Outlying Island Sewerage – Stage I Phase I (Maunsell, 1997)

Measurements of sediment quality at sampling stations PC1, PC2, PC3, PC4 and PC5 were carried out in 1996 across the channel between Tai Lei Island and Discovery Bay (**Figure 5-2**). The results were classified according to EPD Technical Circular No. TC 1-1-92 “Classification of Dredged Sediments for Marine Disposal”. For comparison, **Table 6-2** shows these survey results and the chemical exceedance level specified in Appendix A of ETWB TCW No. 34/2002. The sediment contamination level for heavy metals was low.

**Table 6-2 Sediment Quality around Peng Chau (Maunsell 1997)**

Contaminant	LCEL	UCEL	PC1	PC2	PC3	PC4
<i>Metals (mg/kg dry weight)</i>						
Cadmium (Cd)	1.5	4	0.05	0.09	0.05	0.14
Chromium (Cr)	80	160	30	32.5	13.8	17.8
Copper (Cu)	65	110	29.3	42.6	17.8	24.9
Mercury (Hg)	0.5	1	0.14	0.2	0.11	0.12
Nickel (Ni)	40	40	17.3	19.5	8.7	10.9
Lead (Pb)	75	110	38	48.7	30.4	57.5
Silver (Ag)	1	2	NA	NA	NA	NA
Zinc (Zn)	200	270	85	104	51	85
<i>Metalloid (mg/kg dry weight)</i>						
Arsenic (As)	12	42	NA	NA	NA	NA
<i>Organic -PAHs (ug/kg/dry weight)</i>						
Low Molecular Weight PAHs	550	3160	NA	NA	NA	NA
High Molecular Weight PAHs	1700	9600	NA	NA	NA	NA
<i>Organic-non-PAHs (ug/kg/dry weight)</i>						
Total PCBs	23	180	NA	NA	NA	NA

Note: NA - Not applicable as no measurement was performed

b) EPD Marine Water in Hong Kong in 2001 (EPD, 2002c)

This report summarises and presents the sediment quality of monitoring stations from 1997 to 2001. The closest sediment monitoring station to the proposed dredging boundary is SS5, which is located in the secondary contact recreation zone between Lantau Island and Hei Ling Chau. Sediment quality was classified according to the ETWB TCW No. 34/2002 and the contaminant levels belong to Category L.

c) Geophysical Survey conducted under this Project (Jan 2003)

A geophysical survey was conducted under this Project. Findings of the survey reveal that the seabed of the proposed boundary is composed of predominantly mud or fine sand with some small stones or gravel.

## 6.4 SEDIMENT SAMPLING AND ANALYSIS

- 6.4.1 The baseline review indicates that the sediment near Peng Chau was relatively uncontaminated with respect to metals, because all the tested metals fall below the LCEL as shown in Table 6-2. In order to provide more accurate and updated information on the baseline sediment quality of the proposed submarine outfall site, a survey for sediment quality assessment was conducted under this Project. The sediment contamination survey involved taking vibrocore sediment samples and carry out chemical screening of the samples for metals and organics. The proposal for the sediment contamination survey was submitted to and accepted by the Waste and Water Management Group of EPD under the requirements of ETWB TCW No. 34/2002.
- 6.4.2 Given the relatively small dredged site, samples were collected at two sampling locations as shown in **Figure 6-2**. These two sampling locations are approximately 75m apart. As dredging of submarine outfall would remove sediment deeper than the seabed, sampling of continuous vertical profiles by vibrocores were conducted. Five samples were taken from each core (at seabed, 0.9m down, 1.9 m down, 2.9m down and 4.9m down from the seabed). Reference sample was collected at Port Shelter for further biological screening test if the sediment quality is determined to be contaminated.
- 6.4.3 Collected sediment samples were sent to a HOKLAS Accredited Laboratory Lam Geotechnics for chemical screening test. Analytical testing methods were developed in accordance with ETWB (Works) TC 34/2002 or the in-house methods approved by EPD.
- 6.4.4 The results of the chemical screening of the vibrocore samples are shown in **Table 6-3**. These results indicate that the marine sediment (if to be dredged) belongs to Category L. As the proposed dredged volume is 22,000m<sup>3</sup>, a dumping permit would be required from the Waste and Water Management Group (WVG) of EPD under the Dumping at Sea Ordinance.

**Table 6-3 Results of the Chemical Screening**

Sampling Location	Sampling Depth (m)	Metal and Metalloid Content (mg/kg)									Organics Content (ug/kg)		
		Cd	Cr	Cu	Hg	Ni	Pb	Ag	Zn	As	Total PCBs	PAHs Low	PAHs High
A1	0.2- 0.3	0.2	10	6.1	0.2	6.9	20	0.1	17	2.6	<2	<55	<170
A1	0.3- 0.9	0.1	7.9	4.9	0.2	6.2	23	<0.1	24	2.2	<2	<55	<170
A1	0.9- 1.9	0.2	3.5	1.6	0.08	3.5	12	<0.1	<10	2.6	<2	<55	<170
A1	1.9- 2.9	0.2	5.1	1.8	<0.05	2.4	25	<0.1	16	4.6	<2	<55	<170
A1	2.9- 4.9	0.2	6.1	1.9	0.1	2.0	18	<0.1	12	3.0	<2	<55	<170
A2	0- 0.3	0.2	11	8.9	0.08	7.7	23	0.1	34	3.2	<2	<55	<170
A2	0.3- 0.9	0.1	5.8	1.8	0.1	3.8	9.9	<0.1	13	2.8	<2	<55	<170
A2	0.9- 1.9	0.2	3.1	1.2	<0.05	2.1	21	<0.1	<10	3.5	<2	<55	<170
A2	1.9- 2.9	0.2	2.2	1.1	0.07	1.4	20	<0.1	<10	1.9	<2	<55	<170
A2	2.9- 4.9	0.2	1.4	<1	0.09	<1	14	<0.1	<10	<1	<2	<55	<170
Reference	Surface	<0.1	9.4	4.7	0.1	6.8	14	<0.1	22	2.1	<2	<55	<170

Note:

- (1) The reference sample was a grab sample and was taken at Port Shelter, Hong Kong
- (2) "<" indicates that the content is below the reporting limit

## 6.5 ENVIRONMENTAL IMPLICATIONS

- 6.5.1 If open trench method is adopted for submarine and emergency overflow outfalls construction, the associated dredging works would have potential impacts to the immediate surrounding marine water environment.
- 6.5.2 Increase in suspended solids concentration would be resulted from dredging of seabed sediments. If the seabed is contaminated, release of contaminants into the water column would likely to occur.
- 6.5.3 The total estimated dredging volume for submarine and emergency overflow outfalls is 22,000m<sup>3</sup>. Results from chemical screening show that the sediment contamination level is classified as Category L. The dredged sediment would be suitable for open sea disposal. The potential environmental impacts due to dredging activities are evaluated in Chapter 5. The water quality impacts are considered to be acceptable with the implementation of mitigation measures during dredging.
- 6.5.4 Other environmental related impacts associated with seabed dredging would be the transportation and disposal of dredged material. Mitigation measures are recommended to minimise the loss of dredged sediment re-entering the water body to cause further suspension. It is anticipated that the overall environmental impact would be minimal with the implementation of mitigation measures during transportation and disposal.

## 6.6 MITIGATION MEASURES DURING TRANSPORTATION AND DISPOSAL OF DREDGED MATERIALS

- 6.6.1 The ETWB TCW No. 34/2002 specifies the basic requirements and procedures for management and disposal of dredged marine sediment. The management of the dredging, use and disposal of marine sediment is monitored by the Marine Fill Committee, while the licensing of marine dumping is the responsibility of the Director of Environmental Protection.
- 6.6.2 The dredged material would be loaded onto barges and transported to a gazetted open sea disposal ground. During transportation and disposal of the dredged material, the following measures are recommended to be adopted to minimise potential environmental impact:
- (a) Bottom opening of barges should be fitted with tight fitting seals to prevent leakage of material. Excess material should be cleaned from the decks, exposed fitting of barges and hopper dredgers before the vessel is moved.
  - (b) Monitoring of the barge loading should be conducted to ensure that loss of material does not take place during transportation. Transport barges or vessels should be equipped with automatic self-monitoring devices as specified by the EPD.

## **6.7 RESIDUAL ENVIRONMENTAL IMPACTS**

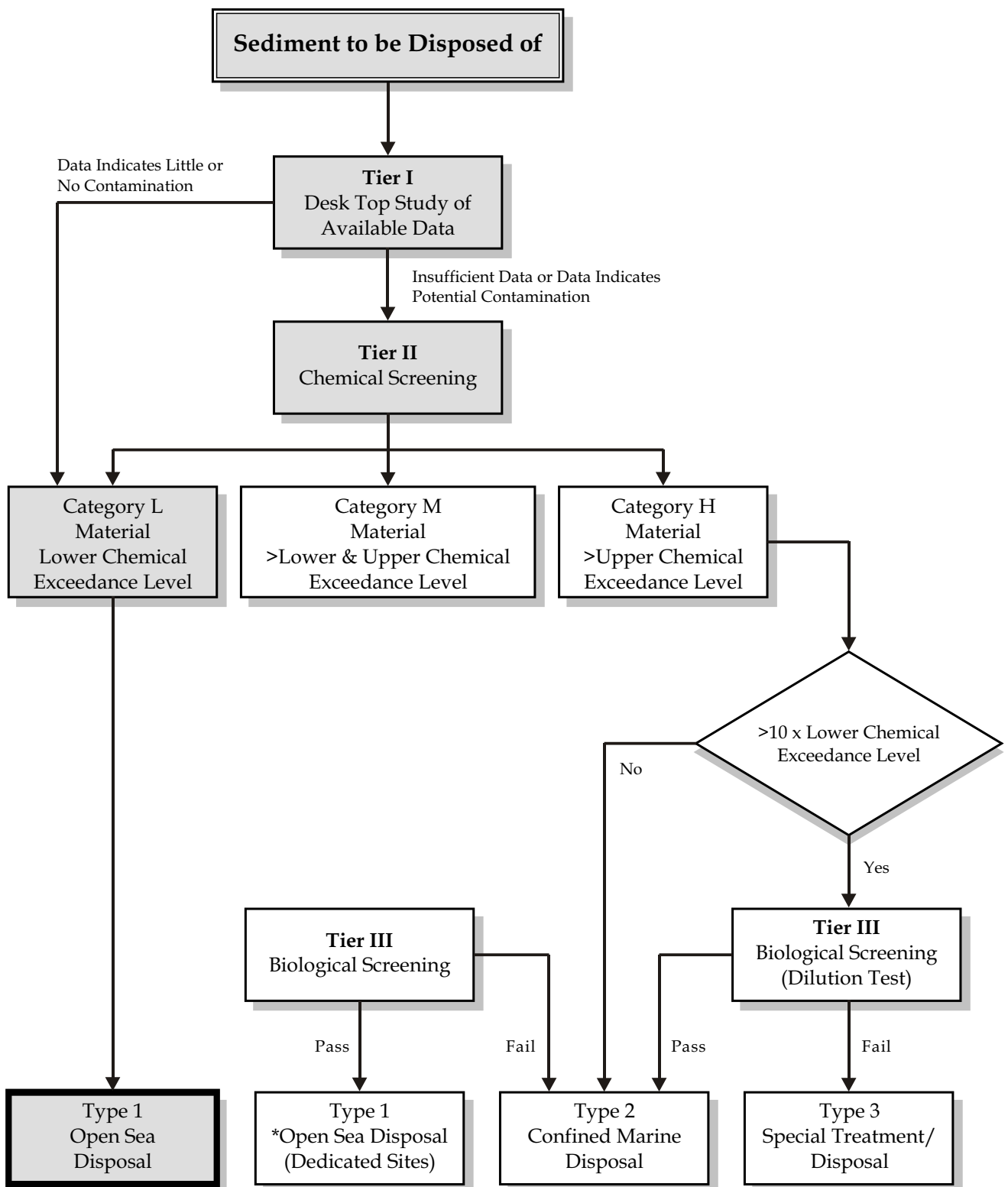
- 6.7.1 It is anticipated that there would be no unacceptable residual environmental impacts due to dredging, transportation and disposal of uncontaminated marine sediment for Peng Chau STW Upgrade Project, with the implementation of the recommended mitigation measures.

## **6.8 ENVIRONMENTAL MONITORING AND AUDIT**

- 6.8.1 It is recommended that the disposal of dredged marine mud follows the environmental monitoring and audits on waste management implication.

## **6.9 CONCLUSIONS AND RECOMMENDATIONS**

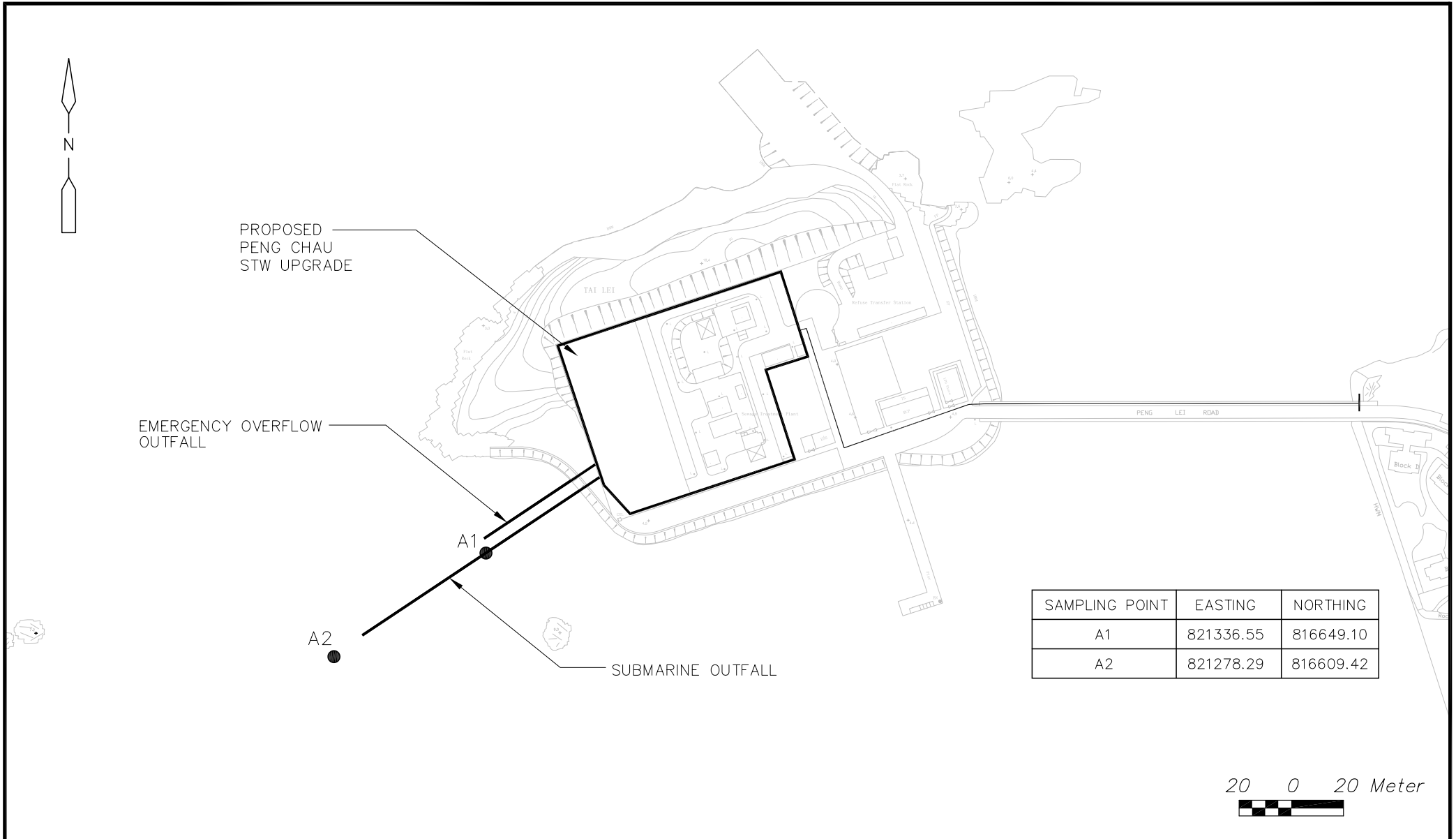
- 6.9.1 Review of previous sediment quality survey reveals that the sediment quality may belong to Category L according to the classification in ETWB TCW No 34/2002. A sediment sampling and analysis was carried out to verify the speculation. Results of chemical screening analysis confirmed that sediment in the proposed dredged area is uncontaminated and belong to Category L sediment. The dredged sediment would be suitable for open sea disposal.



 Proposed Management Scheme for Peng Chau Dredged Mud

\* Dedicated Sites will be monitored to confirm that there is no adverse impact.





**Figure 6-2**  
**Sediment Sampling Locations for the Proposed Project**