Civil Engineering Department

Dredging to Seabed at Castle Peak Beach

PROJECT PROFILE

September 2001

1. INTRODUCTION

Castle Peak Beach is located at 19 Milestone Castle Peak Road, Tuen Mun and is in close proximity to the residential estate of Sam Shing Estate.

Castle Peak Beach, well known as Yung Lung Beach, had for some years been an attractive bathing beach with beautiful seaview. Since 1981 however, the beach has been declared unsuitable for swimming because of poor water quality as a result of rapid urban development in Tuen Mun.

In November 1994, Members of the Tuen Mun District Committee and the Tuen Mun District Board requested to develop the beach into a venue for general recreation and some water borne activities. At the Regional Council Capital Works Select Committee Meeting held in April 1997, Members concluded that the beach should be redeveloped to cater for both boating and bathing activities as the water quality of the beach appeared to have been progressively improved.

To ensure the beach is suitable for swimming, Civil Engineering Department (CED) was requested to undertake a diving inspection at the seabed in 1999. It was found that a 300 - 500mm thick layer of soft mud prevailed. This muddy layer if stirred up by swimmers could affect the clarity and quality of seawater which would become unsuitable for swimming. Thus the removal of the 300 - 500mm thick layer of mud is essential for the re-opening of the beach to public for swimming.

2. BASIC INFORMATION

2.1 Project Title

Dredging at Castle Peak Beach, hereinafter referred to as the “Project”.

2.2 Purpose and Nature of the Project

The Project aims to remove the 300 - 500mm thick layer of mud by grab dredging so as to improve the environmental conditions.

2.3 Name of the Project Proponent

Technical Services Division, Civil Engineering Department

2.4 Location and Scale of Project

Location plan for the Project is presented at Appendix A. The area of dredging site is about 25,000 m^2. Depths of sediment to be dredged range from 300 – 500 mm. A total of approximately 11,000 m^3 sediment will be removed in the Project.

2.5 Number and Types of Designated Projects to be Covered by the Project Profile

The Project comprising dredging operation which is less than 500 m from the nearest boundary of an existing bathing beach (Castle Peak Beach) is classified as a designated project under C.12 of Schedule 2 of the Environmental Impact Assessment Ordinance. Only one designated project is involved.

2.6 Name & Telephone Number of Contact Person(s)

3. OUTLINE OF PLANNING AND IMPLEMENTATION PROGRAMME

3.1 Planning and Implementation

Client Department	:	Leisure and Cultural Services Department
Works Department	:	Civil Engineering Department (responsible for both planning and implementation)
Contractor	:	China Harbour Engineering Company (Group)

3.2 Project Programme

The dredging works is scheduled to commence in December 2001 and will take 10 weeks to complete.

Prior to and after the dredging, a period of 3 weeks will be assigned for the respective baseline and post-project water quality monitoring (WQM). Impact WQM will also be carried out during the whole dredging period.

It is to be noted that dredging must be carried out in winter time, when the bathing activities will be limited and the nearby seawater pump house for cooling purpose will operate at its minimum capacity. The intended project programme is hence worked out as such shown in Appendix B.

4. POSSIBLE IMPACT ON THE ENVIRONMENT

4.1 Implementation Process

Dredging will be carried out to remove the 300-500mm thick layer of mud which will be disposed off site. The details are as follows:

Dredging method	:	By grab dredging
Dredging plant	:	1 – 2 dredgers, including a closed grab dredger and a derrick lighter
Maximum dredging rate	:	300 m^3/day/dredger;

4.2 Environmental Impacts

4.2.1 Water Quality

Material to be dredged has been tested to be approximately 8,300 m^3 contaminated sediment and 2,700 m^3 uncontaminated. The contamination mainly arises from relatively high content of Copper and Zinc. Dredging of the marine sediments may create a plume of suspended solids around the dredging area. However, it is likely that suspended solids content will be low due to the anticipated slow dredging rates.

4.2.2 Noise Impact

Works will normally be confined to daytime only. In addition, the plant are small in scale. Noise impact during the dredging operation will, if any, be minimal.

4.2.3 Other Residual Impacts

No other operational and decommissioning impacts are identified.

5. MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT

5.1 Existing Sensitive Receivers

5.1.1 Seafood Restaurants

Some seafood restaurants adjacent to Castle Peak Beach may draw seawater for fishes via those inlet pipes located as shown in Appendix A. The suspended solids and the relatively high levels of the heavy metals, predominantly Copper & Zinc contents present within the existing seabed sediment, might be a concern.

5.1.2 Nearby Bathing Beaches

The nearby bathing beaches include Kadoorie Beach and Cafeteria Old Beach. They may be affected by sediment plume caused by the Project.

5.1.3 Seawater Pump House

A seawater pump house is located at the entrance of Tuen Mun Typhoon Shelter as shown in Appendix A. It is about 500m away from the dredging site. Sediment plume may pose a threat to clogging up the pump sets.

6. ENVIRONMENTAL PROTECTION MEASURES AND FURTHER ENVIRONMENTAL IMPLICATIONS

6.1 Measures to Minimize Environmental Impacts

6.1.1 Against Water Quality Impact

6.1.1.1 Planning to carry out dredging in winter time

As stated in Clause 3, to limit dredging within winter time will effectively reduce impacts, if any, to the beaches and the pump house.

6.1.1.2 Erection of silt curtain at grab

In order to contain dispersion of sediments during dredging, silt curtain will be installed at the grab. The curtain will be in the form of permeable, tough, abrasion resistant membrane like geotextiles which will be mounted on a floating boom structure surrounding the grab. Details of silt curtain at grab are shown in Appendix C.

6.1.1.3 Exercising good housekeeping methods

The Contractor shall design and implement the following good housekeeping methods:

- 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.

6.1.1.4 Intermittent dredging & alternative source of water supply

To ensure that seafood restaurants will have a constant supply of seawater of satisfactory quality, dredging will halt at between 23:00 hr. and 7:00 hr. next morning. It is anticipated that substantial settling of solids will occur after the long idling period (See Clause 4.2 of Appendix E for details). Seawater drawn between 6:00 hr. to 7:00 hr. would be free from noticeable suspended solids.

Alternative source of seawater supply may be considered, either from a draw-off near to the existing pump house or by truck from elsewhere.

6.1.1.5 Erection of silt curtain at seawater pump house

Silt curtain will be installed at the intake of the pump house to protect it. Details of the silt curtain are shown in Appendix D.

6.1.1.6 Water quality modeling/monitoring

A sediment plume modeling has been carried out to project movement of sediments as a result of the proposed dredging works. The net increase in concentration of suspended solids in the adjacent beaches was estimated. The result concluded that the impact which might be caused to the adjacent beaches would be minimal.

Details of the modeling and its results are presented in Appendix E.

During dredging, water quality monitoring will be carried out; details are shown in Appendix F. Action/Event plans will be implemented accordingly to ensure no unacceptable water quality impact will arise.

6.1.2 Against Noise Impact

No noise sensitive receivers are identified near to the dredging site. A Construction Noise Permit (CNP) for working between 07:00 hr. to 23:00 hr. on weekdays will be applied. If necessary, noise abatement measures such as erecting acoustic barriers on board the dredgers may be considered.

6.2 Possible Severity, Distribution and Duration of Environmental Effects

In view of the small dredging volume and that the dredging will be completed within 10 weeks, any environmental impacts which may be caused by the Project should be short-termed, localized and minimal.

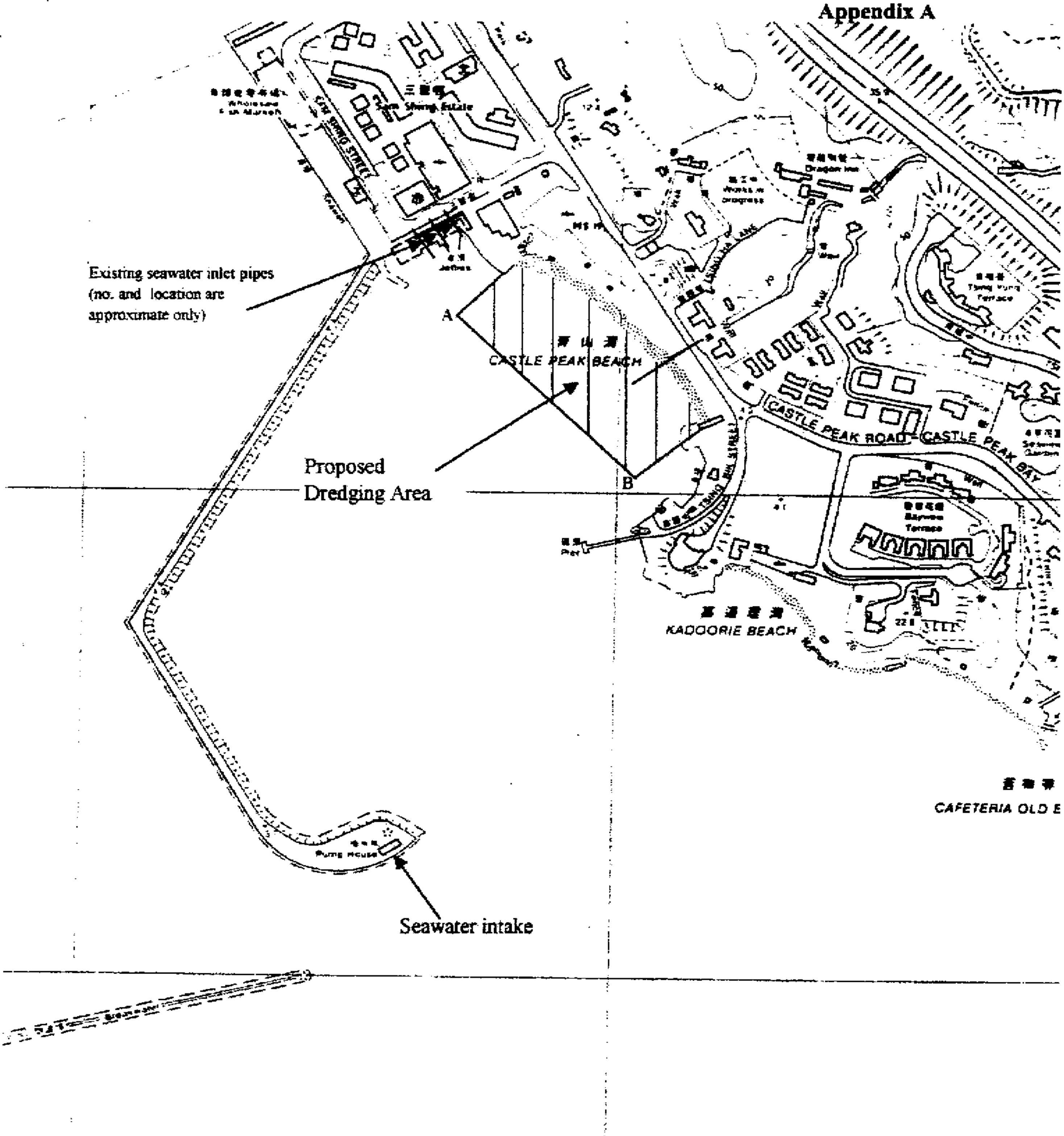
6.3 Further Consultation

Consultation with Tuen Mun District Committee has been made, which fully supported the Project. A few meetings were convened in April to June 2001 with the seafood restaurant operators and other public members which may have interests on the Project. Their concerns were generally addressed by the aforementioned mitigation measures.

7. USE OF PREVIOUSLY APPROVED EIA REPORTS

Not applicable as there had been no previously approved EIA Reports.

Appendix A



Points	Co-ordinates	
	Northing	Easting
A	826 675	815 835
B	826 510	816 030

Proposed Dredging at Castle Peak Beach

APPENDIX B

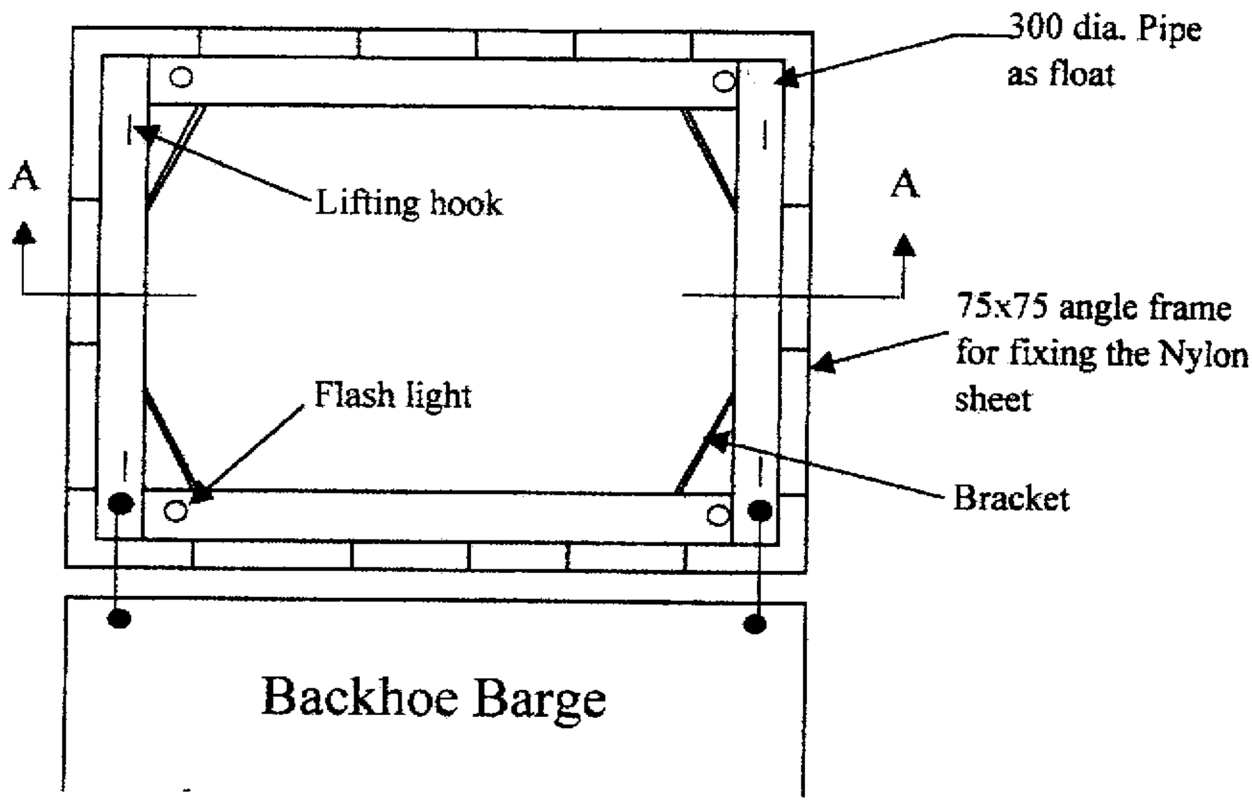
Programme of Dredging at Castle Peak Beach Project

	2001					2002			
	August	September	October	November	December	January	February	March	April
Submission of Draft Project Profile	⬇								
Comment on Draft Project Profile by EPD	(1 week)								
Approval for Final Project Profile by EPD			(45 days)						
Issue of Environmental Permit by EPD				(30 days)					
Issue of Works Order by CED				(1 week)					
Apply for requisite permits by Contractor					(3 - 4 weeks)				
Baseline WQM					(3 weeks)				
Dredging							(10 weeks)		
Impact WQM							(10 weeks)		
Post-project WQM								(3 weeks)	

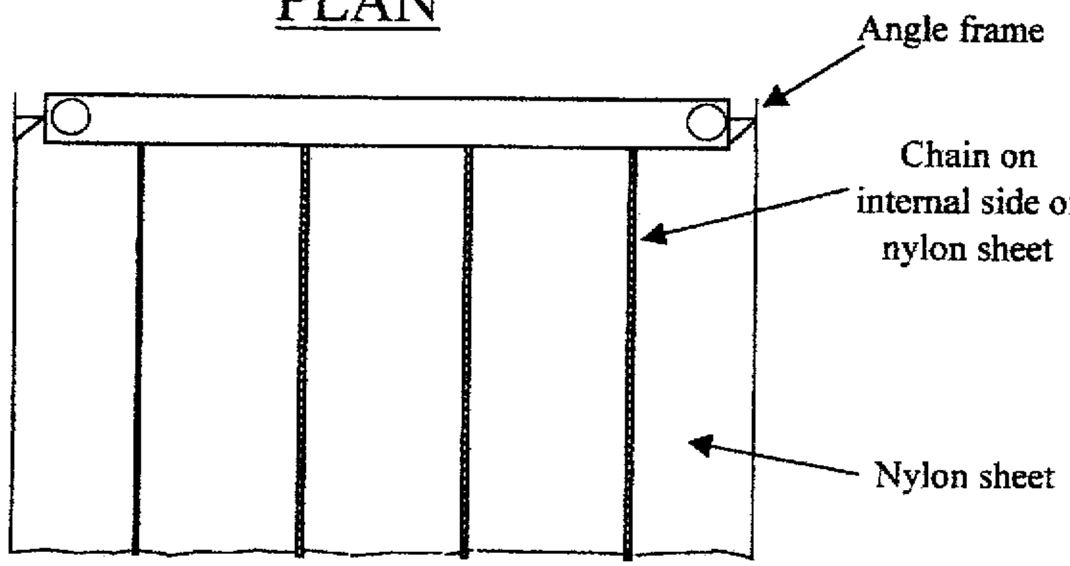
Note: The programme is tentative only and will be subject to minor modifcations.

Appendix C

<u>Proposed sketch of silt curtain frame at dredger's frontage while dredging at Castle Peak Beach</u>

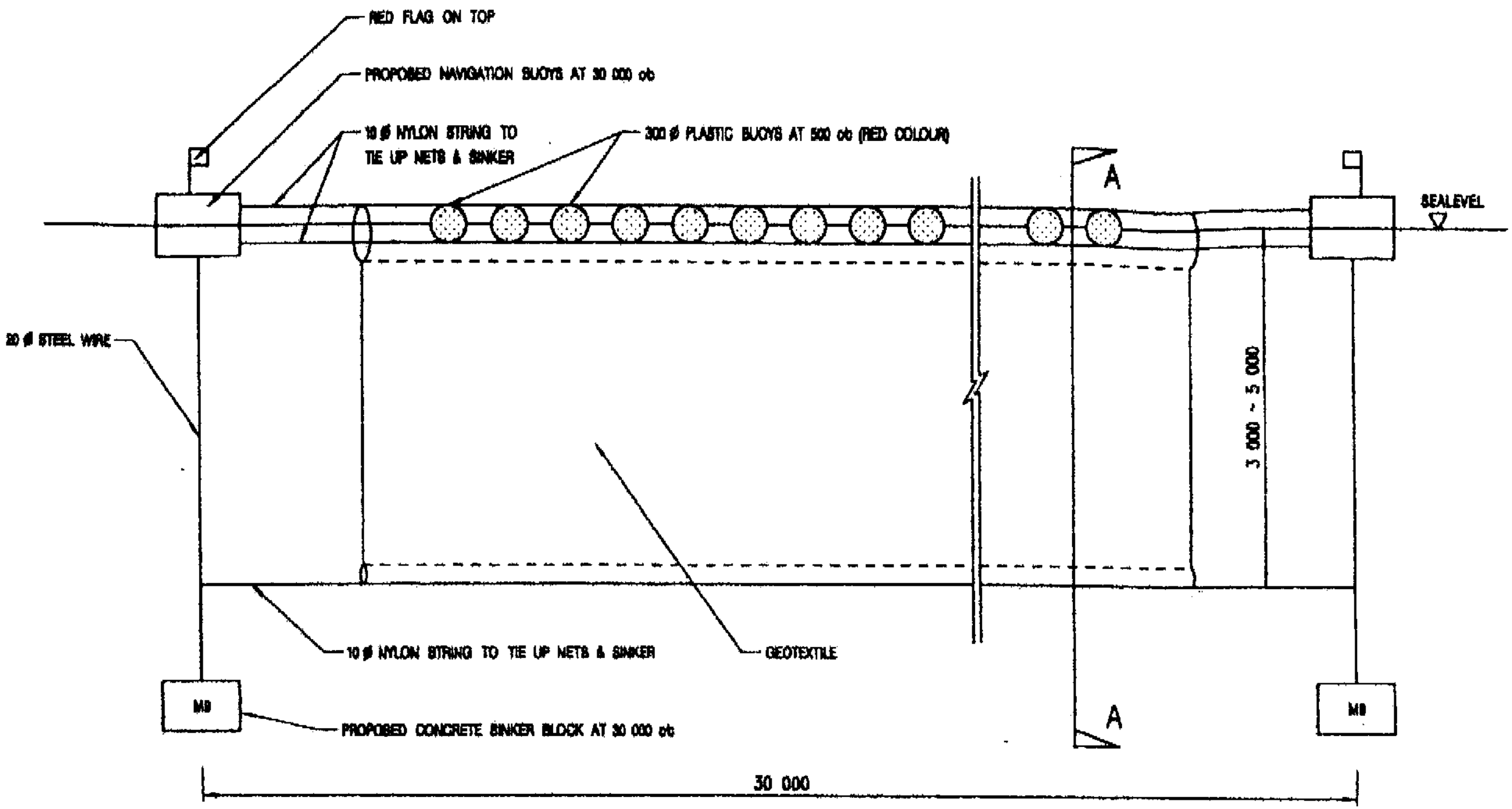


<u>PLAN</u>



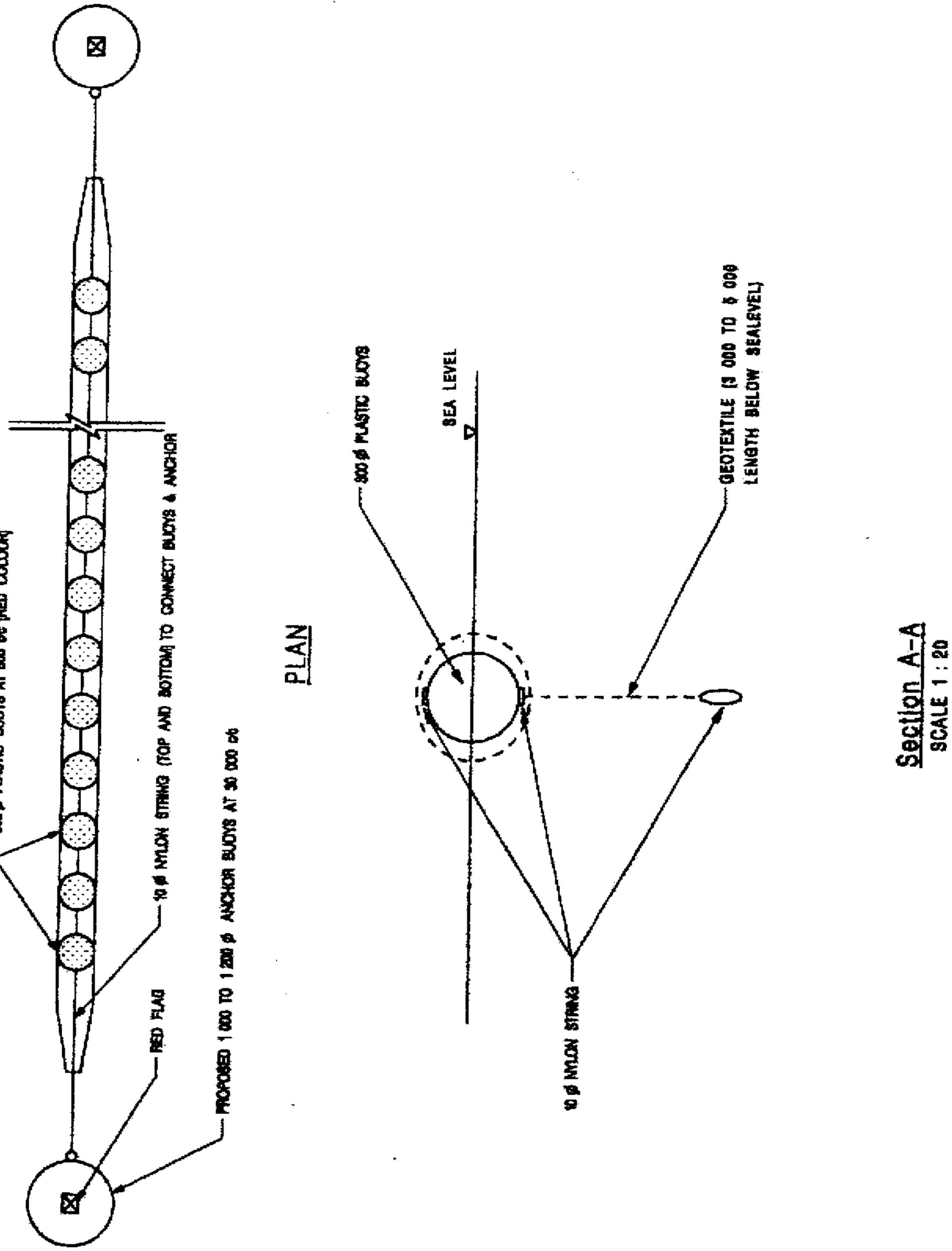
<u>SECTION A-A</u>

Appendix D



ELEVATION

FLOATING SILT CURTAIN



FLOATING SILT CURTAIN

DREDGING AT CASTLE PEAK BEACH
Sediment Plume Modelling

1. INTRODUCTION

1.1. DLCS has requested the Technical Services Division to remove by dredging the existing top layer of loose mud on the seabed of Castle Peak Beach. The muddy layer (when stirred up by swimmers) will seriously affect the clarity and quality of the seawater, which will become unsuitable for swimming. Thus the mud removal is essential for the re-opening of the beach to public for swimming scheduled in the summer season of 2002.

1.2. As the above dredging works will be carried out in proximity to a bathing beach, it will be a designated Project under Environmental Impact Assessment Ordinance. An Environmental Permit (EP) is needed for the works. However, in view of the nature and the scale of the works, direct application of the EP is very likely, subject to DEP's approval. In this connection, DEP has indicated that they would be agreeable to the direct EP application if the effect of the sediment plume as a result of the dredging has been briefly assessed.

1.3. Mathematical models were set up to simulate the extent and assess the nature of the sediment plume that would be formed as a result of the above dredging works.

1.4. The objective of this paper is to outline the methodology with which the above sediment plume assessment was conducted and the modelling results are also summarized herein.

2. MODELLING METHODOLOGY

General

2.1 The objective of the above sediment plume assessment was to determine the movement of sediment as a result of the above dredging activity. The net increase in suspended solids (SS) in the adjacent waters was estimated by way of hydraulic modelling. To achieve this objective, two hydraulic models, a hydrodynamic model and a particle-tracking model were set up for the proposed dredging works.

2.2 The particle-tracking model simulated the convection and deposition of sediment, which was based on the output from the hydrodynamic model. Details of the particle-tracking model and the hydrodynamic model are described in the following sections.

Hydrodynamic Model

2.3. The hydrodynamic conditions of the particle-tracking model are based on the Upgrade Model, which was set up, calibrated and validated under Agreement No. CE 48/96 by Delft Hydraulics. The Upgrade model covered Hong Kong waters, the Pearl Estuary and a coastal stretch of approximately 200 x 80 km^2. The Upgrade Model had 10 hydrodynamic layers.

2.4. In the Upgrade Model, the grid sizes for the Castle Peak Beach area were too coarse (approximately 300m by 300m) for this modelling assignment. Hence, a detailed model was set up to improve the grid resolution. Figure 1 shows the coverage and grid schematization of the detailed model.

2.5. As curvilinear grids were adopted for the hydrodynamic model, the grid resolution varied from location to location. To enhance the accuracy of the sedimentation simulation, the grid sizes were reduced to about 50m by 50m in the Castle Peak Beach and surrounding areas.

2.6. The hydrodynamic model was used to generate typical spring/neap flow conditions for the dry season in 2002 (dredging is proposed to be carried out between December to February 2002). The open boundary conditions for the detailed model were generated using the Upgrade Model.

Particle-tracking model

2.7. The sedimentation, deposition and resuspension of suspended substances were simulated by the particle-tracking module (Delft-PART) of Delft3D. The sediment released in the dredging activity was simulated as a conservative substance loaded at the dredging site.

2.8. The base grid for the particle-tracking model was the same one adopted for the hydrodynamics detailed model. To speed up the computation, however, the 10 hydrodynamic layers were aggregated to five sedimentation layers.

2.9. Sedimentation simulations were carried out for both the spring and neap tidal conditions to assess the spread of the sediment plume and the increase in SS in the nearby marine waters as a result of the proposed dredging works.

2.10. The sediment release rate which was used as an input for the particle-tracking model were derived from the expected daily dredging rate and an estimation of the sediment that would be released when grab dredging plant was deployed at Castle Peak Beach. Details of the sediment release calculations and the associated input adopted for the particle-tracking simulations are discussed in Appendix 1.

3. RESULTS OF SEDIMENT PLUME SIMULATIONS

3.1. Because of the small dredging area involved, sensitivity tests indicated that the resultant sediment plume was not very sensitive to the actual position at which dredging was being carried out. Modelling Plot 1 – 4 summarized the results of the sediment plume simulation that were based on a dredging plant operating at the eastern end of the proposed dredging site under spring tide condition. The above four plots show the extent of the sediment plume as well as the maximum increase in SS within the region of marine waters that would be affected by the sediment plume at various timings during the dredging process.

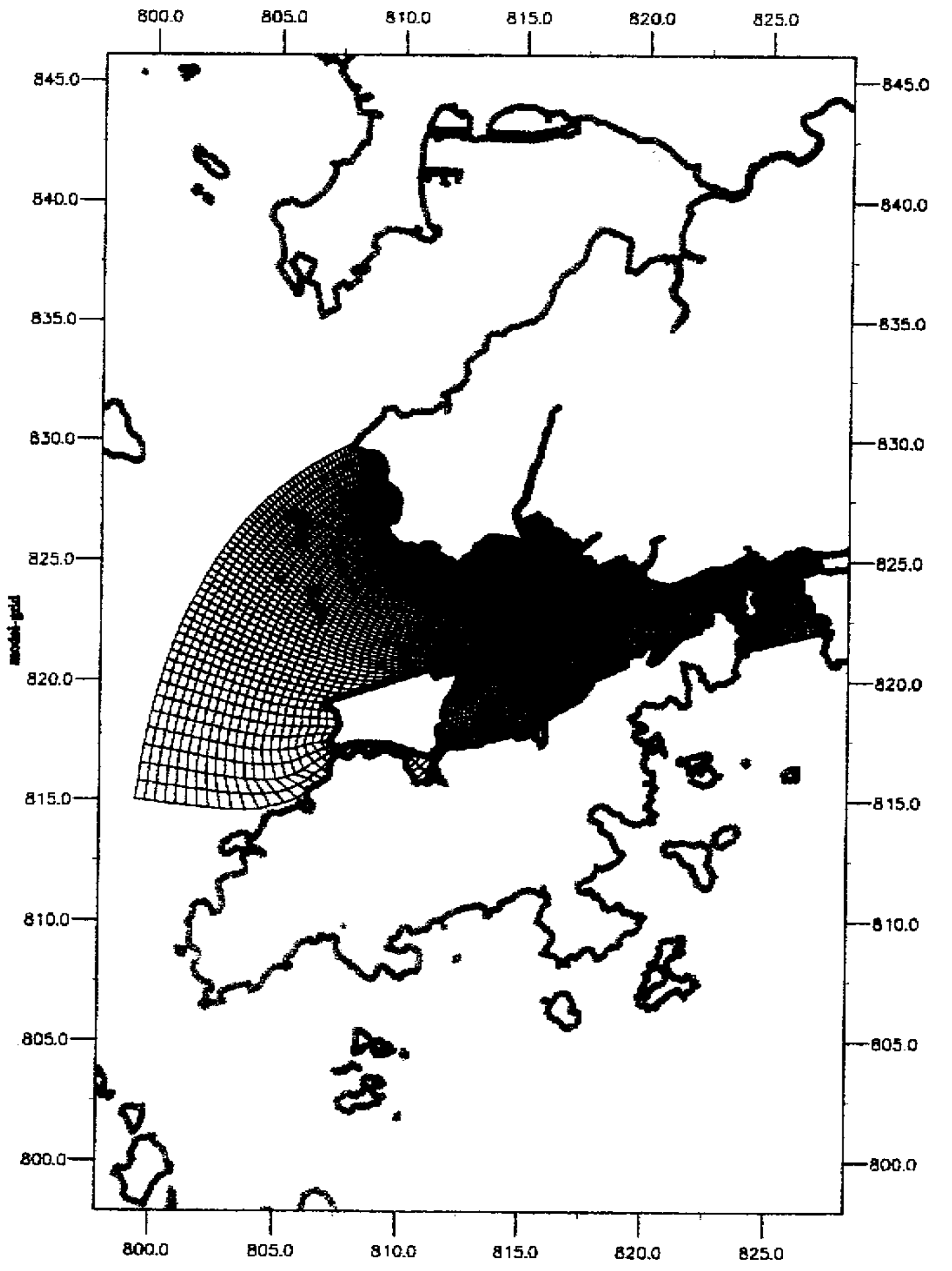
3.2. As expected, the simulation results indicated that the extent of the sediment plume as well as the net increase in SS in the vicinity of the dredging site increased with the cumulative duration of the dredging process. However, due to the slow dredging rate and the sheltered hydrodynamic condition, the simulated results confirmed that the resultant sediment plume would be confined to the region within the existing breakwater. The simulation results shown that the maximum increase in SS dropped quite quickly from the point of dredging to less than 2.5g/m^3 further seawards. It was also noted that the fine sediment settled out slowly during the night and the increase in SS within the affected area would gradually drop to less than 2.5g/m^3 in the morning before the commencement of dredging the next day.

3.3. Modelling Plot 5 shown that the extent of the sediment plume would be smaller when dredging was being carried out under neap tide condition. This was reasonably as the slower tidal current during a neap tide would tend less to carry the sediment released further from the dredging site.

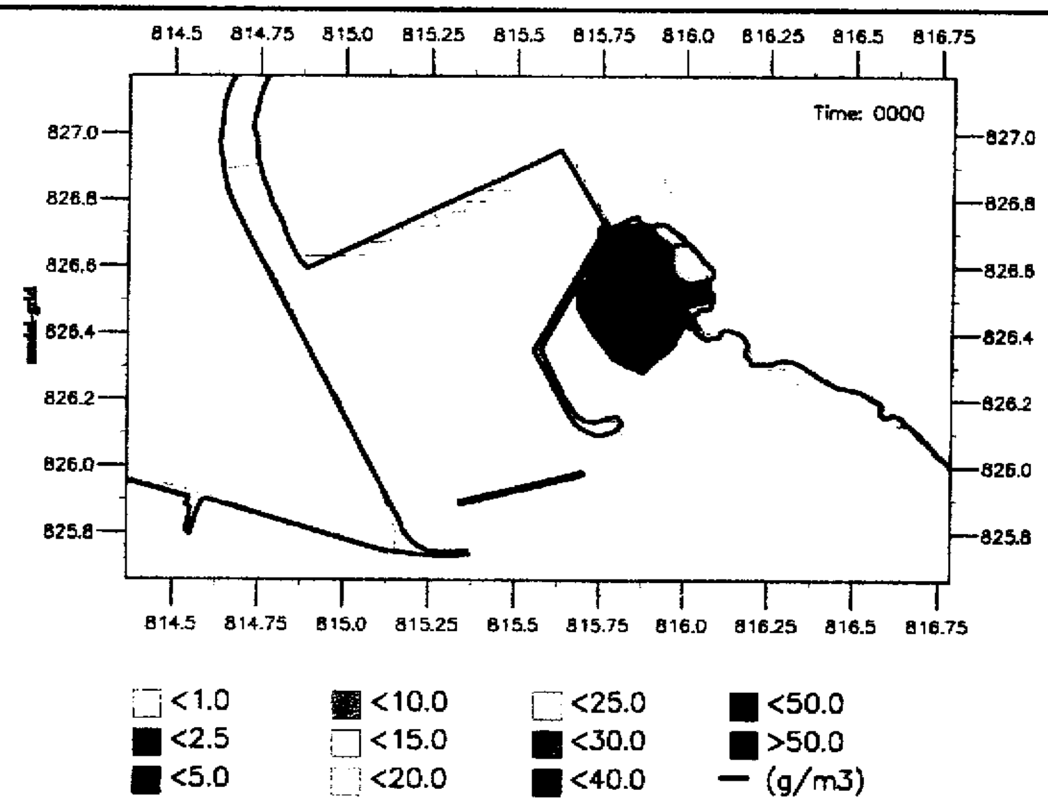
4. CONCLUSIONS

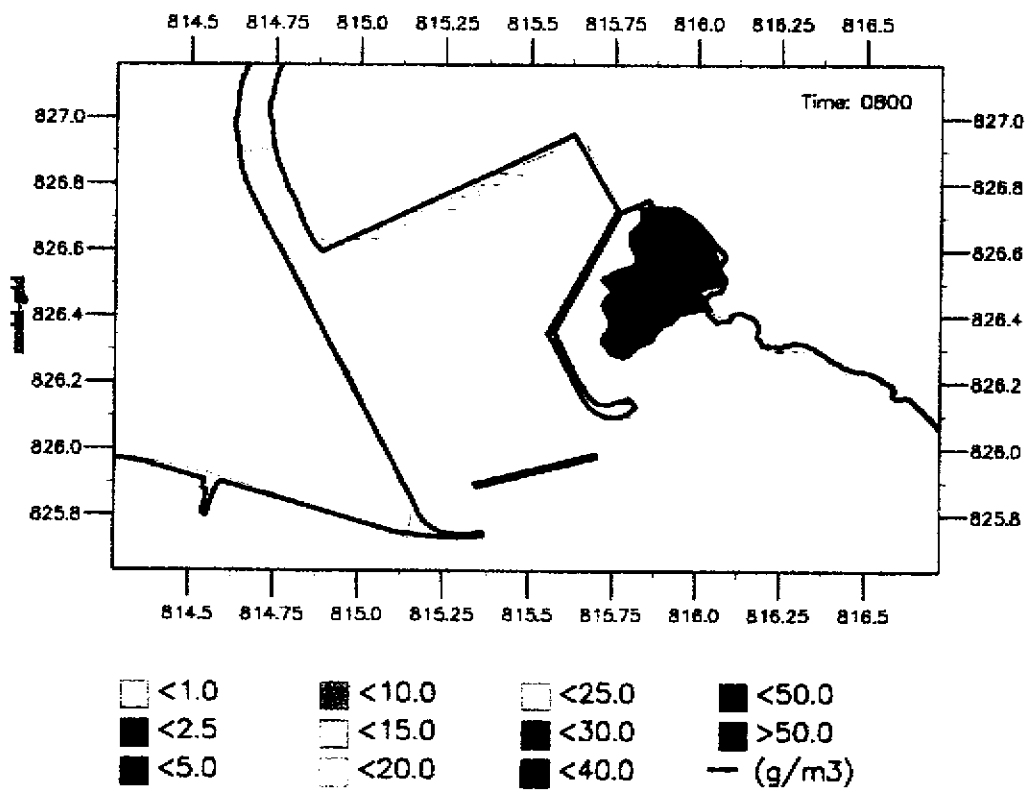
4.1. Based on the hydrodynamics conditions during the December 2001/ February 2002 period and the dredging rates anticipated, hydraulic model simulations indicated that the sediment plume associated with the proposed mud dredging works at Castle Peak Bay would generally be confined to the region within the existing breakwater.

4.2. The suspended solid (SS) within the affected waters would drop quite quickly from the point of dredging to the background level further seawards when dredging works was underway in the day time. The fine sediment would also settled out slowly during the night and the increase in SS within the entire affected area would gradually drop to less than 2.5g/m^3 in the morning before the commencement of dredging the next day.

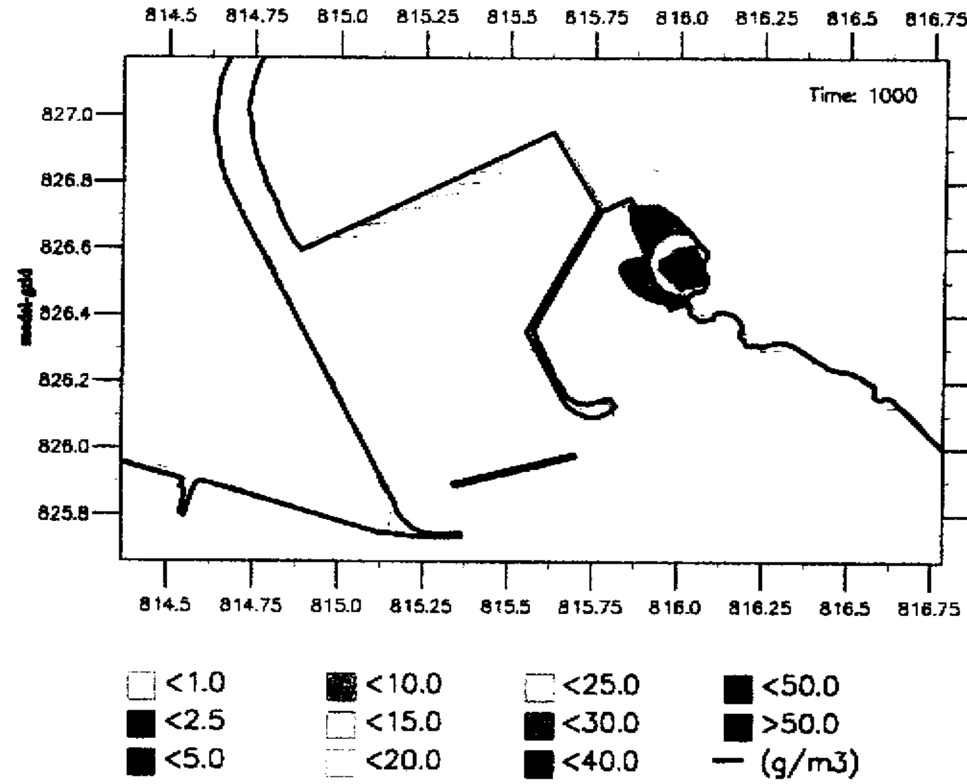


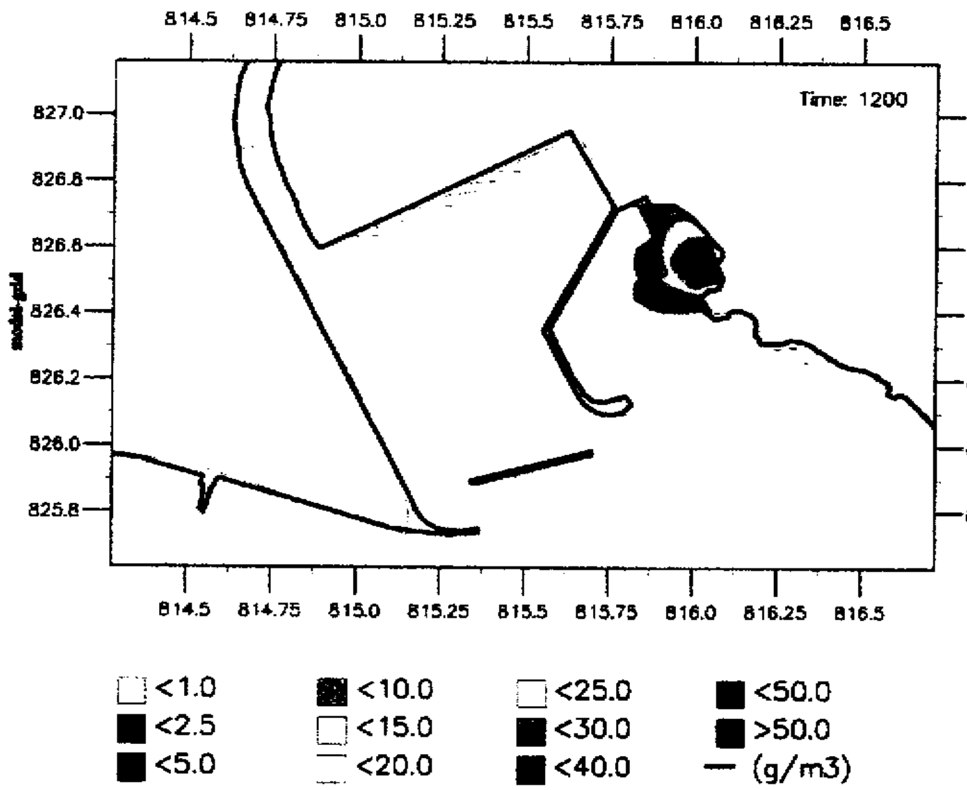
Coverage & Grid Schematization of Detailed Model Set up for the Determination of Flow Conditions for Running Particle-tracking Model	Figure 1	
TECHNICAL SERVICES DIVISION, CEO, CED		



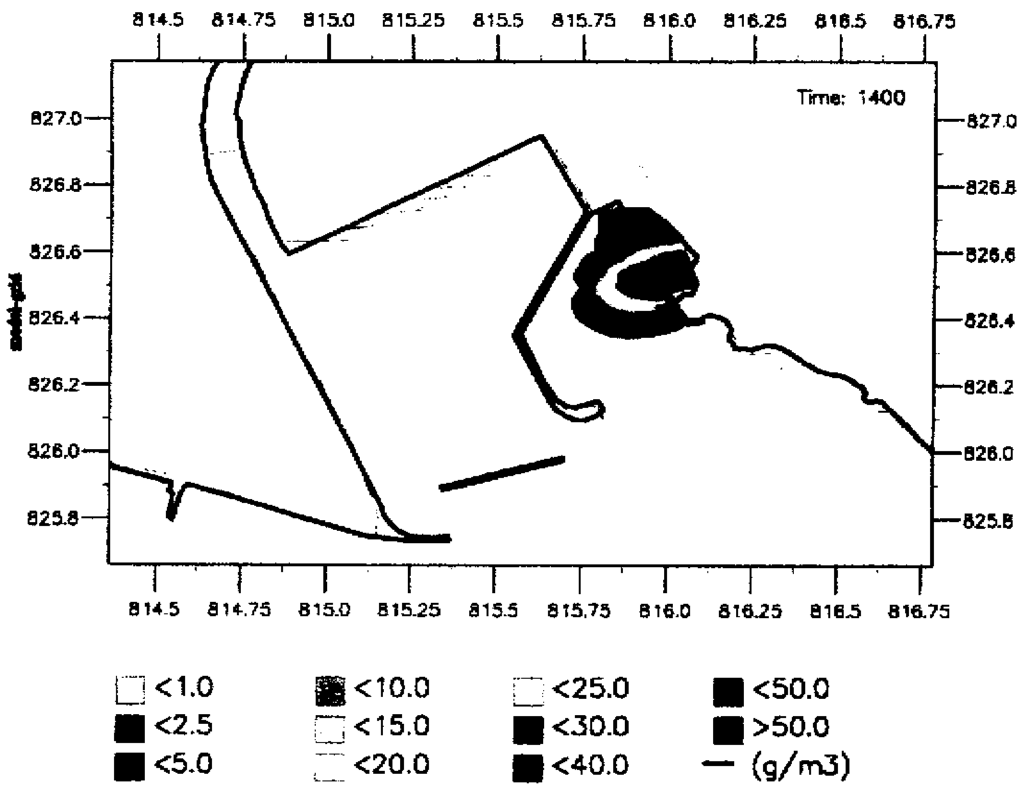


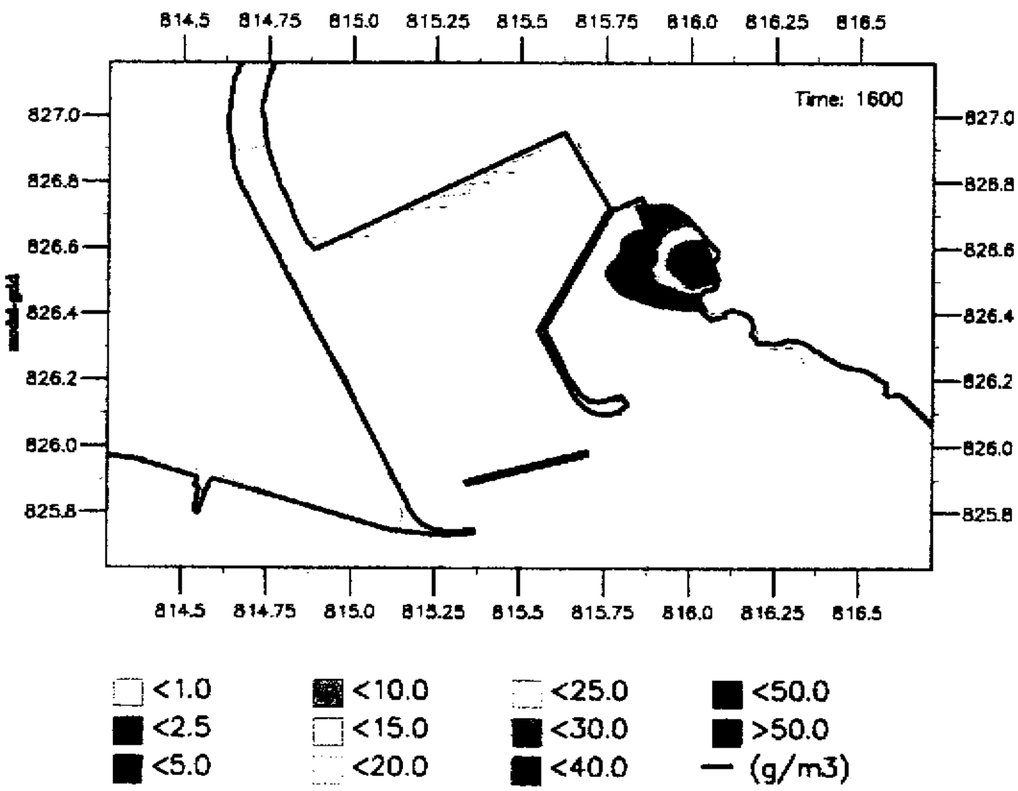
Maximum Increase in Suspended Soilds Concentration Between Midnight and Morning Period (Spring Tide) After Continuous Dredging the Day Before	Modelling Plot – 1
TECHNICAL SERVICES DIVISION, CEO, CED	



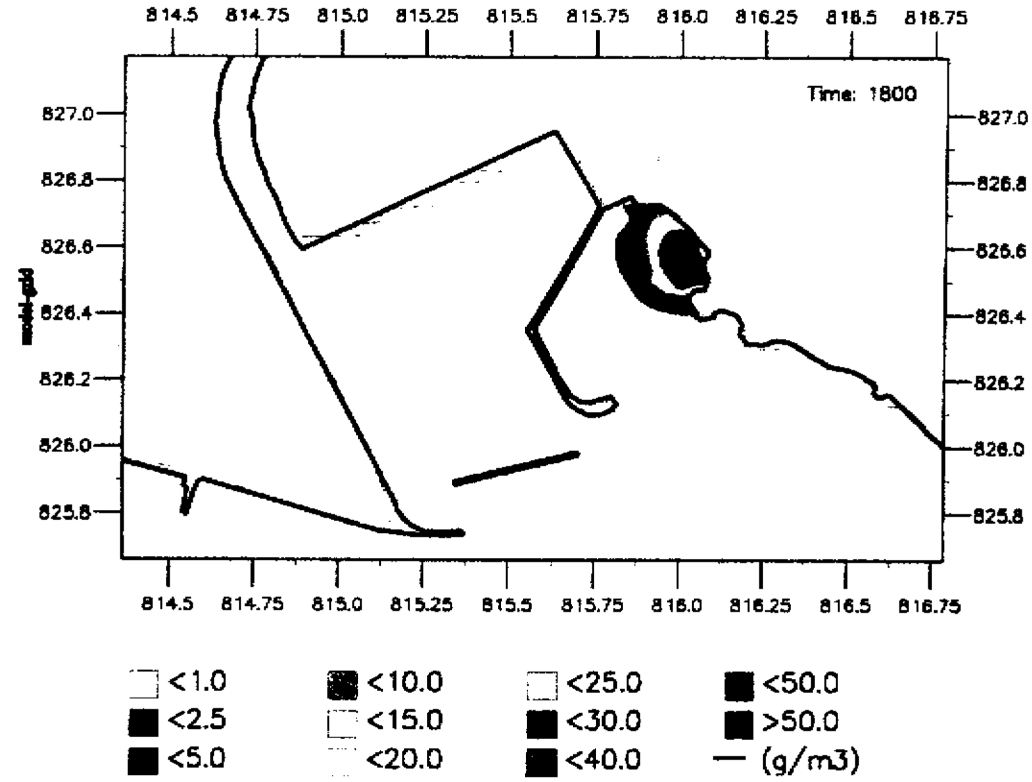


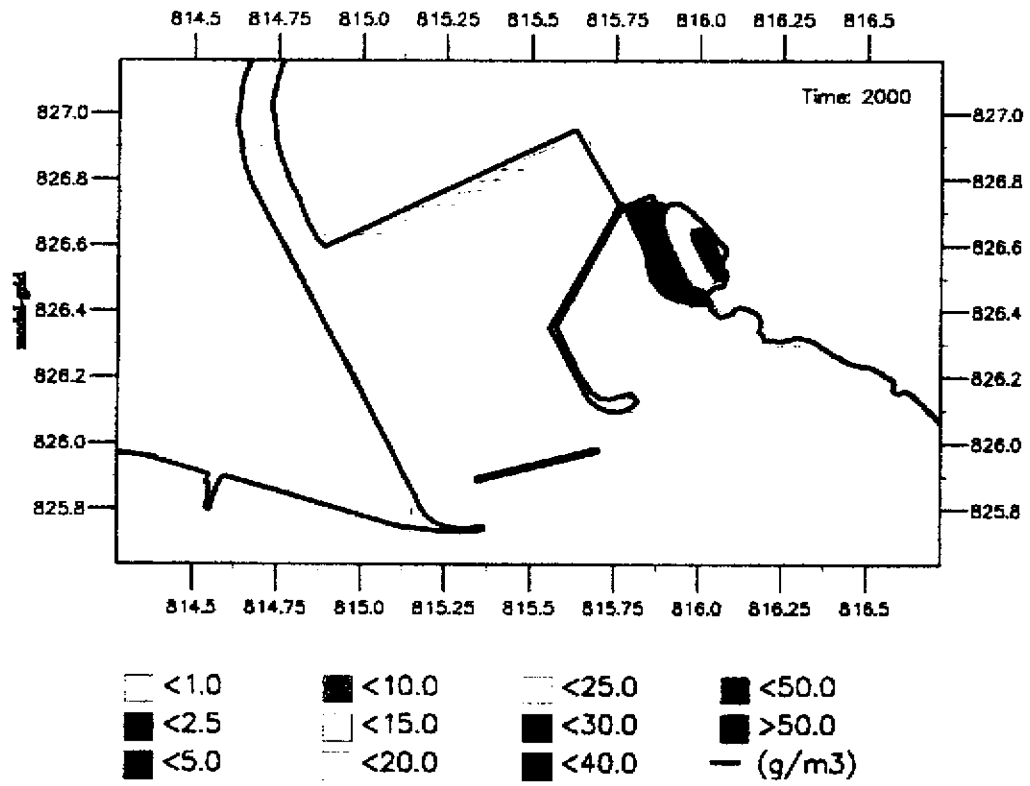
Maximum Increase in Suspended Soilds Concentration At 10am & 12 noon (Spring Tide) After Continuous Dredging since Morning	Modelling Plot – 2
TECHNICAL SERVICES DIVISION, CEO, CED	



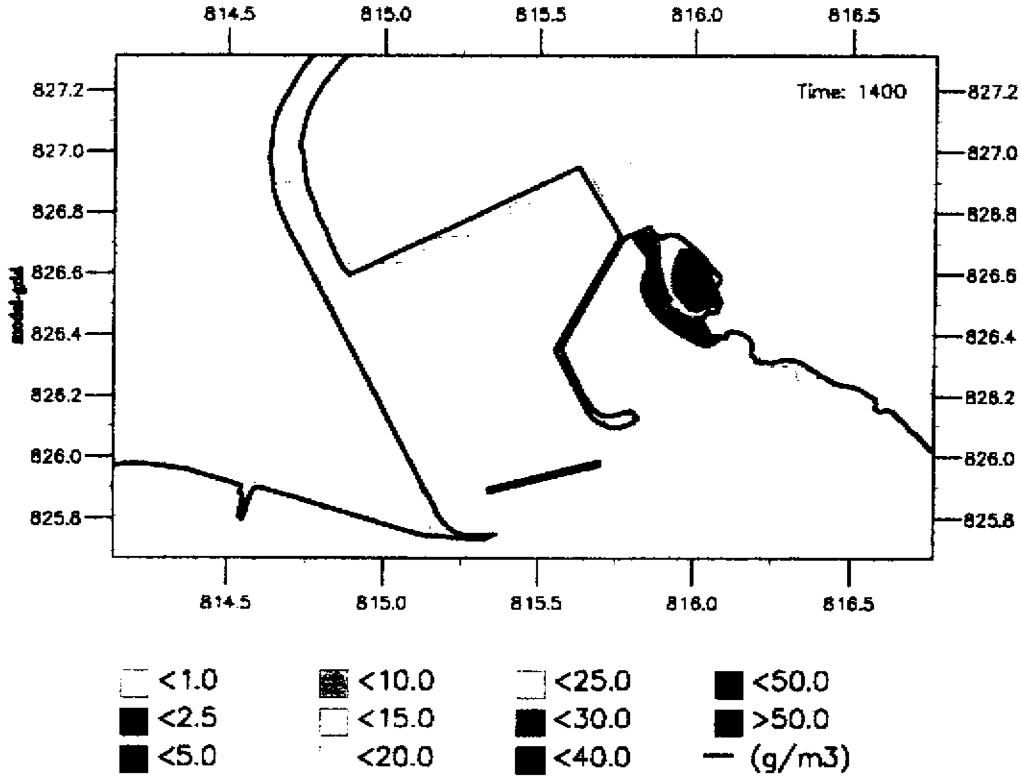


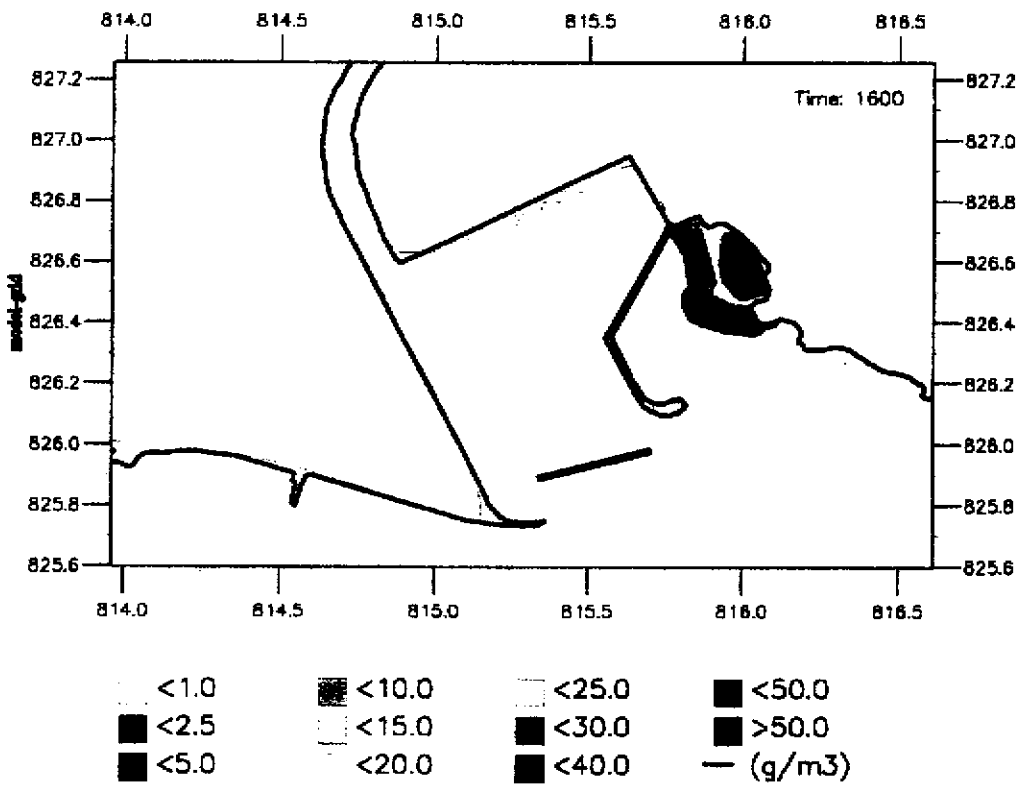
Maximum Increase in Suspended Soilds Concentration At 2pm & 4pm (Spring Tide) After Continuous Dredging since Morning		
	Modelling Plot – 3	
TECHNICAL SERVICES DIVISION, CEO, CED		





Maximum Increase in Suspended Solids Concentration At 6pm & 8pm (Spring Tide) After Continuous Dredging during the Day Time	Modelling Plot – 4
TECHNICAL SERVICES DIVISION, CEO, CED	





Maximum Increase in Suspended Solids Concentration
At 2pm & 4pm (Neap Tide)
After Continuous Dredging since Morning

Modelling Plot – 5

TECHNICAL SERVICES DIVISION, CEO, CED

APPENDIX 1

Sediment Input Parameters for Delft-PART

Calculation of Sediment Release Rate:

Total volume of mud to be dredged =	11000 m^3
Stipulating a daily dredging rate of	300 m^3/day
=> total no. of working days required to complete the dredging works =	36.7 days
Assuming conservatively that the dredger operates continuous for	8 hr/day
=> an hourly dredging rate of	37.5 m3/hr

This production rate was adopted to estimate the sediment release rate during the dredging process.

The Contaminated Spoil Management Study (Mott MacDonald, 1991; Table 6.12) which reviewed relevant literature, concluded that open-grab dredgers would release sediment at a rate of 12 - 25 kg/m^3 as a result of mud dredging. Taking the upper figure of 25 kg/m^3 (conservative) for this dredging exercise :

=> the sediment release rate during the dredging operation =		937.5 kg/hr
	or	15625 g/min

Hence, a constant loading rate of **15,625 g/min** was used as the sediment release rate during the 8-hour dredging operation.

No. of Particles Used for Simulation

According to the Delft-PART manual, 100,000 particles were recommended to simulate a continuous sediment release. The dredging process was simulated as three continuous sediment sources during a 3-day simulation period under both the spring & neap conditions.

To assess the number of particles to use for the 3-day simulation (for the release rate of 15,625 g/min), consider the mass of sediment which would be released (in 3 days) = 22500 kg

Adopting a minimum resolution of 100g /particle for the simulation,
=> for Delft-PART simulation, a minimum of 225,000 particles

To ensure accuracy, **400,000** particles were used for the 3-day simulation.

Settling Velocity for Fine Sediment

It should be pointed out that this modelling exercise was aimed to simulate the sedimentation pheomena of fine particles which were released as a result of mud dredging. In accordance with the findings of the Comprehensive Water Quality Survey in the Western Harbour conducted recently by EPD, the settling velocity for fine sediment released by mud disposal was in the order of **0.1mm/sec.** This settling velocity was adopted for this modelling job.

Outlines of Environmental Monitoring & Audit (EM&A) Programme

(1) An Environmental Team (HOKLAS accredited) will be set up which comprise WQM field staff, an environmental auditor and laboratory staff. They will work under CED close supervision.

(2) A baseline, impact and post-project water quality monitoring (WQM) will be performed. The baseline & post-project WQM will each take at least 3 weeks.

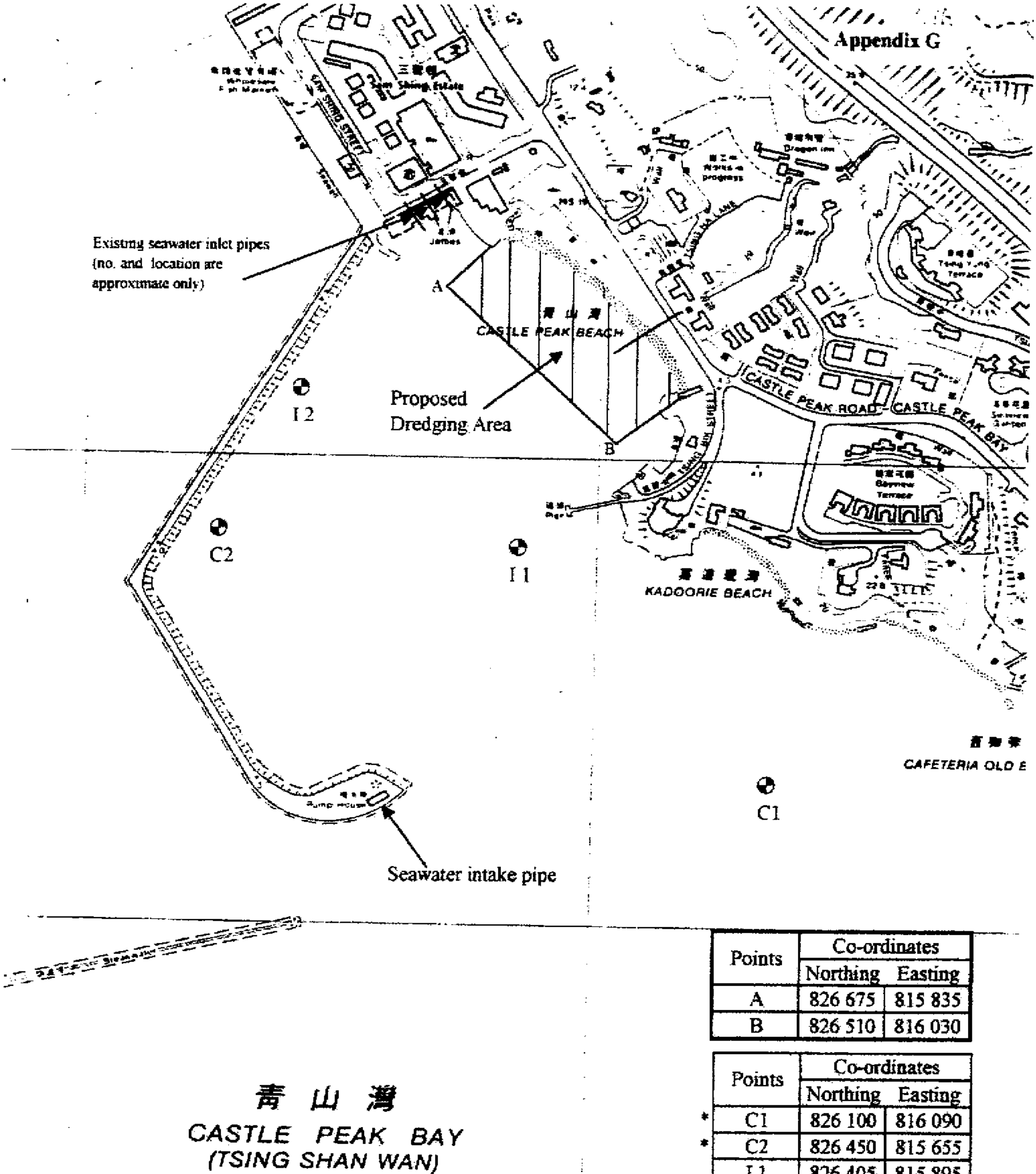
(3) All WQM will be performed in accordance with EPD's generic EM&A Programme.

(4) The locations of control & impact WQM stations are shown in Appendix G

(5) WQM parameters are turbidity, dissolved oxygen, dissolved oxygen saturation, water temperature, suspended solids, salinity water depth, and dissolved Copper & Zinc. Measurements for Copper and Zinc will be at least once weekly.

(6) Action and Limit Levels for WQM, together with Action/Event Plan are shown in Appendix H.

Appendix G



Points	Co-ordinates	
	Northing	Easting
A	826 675	815 835
B	826 510	816 030

Points	Co-ordinates	
	Northing	Easting
* C1	826 100	816 090
* C2	826 450	815 655
I 1	826 405	815 895
I 2	826 575	815 705

* Control Station

Proposed WQM Stations

Action and Limit Levels for Water Quality Monitoring

The AL Levels are to be formulated based on the baseline monitoring data. A framework of AL levels is illustrated in the following table:

Parameters	Action	Limit
Dissolved oxygen, DO mg/L (Depth-average of surface and Middle)	DO < 5%-ile of baseline data for surface and middle layers.	DO < 4mg/L or DO < 1%-ile of baseline data for surface and middle layers.
Dissolved oxygen, DO mg/L (Bottom)	DO < 5%-ile of baseline data for bottom layer.	DO < 2mg/L or DO < 1%-ile of baseline data for bottom layer.
Suspended solids, SS mg/L (Depth-averaged)	SS > 95%-ile of baseline data OR SS > 120% of upstream control station's SS at the same tide of the same day. (whichever the value is higher)	SS > 99%-ile of baseline data OR SS > 130% of upstream control station's SS at the same tide of the same day. (whichever the value is higher)
Turbidity, Tby NTU (Depth-averaged)	Tby > 95%-ile of baseline data OR Tby > 120% of upstream control station's Tby at the same tide of the same day. (whichever the value is higher)	Tby > 99%-ile of baseline data OR Tby > 130% of upstream control station's Tby at the same tide of the same day. (whichever the value is higher)

Appendix H

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 the following table are to be carried out.

Exceedances	Environmental Team (ET)	Contractor	Engineer (ER)
Action level being exceeded by one sampling day	• Repeat in-situ measurement to confirm findings; • Identify source(s) of impact; • Inform Contractor and EPD; • Check monitoring data, all plant, equipment and contractor's working methods; • Discuss mitigation measures with the ER and Contractor; • Repeat measurement on the next day of exceedance.	• Inform the Engineer and confirm notification of exceedance in writing; • Rectify unacceptable practice; • Check all plant and equipment; • Consider changes of working methods; • Propose mitigation measures to ER and discuss with ET and ER; • Implement the agreed mitigation measures.	• Discuss with ET and the Contractor on the proposed mitigation measures; • Make agreement on the mitigation measures to be implemented; • Assess the effectiveness of the implemented mitigation measures.
Action level being exceeded by more than two consecutive sampling days	• Repeat in-situ measurement to confirm findings; • Identify source(s) of impact; • Inform Contractor and EPD; • Check monitoring data, all plant, equipment and contractor's working methods; • Discuss mitigation measures with the ER and Contractor; • Ensure mitigation measures are implemented; • Prepare to increase the monitoring frequency to daily; • Repeat measurement on the next day of exceedance.	• Inform the Engineer and confirm notification of exceedance in writing; • Rectify unacceptable practice; • Check all plant and equipment; • Consider changes of working methods; • Propose mitigation measures to ER within 3 working days and discuss with ET and ER; • Implement the agreed mitigation measures.	• Discuss with ET and the Contractor on the proposed mitigation measures; • Make agreement on the mitigation measures to be implemented; • Assess the effectiveness of the implemented mitigation measures.
Limit level being exceeded by one sampling day	• Repeat in-situ measurement to confirm findings; • Identify source(s) of impact; • Inform Contractor and EPD; • Check monitoring data, all plant, equipment and Contractor's working methods; • Discuss mitigation measures with the ER and Contractor; • Ensure mitigation measures are implemented; • Increase the monitoring frequency to daily until no exceedance of Limit level.	• Inform the Engineer and confirm notification of exceedance in writing; • Rectify unacceptable practice; • Check all plant and equipment; • Consider changes of working methods; • Propose mitigation measures to ER within 3 working days and discuss with ET and ER; • Implement the agreed mitigation measures.	• Discuss with ET and the Contractor on the proposed mitigation measures; • 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.