(32) EIA/027.1/91

BELCHER'S BAY LINK

ENVIRONMENTAL ASSESSMENT REPORT

VOLUME II - WATER QUALITY & AIR QUALITY

PYPUN - HOWARD HUMPHREYS LTD.

DECEMBER 1991

BELCHERS BAY RECLAMATION

WATER QUALITY AND AIR QUALITY ASSESSMENT

CONTENTS LIST

1.0 INTRODUCTION

2.0 LEGISLATIVE CONTROLS

3.0 EXISTING SITUATION

3.1 Existing Water Quality
3.2 Existing Water Flow Patterns
3.3 Existing Air Quality

4.0 PROPOSALS

5.0 CONSTRUCTION EFFECTS

5.1 Water Quality
5.2 Water Quality Monitoring
5.3 Air Quality

6.0 OPERATIONAL EFFECTS*

6.1 Water Quality
6.2 Air Quality

7.0 CONCLUSIONS

Appendix I Comments and Responses

1.0 INTRODUCTION

This report consists of an assessment of the environmental impacts caused by the proposed Belcher's Bay reclamation. The impacts covered by this report are limited to water and air quality.

The report considers the existing situation, provides a brief description of the proposals and then considers the effects of the proposals. Mitigation measures that need to be included in the contract conditions are described.

A water quality monitoring programme and methodology that should be implemented by the Contractor is also included.

2.0 LEGISLATIVE CONTROLS

2.1 Water Quality

The Environmental Protection Department have designated ten Water Quality Control Zones. The reclamation works are located within the Victoria Harbour Zone.

The Victoria Harbour Zone is due to be gazetted in 1993 and so at the present time there are no formal Water Quality Objectives that can be applied. However, it can be assumed that water quality within the harbour should be sufficient to maintain the beneficial uses identified for the harbour. These are:

- o a habitat for marine life generally
- o domestic and industrial supply
- o navigation and shipping
- o aesthetic

It may further be assumed that the water quality objectives eventually set for the Victoria Harbour Zones will be similar to those objectives that have been set for the nearby southern waters which have been formalised by gazetting. These objectives are shown in Table 1.

2.2 Air Quality

The Hong Kong Planning Standards and Guidelines provide ambient air quality objectives. These objectives form part of the Air Pollution Control Ordnance which is designed to safeguard the health and well being of the community. The Air Quality Objectives, shown in Table 2 are to be reached throughout Hong Kong.

TABLE 1 : WATER QUALITY OBJECTIVES

Water Quality Parameters	Objective	Sub-Zone
Offensive odour, tints and colours	Not to be present	Whole zone
Visible foam, oil grease, scum, litter	Not to be present	Whole zone
E. coli	Not to exceed 1000/100ml in more than 60% samples	Secondary contact Recreation Subzone
D.O. within 2m of bottom	Not less than 2 mg/l for 90% samples	Whole zone
Depth Average D.O.	Not less than 4 mg/l for 90% samples	Whole zone except fish culture zone
	Not less than 5 mg/l for 90% samples	Fish culture zone
pH	To be in the range 6.5-8.5 change due to waste discharge not to exceed 0.2	Whole zone except bathing beaches
Salinity	Change due to waste discharge not to exceed 10% of natural ambient level	Whole zone
Temperature change	Change due to waste discharge not to exceed 2°	Whole zone
Suspended solids	Waste discharge not to raise the natural ambient level by 30% nor accumulation of suspended solids	Whole zone
Toxicants producing significant toxic effects	Not to be present	Whole zone
Ammonia	Annual mean not to exceed 0.021 mg/l calculated as unionised form	Whole zone
Nutrients	Quality shall not cause excessive algal growth	Whole zone
	Annual mean depth average inorganic nitrogen not to exceed 0.1 mg/l	

TABLE 2 : HONG KONG AIR QUALITY OBJECTIVES

Pollutant	Concentrations in micrograms per cubic metre (i) Averaging Time 1hr (ii)	8hrs (iii)	24hrs (iii)	3mths (iv)	1yr (iv)	Health effects of pollutant at elevated ambient levels
Sulphur Dioxide	800		350		80	Respiratory illness; reduced lung function; morbidity and mortality rates increase at higher levels.
Total suspended particulates			260		80	Respirable fraction has effects on health.
Respirable (v) suspended particulates			180		55	Respiratory illness; reduced lung function; cancer risk for certain particles; morbidity and mortality rates increase at higher levels.
Nitrogen Dioxide	300		150		80	Respiratory irritation; increased susceptibility to respiratory intention; lung development impairment.
Carbon Monoxide	30,000	10,000				Impairment of coordination deleterious to pregnant women and those with heart and circulatory conditions
Photochemical oxidants (as ozone (vi)	240					Eye irritation; cough; reduced athletic performance; possible chromosome change.
Lead				1.5		Affects cell and body processes; likely neuro-psychological effects, particularly in children likely effects on rates of incidents of heart attacks, strokes and hypertension.

(i) Measured at 298°K (25°C) and 101.325 kPa (one atmosphere)
(ii) Not to be exceeded more than three times per year
(iii) Not to be exceeded more than once per year
(iv) Arithmetic means
(v) Respirable suspended particulates means suspended particulates in in air with a nominal aerodynamic diameter of 10 micrometres and smaller
(vi) Photochemical oxidants are determined by measured of ozone only.

3.0 EXISTING SITUATION

3.1 Existing Water Quality

There are several monitoring stations at which EPD obtain samples of water to assess marine water quality and which provide data relevant to the present project.

Of particular interest to this project are water quality parameters of transparency and light penetration that are affected by suspended particles such as clay, silt, finely divided organic and inorganic matter. The transparency and light penetration of waters of Hong Kong, in particular the western waters, are to a large extent, influenced by the Pearl River, which discharges a substantial quantity of suspended solids.

Western waters and Victoria Harbour (appropriate sampling areas for the present study) generally have lower transparency than the eastern and southern waters. Typical annual results for Secchi Disk disappearance vary between 0.5m and 1.9. In Victoria Harbour the low transparency of waters has been accredited to waste discharge from sewage outfalls and urban stormwater runoff.

Victoria Harbour serves as a main channel for navigation and forms the central harbour and main port of Hong Kong. Water movement within the harbour area, especially the central area ensures that effective tidal exchange is experienced.

The most recent report on Marine Water Quality in Hong Kong was published by EPD in September 1990. Two sites may be considered to provide data relevant to the Belcher's Bay area. Summary data for these two monitoring sites is shown in Table 3.

Generally, the water quality at the Western end of Victoria Harbour is acceptable with mean annual surface dissolved oxygen saturation of 75-100%, BOD 0-1 mg/l and maximum EColi levels in the 10^4-10^5/100ml bracket.

Monitoring data show that although generally acceptable, variations do occur and vigilance in preventing pollution is necessary to prevent deteriorating water quality.

As with most areas of Hong Kong, sewerage and surface drainage systems exist in the Belcher's Bay area. However, expedient connections allow surface drainage to become contaminated with foul drainage and this subsequently flows into harbour waters. The waters immediately offshore in the study area are contaminated in this way to some extent.

TABLE 3 : SUMMARY STATISTICS FOR 1989 WATER QUALITY

Determinand		Harbour East & Central	Harbour West
Temperature °C	Surface	22.6 (15.3-28.3)	22.7 (15.3-28.4)
	Bottom	22.1 (15.2-28.1)	22.5 (15.3-28.2)
Salinity (ppt)	Surface	31.0 (22.8-33.2)	30.6 (19.1-33.1)
	Bottom	31.7 (23.6-33.7)	31.3 (25.9-33.3)
DO %Satn	Surface	66.0 (33.2-143.7)	74.4 (38.6-139.0)
	Bottom	56.8 (12.0-97.1)	68.8 (26.3-98.6)
Turbidity (NTU)		5.9 (1.5-21.8)	8.8 (2.5-37.0)
S S (mg/l)		5.2 (1.2-19.5)	8.6 (2.0-30.0)
BOD_5 (mg/l)		1.1 (0.3-2.9)	0.9 (0.1-3.2)
E Coli (no/100ml)		2484 (0-49,000)	960 (0-11,133)

The lighterage traffic that currently utilises the sea wall facilities at Belcher's Bay will also give rise to Harbour Water contamination. This will occur due both to cargo spillage and domestic wastes discharged from the boats which often provide residential accommodation for the operators.

3.2 Existing Water Flow Patterns

Flow patterns and velocities within the harbour waters are available from both physical and computer modelling (WAHMO studies and from measurements taken in situ).

In general, flow patterns are influenced by the discharge of the Pearl River and the coastal configuration of the islands that make up Hong Kong. Patterns in the vicinity of Belcher's Bay are influenced by the main channels which flow through Victoria Harbour, Sulphur Channel and then generally North/South through the waters of the Western Buffer and Southern zones.

Figures 1 and 2 show the current vectors for the whole of the Hong Hng area.

The tidal range varies according to the stage of the spring/neap cycle and has a maximum range of about 2.5m on spring tides and 1m on neap tides.

Tidal flow is observed at various points in the waters of Hong Kong, the most relevant to the present study are shown in Figure 3.

Currents observed at Station 5 vary from 0.4 m/s to zero during spring tide conditions and from 0.2 m/s to zero on neap tides. Currents closer to the sea wall (C1, E1) are variable with maximum values of 0.1 m/s and 0.25 m/s respectively for neap tides and 0.2 m/s and 0.6 m/s on spring tides. Figure 4 gives plots of the current variations over periods of 24 hours.

Closer in to shore, water movements will vary according to more local conditions including vessel activity. In general terms the Shek Tong Tsui finger pier is expected to provide a shielding effect which will tend to negate natural current flows. However, vessel activity will provide some degree of mixing which will help to prevent stagnant water bodies forming within the inner confines of the pier.

3.3 Existing Air Quality

The existing atmospheric environment of the area under study is influenced at the present time by congested vehicle flow. The buildings of the area comprise godowns, residential and industrial premises. The industrial buildings are a mixture of small industries with no dominant emissions, thus although there may be local air quality problems caused by industrial operations the most significant air quality feature of the area is the traffic.

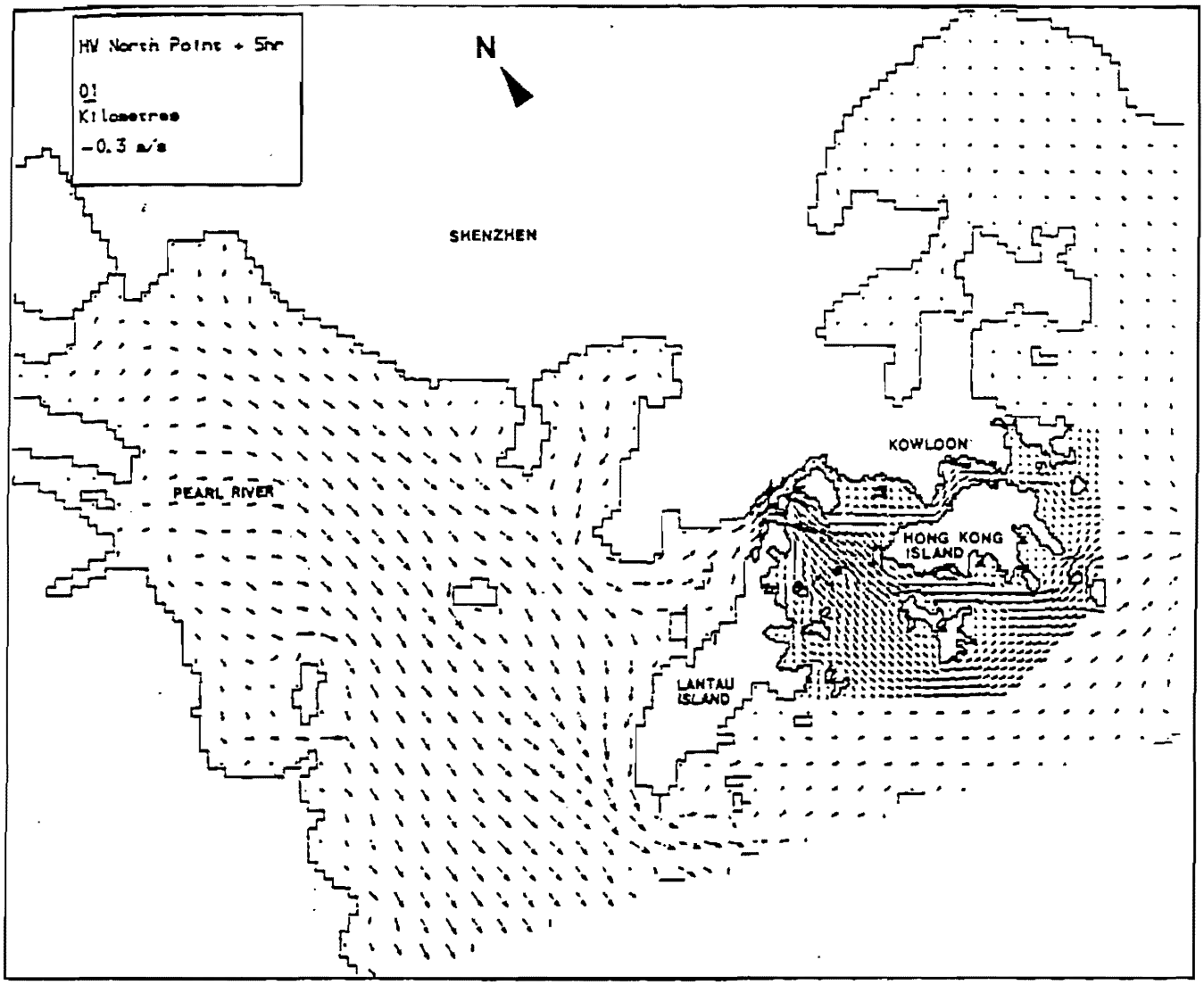


Fig. 1 The current vectors in the Pearl River estuary during ebb tide (From Water Quality and Hydraulic Model studies)

L 4289/1 D/91 193

FIGURE 1

SOURCE EPD 1990

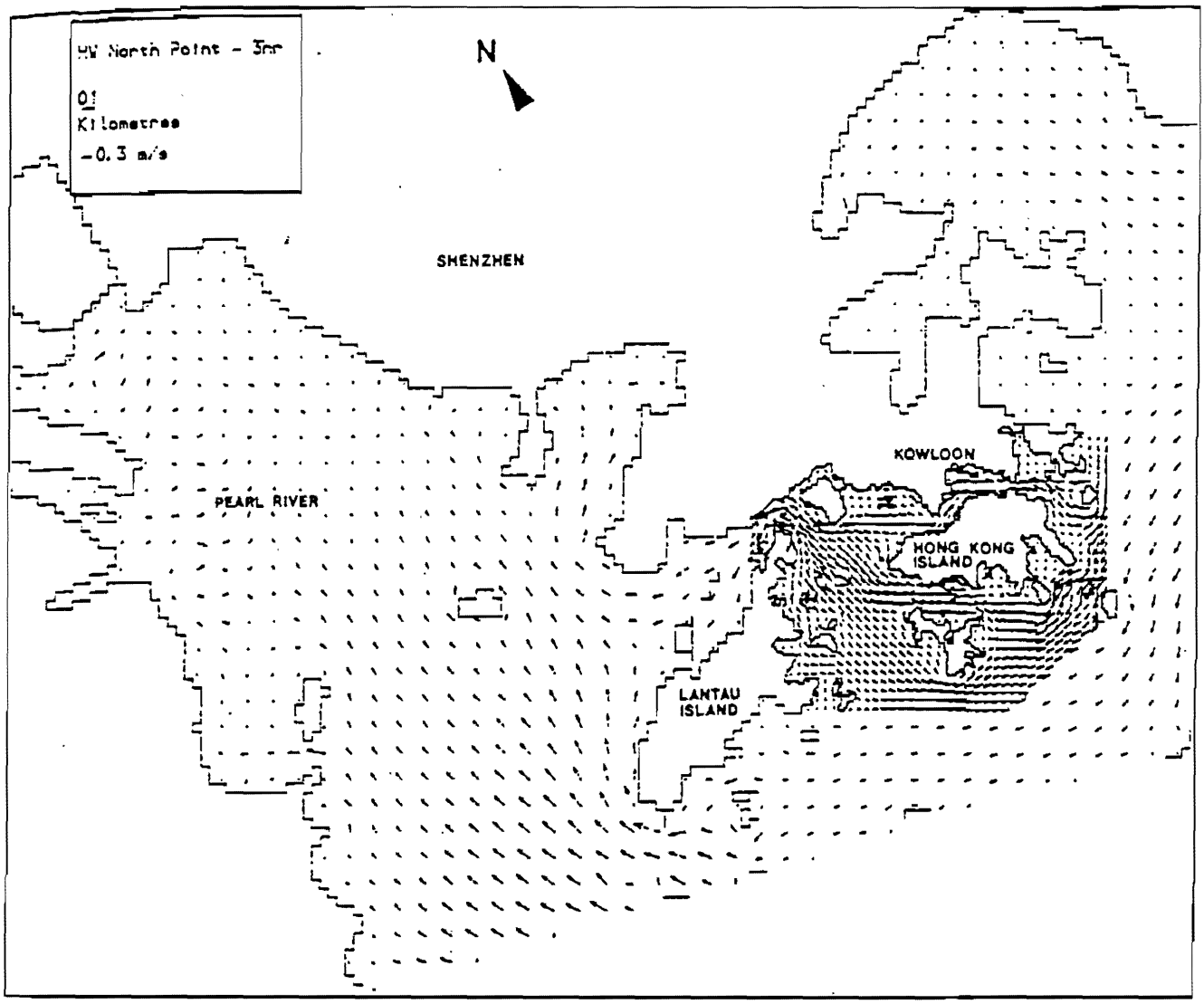
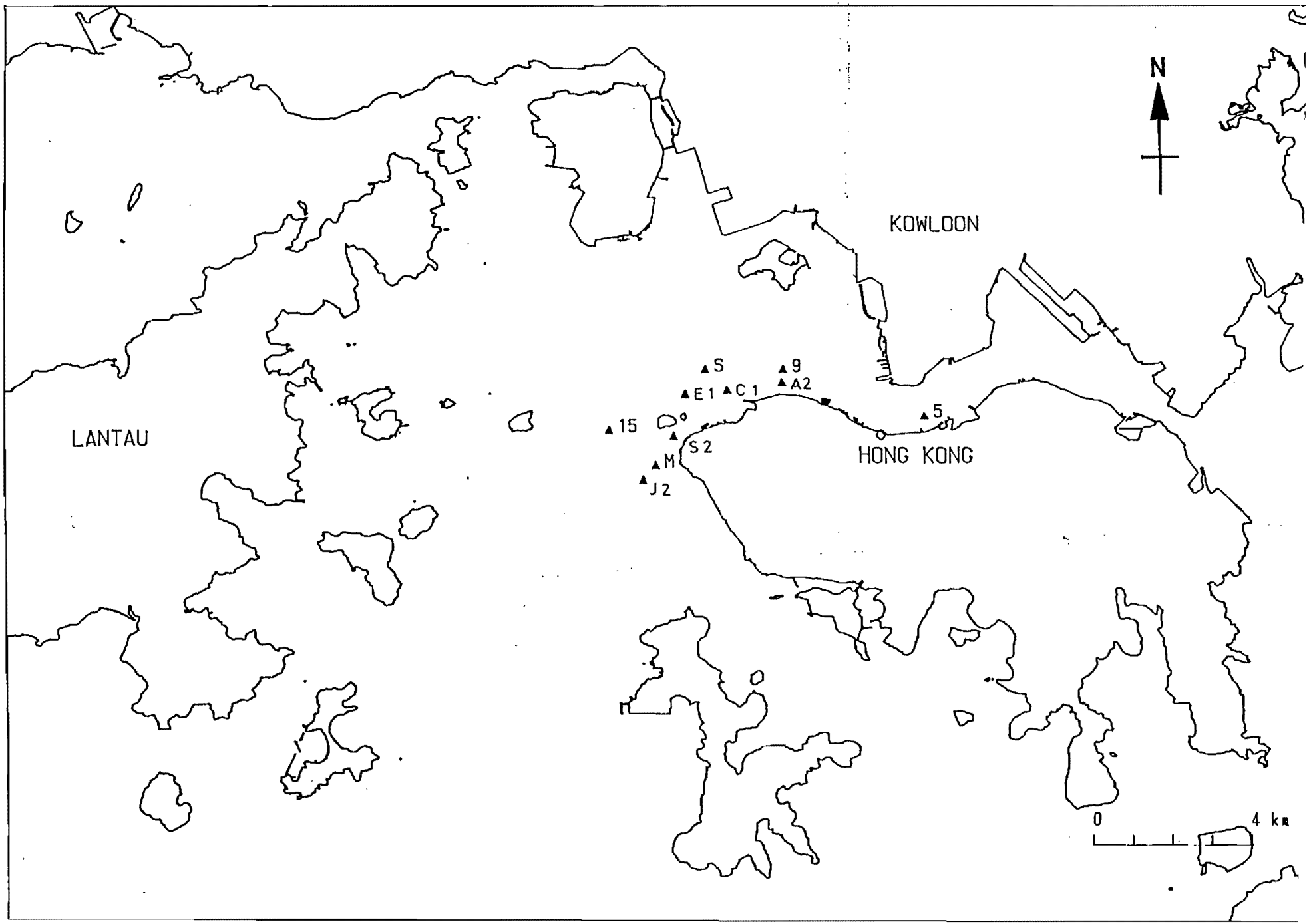


Fig. 2 The current vectors in the Pearl River estuary during flood tide (From Water Quality and Hydraulic Model studies)

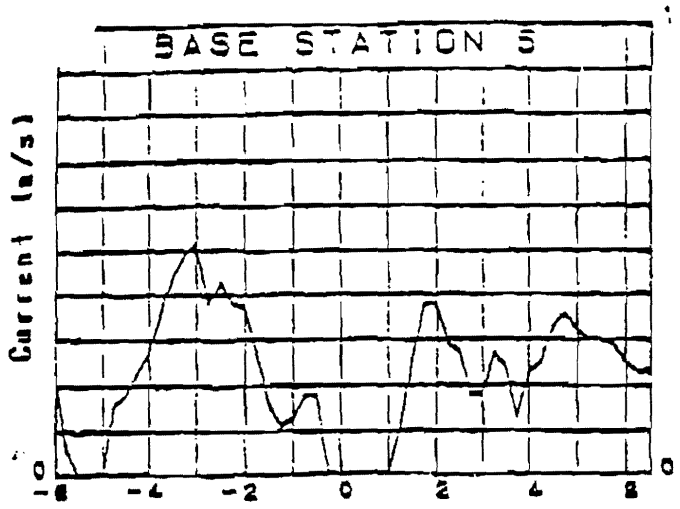
L 4289/1 D/91 193

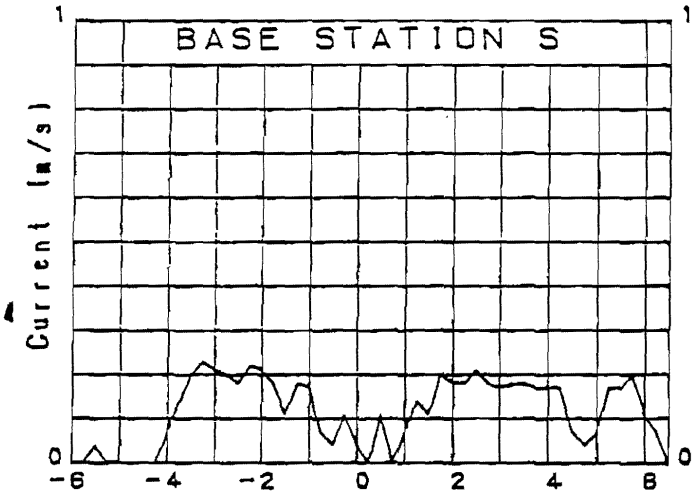
FIGURE 2

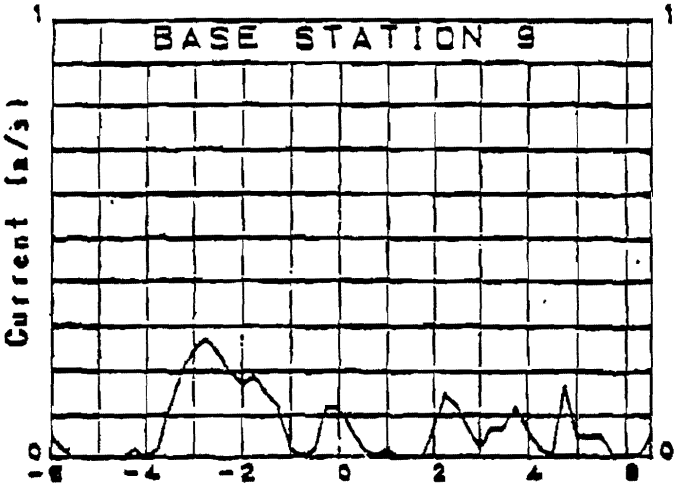


L 4289/1 D/91 193

TIDAL FLOW MONITORING STATIONS FIGURE 3





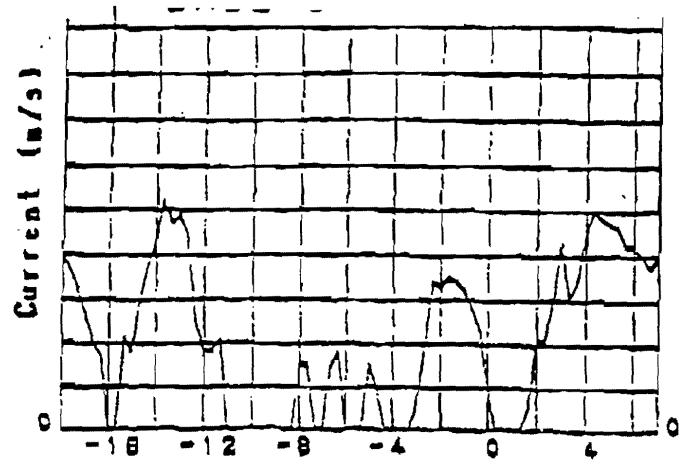


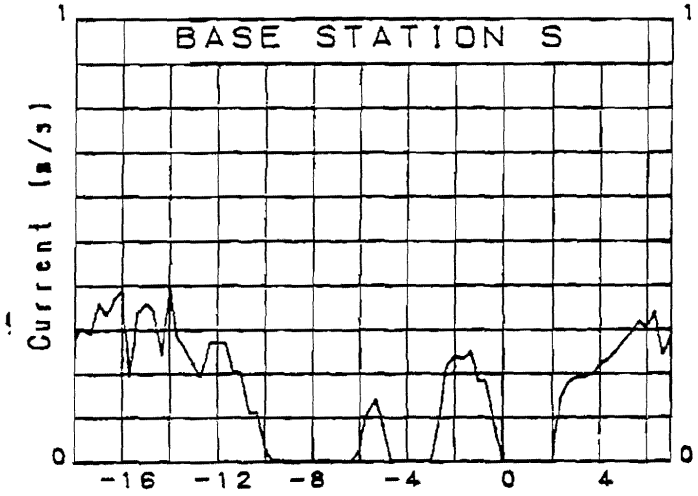
TIME IN HOURS AFTER HHW
NORTH POINT

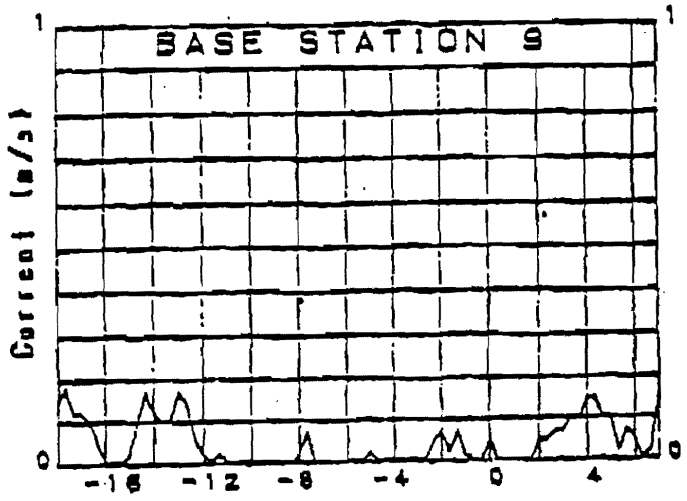
CREMER & WARNER
CONSULTING ENGINEERS & SCIENTISTS
Member of The Robertson Group plc

TITLE: CURRENT VELOCITY
NEAP TIDE

SCALE	DRAWN BY	CHECKED	APPROVED
DRAWING NO. D/91 193			DATE

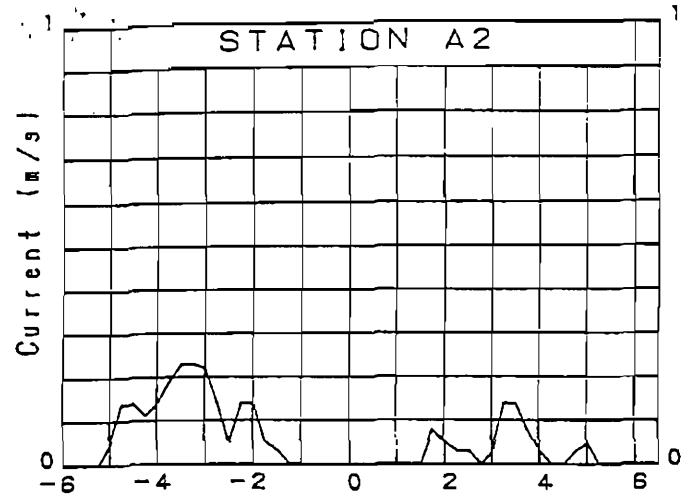


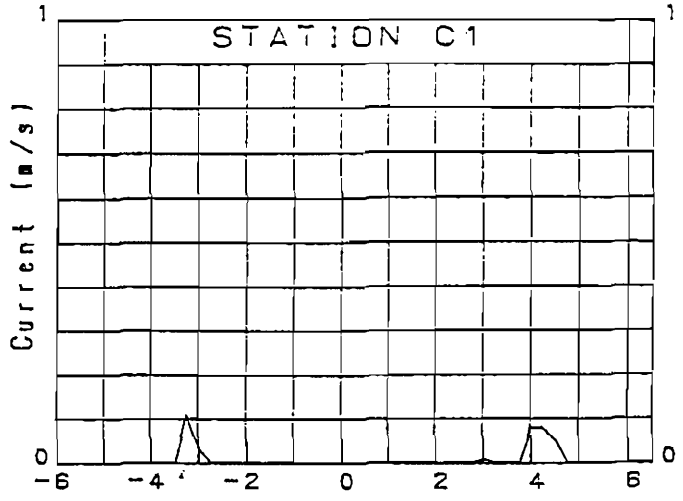


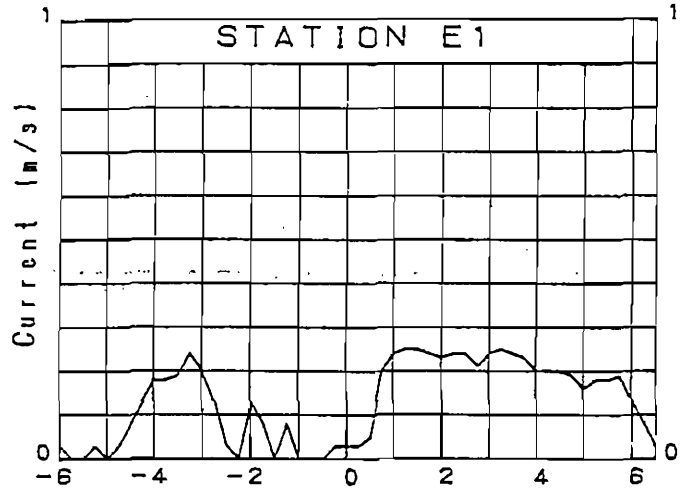


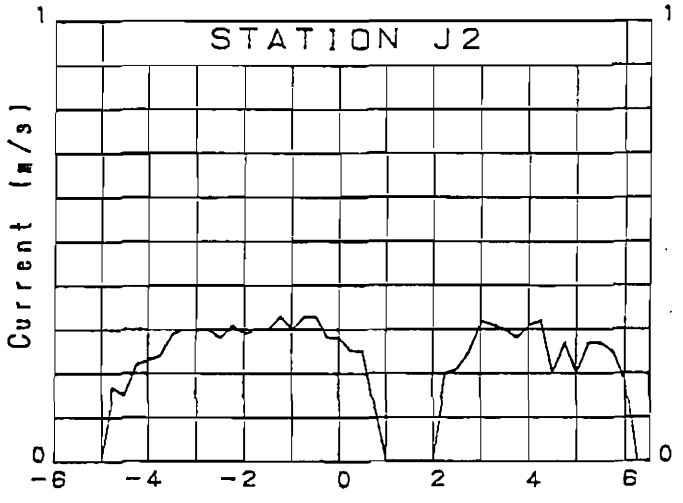
TIME IN HOURS AFTER HHW
NORTH POINT

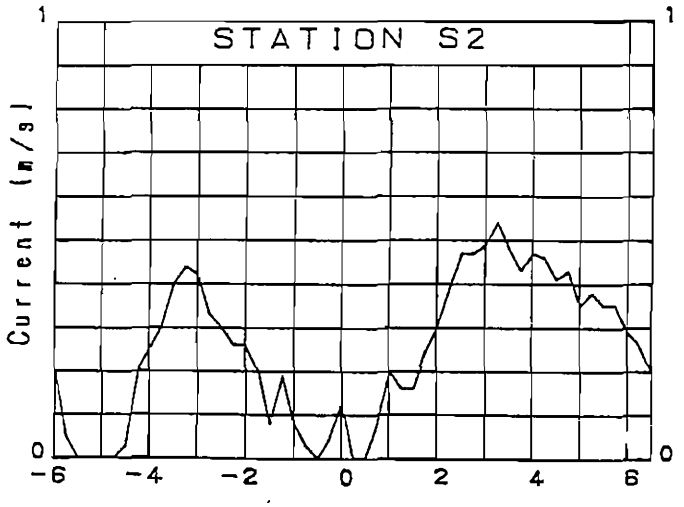
CREMER & WARNER CONSULTING ENGINEERS & SCIENTISTS Member of The Robertson Group plc	TITLE: CURRENT VELOCITY SPRING TIDE	SCALE	DRAWN BY	CHECKED	APPROVED
		DRAWING NO. D/91 193			DATE
FIGURE 4 CONTD.	PROJECT: L 4289/1	REVISION			

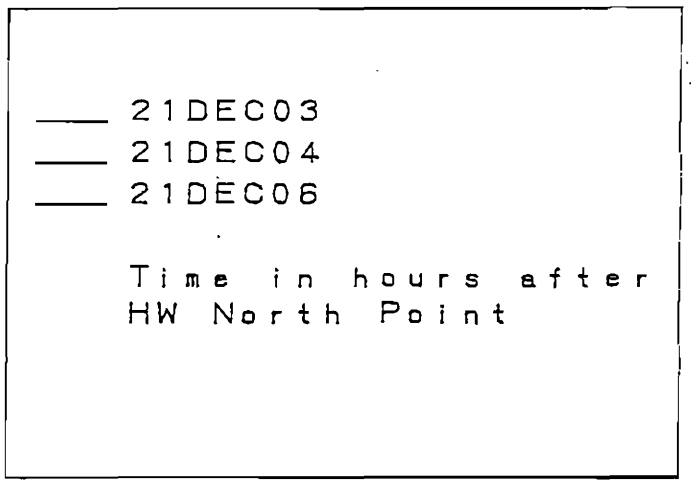








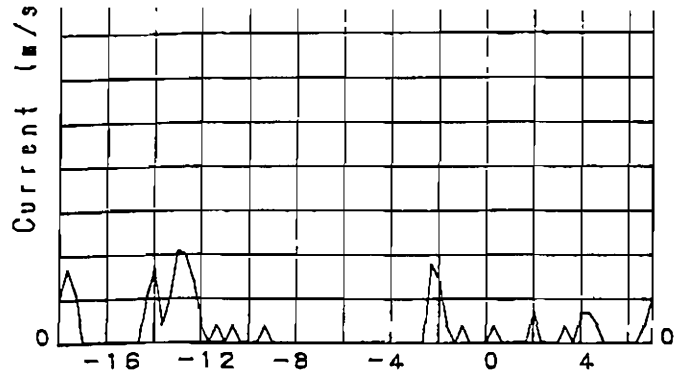


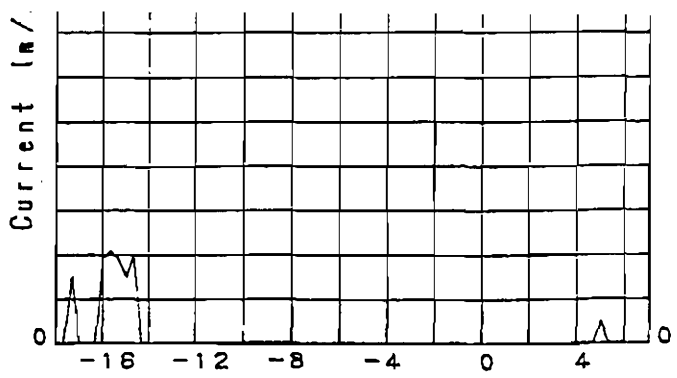


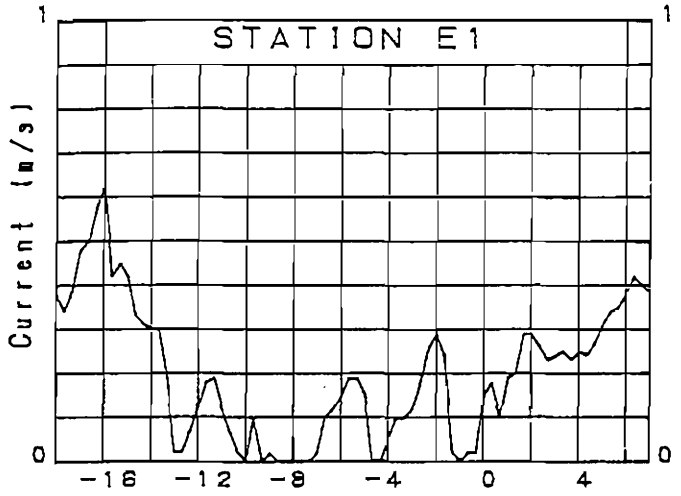
L 4289/1 D/91 193

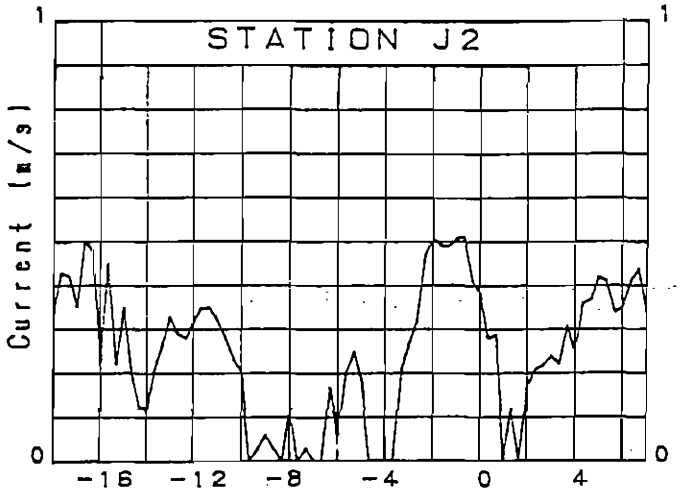
FIGURE 4 CONTD.

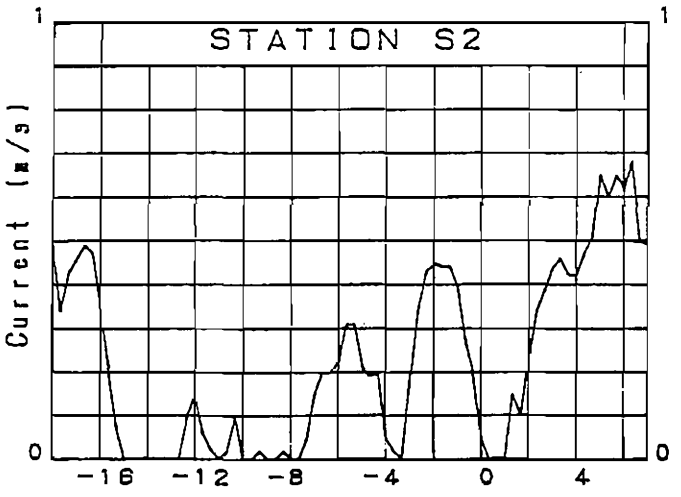
BELCHER BAY NEAR TIDE

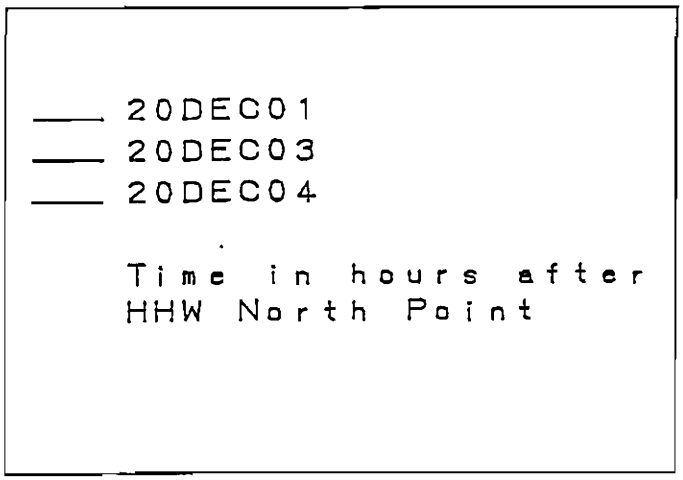












L 4289/1 D/91 193

FIGURE 4 CONTD.

BELCHER BAY - SPRING TIDE CURRENT VELOCITY

Traffic emissions from vehicles utilising the Kennedy Town Praya route are subject to good dispersion as the road is open to the harbour, but traffic emissions from Belcher's Street and the side streets will not be so well diluted. The tall buildings enclosing the streets will further impede dilution. Predictions done in other studies show that air quality objectives may, from time to time, be exceeded or approached and that generally, although air quality may be considered acceptable it is not good.

At the most westerly extent of the study area is the Green Island Cement facility which is a source of particulates and cause of complaints. The dust emissions arise as a result of handling and mixing operations and spills that occur during these operations. Dusty material is tracked onto roads in the vicinity by the cement lorries and provides sources of material that will subsequently be dispersed as dust by turbulent vehicle wake.

Routine air quality monitoring, undertaken by EPD shows that the annual average sulphur dioxide level is well below the air quality objective in the vicinity of the Belcher's Bay link. Results for total and respirable particulates exceed the AQO however, probably as a result of construction and combustion sources. Nitrogen dioxide levels and lead levels are also within the air quality objectives. These results were gained from a monitoring station exhibiting worse dispersion characteristics than at the location of the link road which will benefit from the effects of the well ventilated harbour area.

Average monitoring results for SO_2 are approximately 20 $\mu g/m^3$, for NO_2 approximately 70 $\mu g/m^3$, for ozone approximately 25 $\mu g/m^3$, for total particulates about 100 $\mu g/m^3$, respirable particulates about 70 $\mu g/m^3$, and for lead approximately 0.1 $\mu g/m^3$.

4.0 THE PROPOSED RECLAMATION

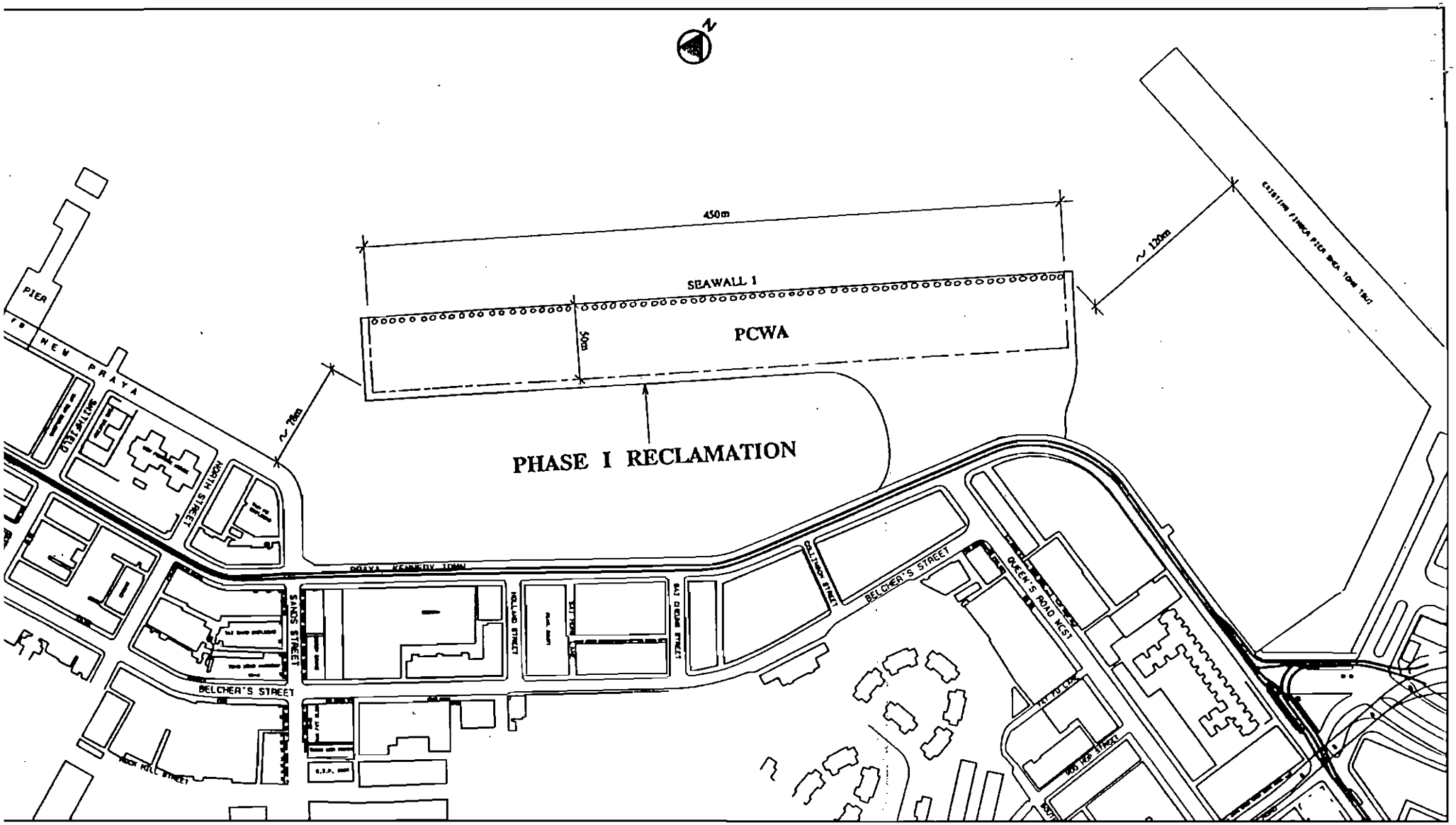
The Belcher's Bay link proposals are basically to provide an area of reclaimed land that extends into Belcher's Bay from the Kennedy Town Praya for a distance of some 165m. This new area will be used to provide land for the alignment of a road that links Connaught Road West/Sai Ying Pun with Kennedy Town New Praya. The reclamation thus provides a temporary link which will be realigned to form Route 7 once the GIR is complete. The area for reclamation is approximately 10 hectares and also provides the first step in Green Island reclamation proposals.

A preliminary report presented in December 1989 described the initial proposals but the extent of the reclamation was reduced to reduce costs; a report discussing the cost saving options was submitted in March 1991 and this report forms the basis for the extent of the present study.

The reclamation will proceed by three stages, as illustrated in Figure 5. Phase 1 will be formed as a pier with a sea wall of 450m separated from the Shek Tong Tsui cargo handling basin by approximately 120m. Phase 2 will complete the easterly extent of the sea wall (approximately 280m) and join the eastern end of the pier formed in Phase 1 to the existing shoreline. Phase 3 will fill in between Phase 1 and the existing sea wall of Kennedy Town Praya and New Praya.

The reclamation will proceed following complete removal of marine mud from the area. The new land will be formed largely with sand fill, but public dumping in certain areas which are not critical for sea wall or road foundations will be possible.

The reclaimed area will thus contain a public cargo working area and the new carriageway linking Sai Ying Pun to Kennedy Town, and it is these developments that the present study covers. The area of land to the south of the new carriageway will be assumed to be vacant until land use options proposed for Green Island Reclamation are developed. The current assumption is that Green Island Reclamation would not be in place until 7 to 10 years after the completion of the Belcher's Bay Link. The eventual Route 7 alignment will be to the north of the Belcher's Bay Link road presently proposed.



ONSTRUCTION ROGRAM

CONSTRUCTION ACTIVITY	1/92	1/93	1/94	1/95
MOBILISATION	2/92			
PHASE I CONSTRUCTION		6/93		
PHASE II CONSTRUCTION			6/94	
PHASE III CONSTRUCTION				2/95

LEGEND :

- SEAWALL UNDER CONSTRUCTION
- BOUNDARY OF PERMANENT PCWA
- RECLAIMED AREA
- CHAIN LINK FENCE

L 4289/1 D/91 193

GENERAL NOTES

1 DIMENSIONS MUST NOT BE SCALED FROM THIS DRAWING

2 THE COPYRIGHT OF THE CONTENT OF THIS DRAWING IS RETAINED BY THE CONSULTANTS UNLESS EXPRESSLY AGREED OTHERWISE. ANY USE OF REPRODUCTION OF THIS DRAWING OR ANY PART THEREOF CAN BE MADE ONLY AFTER OBTAINED WRITTEN PERMISSION OF THE CONSULTANTS

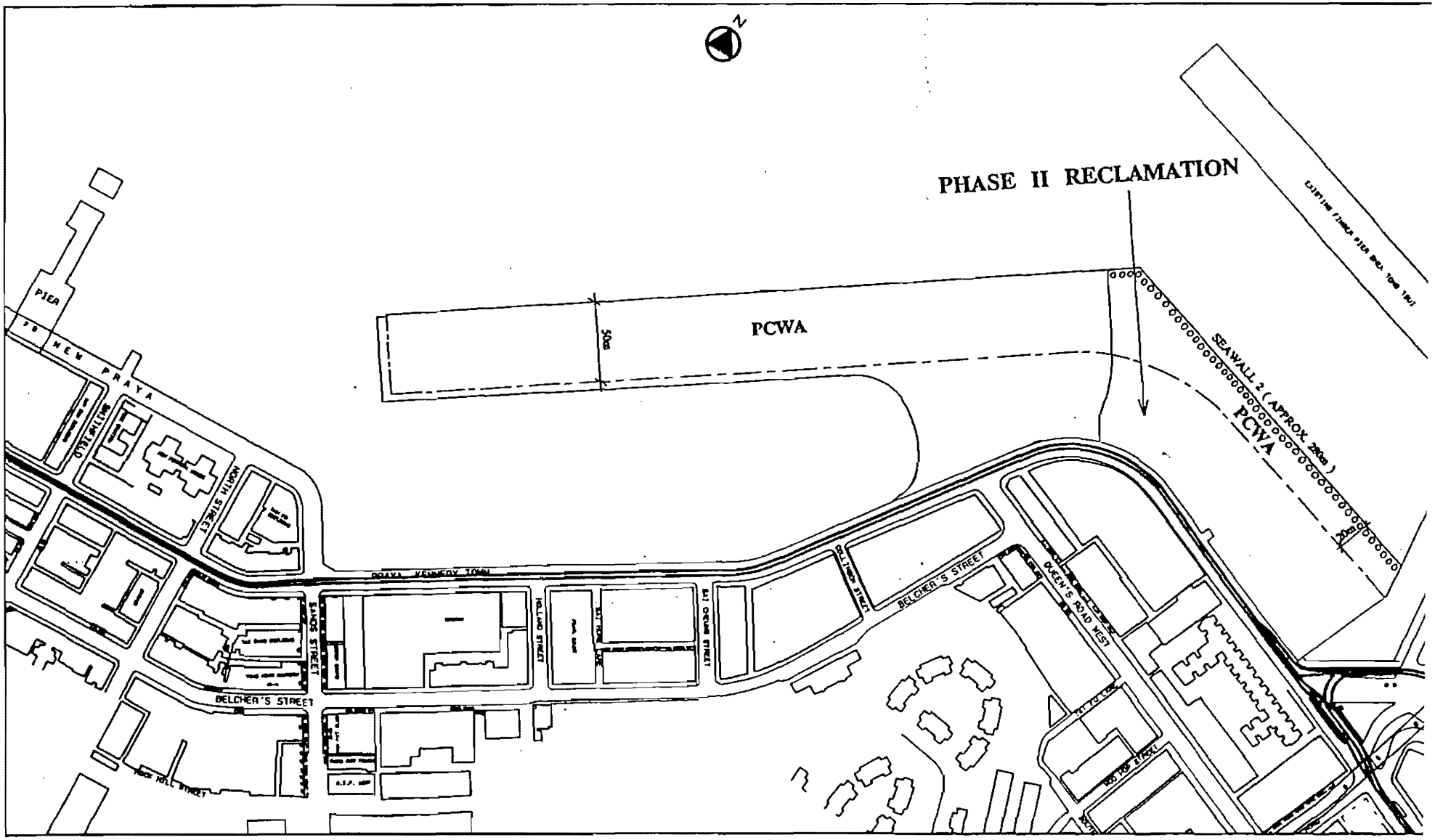
BELCHER BAY LINK

RECLAMATION PHASE I

THE MVA CONSULTANCY

HONG KONG GOVERNMENT HIGHWAYS DEPARTMENT

FIGURE 5A



GENERAL NOTES

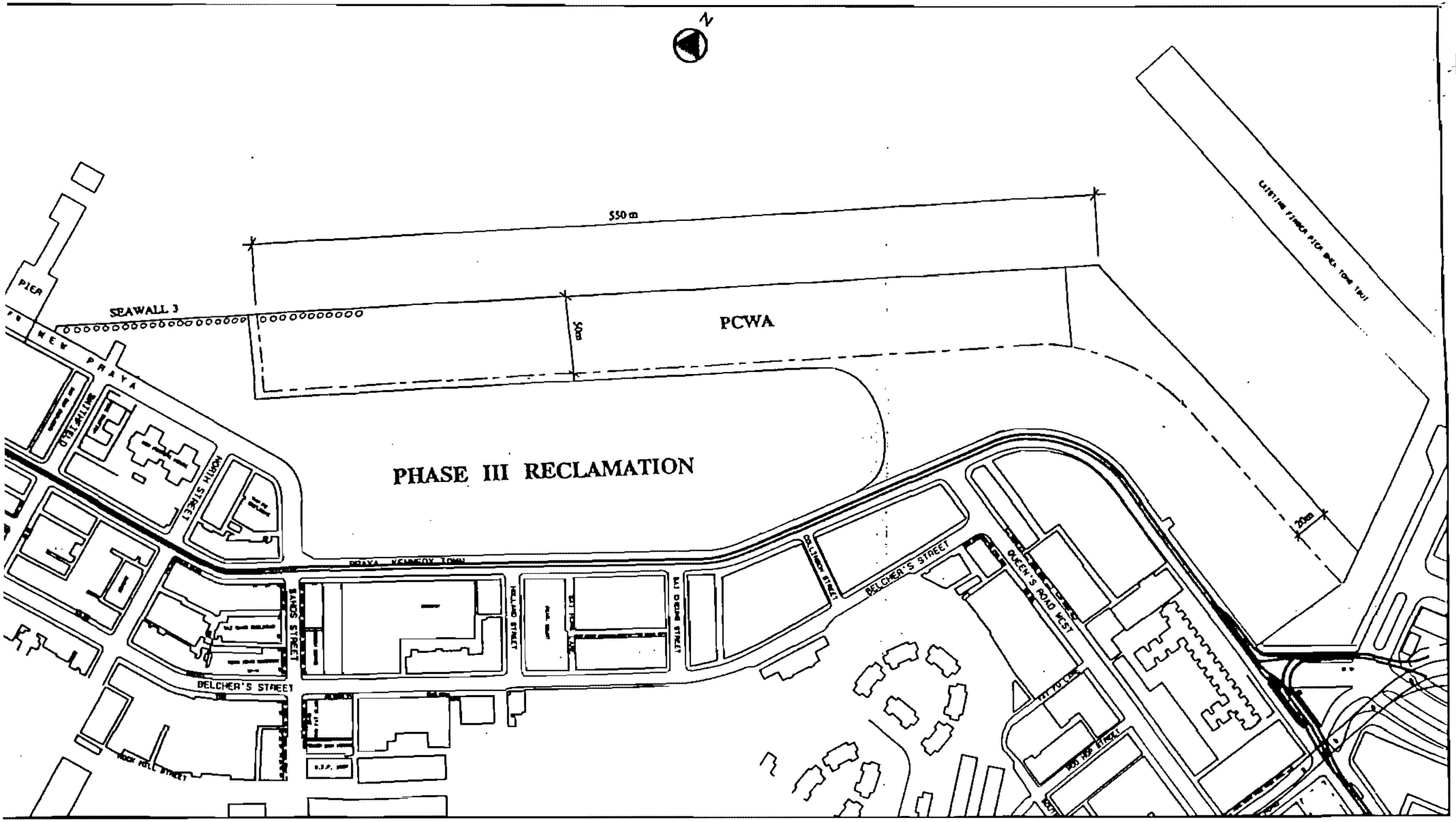
BELCHER BAY LINK

RECLAMA
PHASE II

THE BVA CONSULTANCY

HONG KONG REGION
HIGHWAYS DEPARTMENT

L 4289/1 D/91 193



L 4289/1 D/91 193

GENERAL NOTES

BELCHER BAY LINK

RECLAMATION PHASE III

THE MVA CONSULTANCY

HONG KONG REGION HIGHWAYS DEPARTMENT

FIGURE 5C

The 50m wide pcwa allows for internal traffic, loading and unloading parking, crane operation zones and goods deposit areas. Generally therefore the northern edge of the road will be exposed to the open harbour whereas for most of its length, the southern edge will have approximately 90m "buffer" before sensitive receiver locations are reached. At the study area west and east boundaries, however, the proposed road is in close proximity to residential buildings. As the subject matters of the present study will influence the air quality of the 90m buffer to the south of the roadway it is important that this feature is further studied as other proposals are developed.

As the road alignment has been dictated by cost considerations and the need to proceed with a reduced reclamation area, it has not been possible to introduce extensive buffers to control exposure to vehicle emitted pollutants.

5.0 EFFECTS DURING CONSTRUCTION PHASE

Any consideration of effects caused by the Belcher's Bay reclamation project must also take into account the fact that other reclamation projects in the immediate vicinity and overall plans for the development of Hong Kong will also have an impact on the water and air quality of the area presently under study.

The Green Island Reclamation study, for example, has identified extensive reclamation limits which will eventually alter the seaward extent of the Belcher's Bay proposals. Once the Green Island reclamation has proceeded the Belcher's Bay reclamation will not have any identifiable, specific impact as the effects of Belcher's Bay and Green Island will combine.

It is thus important that an overview is undertaken that considers the combined effects of development proposals. This overview is outside the scope of the present study. It is nevertheless, considered an important step in the assessment of Hong Kong's environmental quality and it is recommended that Government should undertake or commission such a study.

5.1 Water Quality

5.1.1 General

The effects of the construction process on water quality are determined by:

- o reclamation construction methods
- o reclamation construction timetable and phasing
- o reclamation construction materials
- o sea wall limit.

The construction method that is proposed will be to dredge sea muds from the reclamation area; provide a sea wall and then fill the area enclosed by the new sea wall and the existing sea wall with marine sourced fill. It is probable that grab dredgers will be used for the excavation of marine mud and sand fill. Although suction dredgers are preferable in terms of ability for enhanced pollution control and have the additional benefit of speed of operation it is unlikely that their use could be justified for this operation on economic grounds.

The reclamation construction timetable is shown in Table 4. Due to the relatively small areal extent of the proposed reclamation the timetable extends for a period of thirty months from February 1992 to July 1994.

TABLE 4

Reclamation Construction Timetable

	Excavation of Muds	Filling with Sand
Phase I	2 1992 ---- 7/92	2/92 ------ 7/92
Phase II	4 1993 ---- 5/93	4/93 ------ 9/93
Phase III	5 1994 ---- 7/94	3/94 ------ 7/94

The construction materials will be land sourced rock for the construction of the sea wall and marine sand for the majority of the reclamation area. Public dumping of construction rubble is an option for Phase III of the reclamation, such material would be limited in the extent of its use and would be surrounded by sandfill. The new sea wall will be approximately 930m in length and will be approximately 165m from the present sea wall at its furthest extent.

5.1.2 Dredging of Marine Muds and Marine Sand

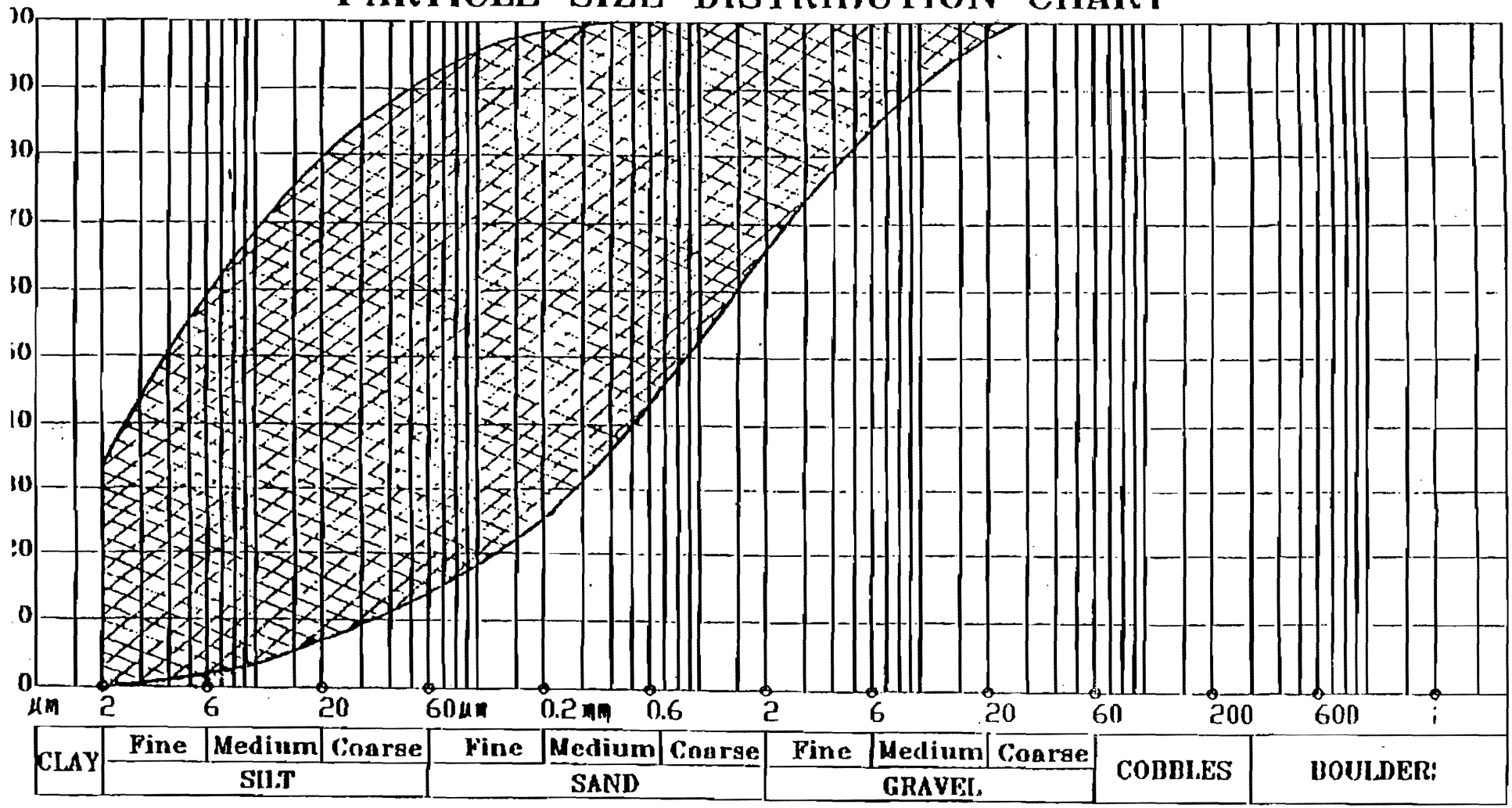
The dredging operation has the potential to release sediment particles into the water column where they may disperse and increase the sediment load and turbidity level of waters in the vicinity of the operation. Depending on the degree of contamination of material to be moved, this operation may also have the potential to decrease the level of dissolved oxygen of the water column in the area and to release possible organic or inorganic contamination (e.g. PCB's or heavy metals) thus raising the availability of these toxic materials in the vicinity of operations.

Information on the degree of contamination of the muds to be removed or the sand to be used as fill does not yet exist. It is recommended that sampling be undertaken prior to the commencement of marine works and the results used in designing the level of control to be exercised in the control of water quality.

The particle size distributions of the materials is known, however, and graphs giving the information are shown in Figures 6 and 7. The grading envelope for material to be removed from the reclamation area shows that the size of the material is such that most of it would be susceptible to suspension and hence dispersion by the water column if it were released.

Dredging activity may lose as much as 3% of the dredged material from the bucket. Based on the schedule of material to be excavated this could result in approximately 36300 m^3 of material loss throughout the construction period, broken down as follows 22500 m^3 between February and June 1992; 9300 m^3 between April and May 1993 and 4500 m^3 between May and July 1994.

PARTICLE SIZE DISTRIBUTION CHART



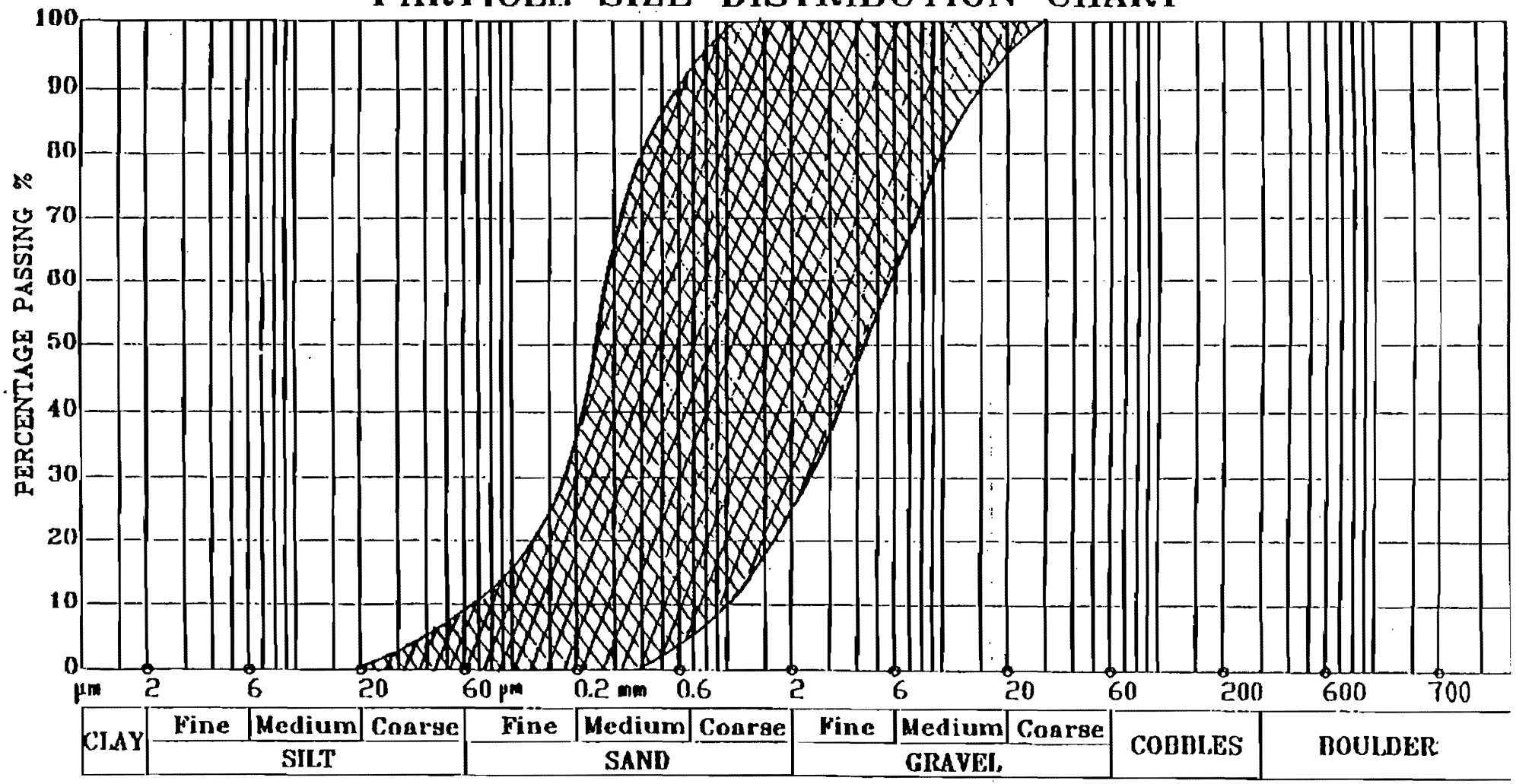
L 4289/1 D/91 193

GRADING ENVELOPE FOR DREDGED MATERIAL

FIGURE 6

PARTICLE SIZE OF DREDGED MUDS

PARTICLE SIZE DISTRIBUTION CHART



L 4289/1 D/91 193

GRADING ENVELOPE FOR PROPOSED FILL

FIGURE 7

PARTICLE SIZE FOR PROPOSED FILL

This activity could give rise to suspended solid loads of up to 3 mg/m^3 during the period of activity over a distance of some 4km which would be the approximate distance travelled by harbour water during the course of 24 hours. Assuming a much more limited dispersal range restricted to within Belcher's Bay waters confined by the Shek Tong Tsui finger pier, loads could increase to approximately 12 mg/m^3. When added to the average suspended solid load of Victoria Harbour waters the resultant load remains well within the natural range of the Harbour which is 2.0 to 30 mg/l. These predictions make assumptions that result in over-estimation of the likely potential adverse affect. Notwithstanding these over-estimates it is unlikely that dredged mud losses will result in unacceptable conditions. It will be necessary, however, to operate a monitoring programme (see Section 5.2) to ensure that any deterioration in water quality is detected and acted upon. Cooling water intakes may be affected by an increase in suspended sediments. The contractor should be aware of the locations of all such intakes in the vicinity and take steps to prevent large increases in suspended sediment load in their locality.

Similar calculations have been carried out for sand dredging and placement and acceptable conditions are maintained (less than 4 mg/m^3 additional suspended solid load) during each of the reclamation phases and at the fill source. When the background, mud excavation and sand placement loads are added together the total load remains well within the natural range.

Potential BOD and COD loads generated during mud removal can be estimated from a marine mud COD of 34500 mg/kg and a BOD:COD ratio of 0.5.

During Phase I operations, the potential BOD and COD loads are 6 and 3 tonnes/day; Phase II 9 and 5 tonnes/day and for Phase III 3 and 2 tonnes/day. These loads may have a significant affect on the dissolved oxygen content of nearby waters and water quality results will need to be carefully assessed to prevent unacceptable deterioration in water quality from occurring. Phase II has the greatest potential load and experience gained during Phase I operations should be used to modify operations as necessary to prevent adverse quality effects. The load will be spread between the excavation and disposal operations and the relative proportion during each will depend on the degree of disturbance to the sediments. The mud disposal area is thus likely to be subjected to most of the potential load.

5.1.3 Public Dumping

It is possible that public dumping may provide a source of fill during Phase III of the construction of the reclamation.

This material may contain a variety of substances which if dumped into the reclamation could give rise to unacceptable water quality. Such material will need to be prevented from causing such problems. This will need to be achieved by careful inspection of material loads to prevent loads from those sources that are found to contain a high percentage of unsuitable material being dumped and by measures to control the spread of unsuitable materials if they are dumped.

Unsuitable materials include putrescible waste which could give rise to ground instability problems if deposited in sufficient quantities. A more likely problem, however, would be material that could float and disperse away from the dump site to other locations in the Harbour. Floating booms and good site management/supervision will minimise the impact, for although there is no point of exit from the public dumping area into the main harbour waters, refuse that could become windblown will need control.

5.1.4 Construction Site Runoff

Runoff from the site following rainfall events has the potential to contain high solids load. Site drainage may need to be managed to prevent such runoff from entering harbour waters. Small runoff holding tanks could be used as part of the construction site drainage management scheme to allow settlement of solids to take place before runoff enters the harbour, it is unlikely that runoff from the reclamation will pose a problem. It is planned that the reclamation areas will be paved as soon as practical after their construction and this in itself will reduce the potential for runoff with high sediment loads being dispersed.

If any temporary fuel or oil stores are installed on-site to supply construction vehicles, these will be placed on an impervious surface and bunded to prevent spills polluting the ground or harbour waters. Facilities for clean-up (absorbant materials vacuum pumps) will be available as necessary.

5.1.5 Existing Sea Wall Drainage

There are a number of sea wall discharge points from surface water drains that drain into the area of proposed reclamation. The presence of foul discharges in such drainage systems cannot be ruled out which together with requirements to maintain access to the pcwa of the existing sea wall pose difficult conditions for the maintenance of good environmental quality during those phases of reclamation which restrict water movement. Whilst vessels are utilising the sea front access their movements will help to some extent in providing water exchange. Once reclamation has proceeded sufficiently it will be possible to construct temporary pipe arches to carry polluted flows away from the reclamation area. These temporary structures will be replaced with reinforced concrete drainage to take these polluted flows away from the reclamation as the progress of the current project allows. The construction of the temporary arches and pipe connections should be given a high priority in the reclamation schedule and should be built as soon as is possible. The timing is such that Phase I does introduce the potential problem of confined waters but given the project parameters it is not possible to circumvent this situation.

It will be necessary to make all reasonable efforts to prevent additional contaminants entering these waters and it may be necessary to draw up a code of practice for users of the confined pcwa to be followed during the period when Phase I reclamation is being constructed.

5.1.6 Water Flow Patterns

The new sea wall position will effect the existing water flow pattern of the area. However, the extent of the effect is limited because the reclamation is also of limited extent. The existing finger pier of Shek Tong Tsiu is a feature which will significantly affect existing flow patterns acting as a restriction to flow following the length of Victoria Harbour sea wall. This finger pier remains as a feature of the proposed reclamation and the restriction to flow will also remain.

It has not been possible to utilise the WAHMO prediction model or physical model to investigate the effects of the Belcher's Bay reclamation proposals in isolation to other reclamation projects proposed for the area.

However, predictions that have been run indicate that the Belcher's Bay proposal should not affect the flow patterns adversely. The much more extensive Green Island reclamation, although possibly resulting in low flow rates and exchange within the confined port areas does not adversely affect the main flow regime within the harbour waters. This will be the case with the Belcher's Bay reclamation which is relatively small in extent and does not significantly alter the existing situation.

5.2 Water Quality Monitoring

To ensure that water quality of the area is not detrimentally affected by the reclamation work, it will be necessary to undertake a programme of water quality monitoring. In the event of deterioration in water quality being detected by the monitoring programme a plan comprising of all necessary steps to ensure that it is not the reclamation activities that are contributing to the deterioration will put into action.

5.2.1 General Requirement

The contractor shall carry out the works in such a manner as to minimise adverse impacts on the environment during execution of the works. In particular he shall arrange his method of working to minimise the effects on the water quality within the site, adjacent to the site, on the transport routes and at the loading, dredging and dumping areas.

The overall objective is to minimise adverse impacts resulting from the reclamation operations on the water quality within Hong Kong waters. To achieve this objective the methods of working to be employed should be designed to:

- minimise disturbance to the seabed while dredging;
- minimise leakage of dredged material during lifting;
- minimise loss of material during transport of fill or dredged material;
- prevent discharge of fill or dredged material except at approved locations;
- prevent the unacceptable reduction, due to the works, of the dissolved oxygen content of the water adjacent to the works; and
- prevent excess suspended solids from being generated.

Before marine works commence, all marine plant to be utilised on site will be inspected to ensure that it conforms with the following guidelines that are designed to avoid or minimise pollution.

i) All construction plant shall be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.

ii) Pollution avoidance measures to be included (but not limited to)

a) mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted (closed grabs shall be used);

b) cutterheads of suction dredgers if used, shall be suitable for the material being excavated and shall minimise overbreak and sedimentation around the cutter;

c) where trailing suction hopper dredgers are in use for dredging of marine mud, overflow from the dredger, and the operation of lean mixture overboard systems, shall not be permitted;

d) 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 propellor wash;

e) all pipe leakages are to be repaired promptly and plant is not to be operated with leaking pipes;

f) the 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);

g) all barges and hopper dredgers shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

h) excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved; and

i) loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water and barges or hoppers shall not be filled to a level which will cause overflowing of material or polluted water during loading or transportation.

iii) The engineer may monitor any or all vessels transporting material to ensure that no dumping takes place outside the approved location. (Dumping outside approved locations is an offence under the Dumping at Sea Act 1974 (Overseas Territories) Order 1975). The Contractor shall provide all reasonable assistance to the Engineer for this purpose.

iv) The Contractor shall ensure that all marine mud and unsuitable material is disposed of at the approved location. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with the Engineer for accurate positional control at disposal sites before commencing dredging.

v) The Engineer may monitor any or all vessels transporting material to ensure that loss of material does not take place during transportation. The Contractor is to provide all reasonable assistance to the Engineer for this purpose.

vi) A monitoring programme will be implemented that will be designed to identify any changes in water quality that may arise as a result of the reclamation operations.

5.2.2 <u>Water Quality Monitoring Parameters and Equipment</u>

The most important monitoring parameter is turbidity. This parameter gives a direct indication of the degree of disturbance and hence the potential for contaminant release. Turbidity shall be measured onsite at the locations specified in Figure 8 in accordance with the schedule given in Table 5 or otherwise agreed.

Dissolved oxygen will also be monitored together with temperature and dissolved oxygen saturation in situ according to the schedule in Table 5. Suspended solids shall be determined by laboratory analysis of water samples collected in situ according to the schedule.

a) Turbidity Measurement Instrument

Turbidity within the water shall be measured in situ by the nephelometric method. The instrument shall be a portable, weather proof turbidity-measuring instrument complete with cable, sensor and comprehensive operation manuals. The equipment shall be operable from a DC power source supplied by the Contractor, it shall have a photoelectric sensor capable of measuring turbidity between 0-100 NTU and be complete with at least 25m of cable. (Partech Turbidimeter Model 7000 3RP Mark 2 or similar approved instrument).

b) Dissolved Oxygen and Temperature Measurement Equipment

Dissolved oxygen and temperature of the water shall be measured in situ. The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals and be operable from a DC power source supplied by the Contractor. It shall be capable of measuring:

i) a dissolved oxygen level in the range of 0-20 mg/l and 0-200% saturation; and

ii) a temperature of 0-45°C.

It shall have a membrane electrode with automatic temperature compension, complete with a cable of not less than 25m in length. Sufficient stocks of spare electrodes and cables shall be maintained for replacement as necessary. (YSI model 58 meter YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or similar approved instrument).

c) Suspended Solids

Water samples shall be collected for the determination of suspended solids. A 12 volt DC powered peristaltic pump equipped with Tygon tubing of at least 25m shall be used to collect samples. Samples should be collected into high density polyethylene bottles, packed in ice (cooled to 5°C without being frozen), and delivered to the laboratory for analysis as soon as possible after collection. Upon arrival to the laboratory, samples should be well mixed and then immediately filtered (with a vacuum of less than 381mm of Hg) through preweighed Millipore matched pair filters (for <5mg/l) or Whatman GF/C filters (for >5mg/l).

Particulates collected on the filter papers should be stored at 5oC and be dried at 103°C to constant weight within 48 hours. A balance providing accuracy to 0.01 mg shall be provided.

d) A laboratory standard certified mercury thermometer with an accuracy of 0.5°C Celsius for calibration of the temperature gauge in b).

e) Water depth detector

A portable battery operated echo sounder shall be used for the determination of water depth at each Designated Monitoring Station.

All monitoring instruments shall be checked, calibrated and certified by an approved, accredited laboratory before use on the Works and subsequently recalibrated at 3 month intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of suspended solids (in mg/l).

Monitoring Methodology

The contractor shall provide approved qualified technicians, capable of operating the monitoring equipment, together with a suitable work boat for carrying out the monitoring.

The monitoring schedule for sampling is shown in Table 5 and the locations for sampling in Figure 8.

The sample locations have been chosen with regard to the size of the proposed reclamation work and are all in quite close proximity to the reclamation site. It is anticipated that with good site practice elevated suspended solid loads will not be detectable beyond the immediate study area. Cooling water intakes at power stations should not be affected, nor should the closest fish culture zones. Careful assessment of monitoring results will ensure that any elevation is detected and steps taken to minimise the extent.

Depending on the location of any other monitoring in the area these locations may be subject to modification but once selected the monitoring stations should be maintained throughout the construction period.

Two further monitoring locations may be required, one at the dumping grounds for mud disposal and at the source grounds for marine sourced sand fill. These monitoring sites, depending on the level of other unrelated, reclamation activity, could be jointly monitored with other contractors or EPD as appropriate. The location of these monitoring sites will be dependant on the final detail and are to be advised.

TABLE 5

MONITORING SCHEDULE

A) Prior to Commencement of Marine Works

Examine 'baseline' variability at all monitoring sites shown in Figure 8.

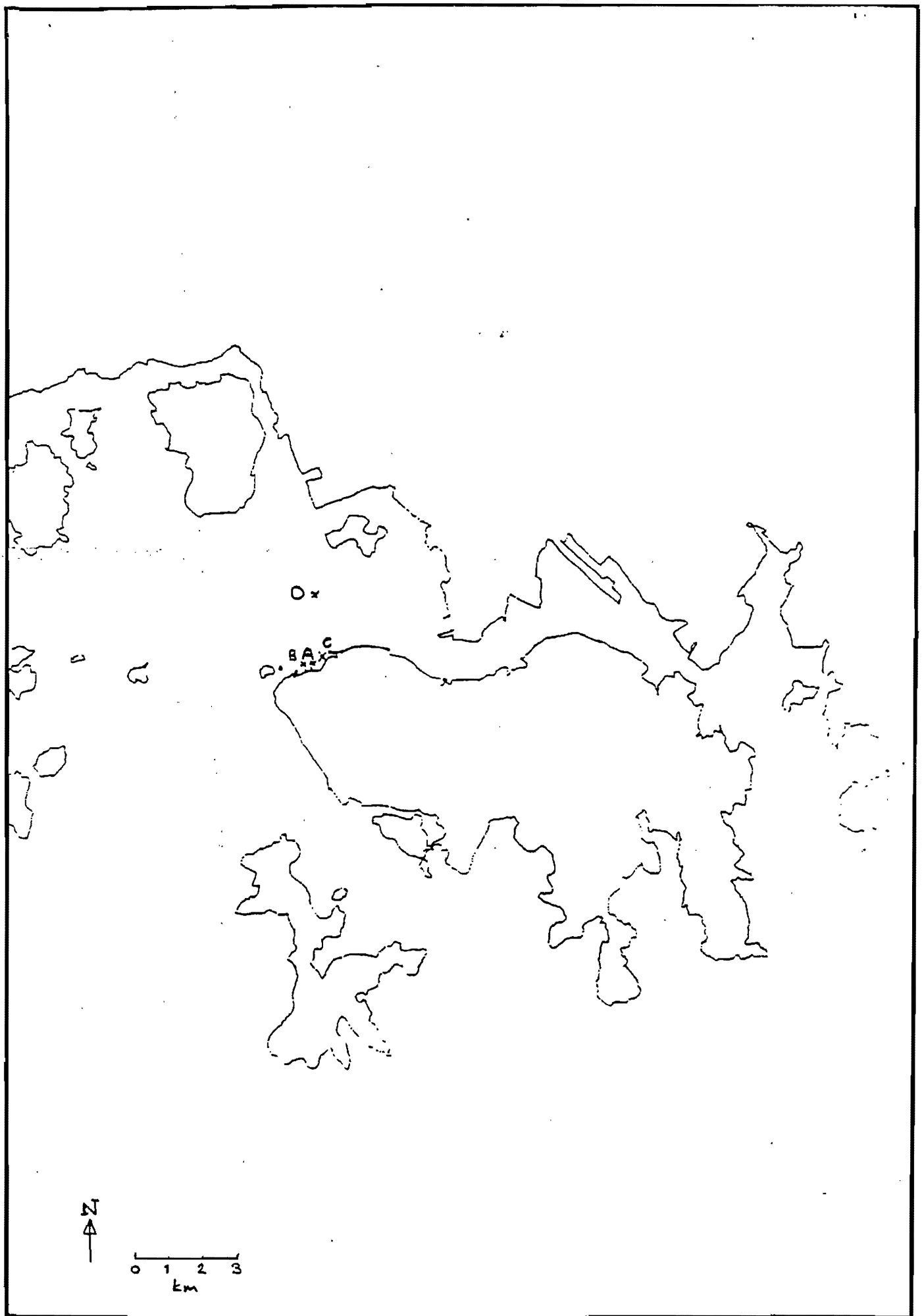
- 2 lots of 5 consecutive days sampling on mid flood and mid ebb at three water depths: surface minus 1m; bottom plus 1m and mid water depth for:
  - o turbidity
  - o dissolved oxygen concentration
  - o dissolved oxygen saturation
  - o temperature
  - o water samples for laboratory suspended solids determination.

B) During the Course of the Works

- monitoring on two working days a week (sampling to be separated by period of at least 36 hours) at each of the designated sampling locations shown in Figure 8. Sampling on mid flood and mid ebb at three water depths; surface minus 1m; bottom plus 1m and mid water depth. Two measurements are to be recorded for each sample location and depth set and determinands shall be:
  - o turbidity
  - o dissolved oxygen concentration
  - o dissolved oxygen saturation
  - o temperature
  - o water samples for laboratory suspended solid determination.

C) After Completion of the Works

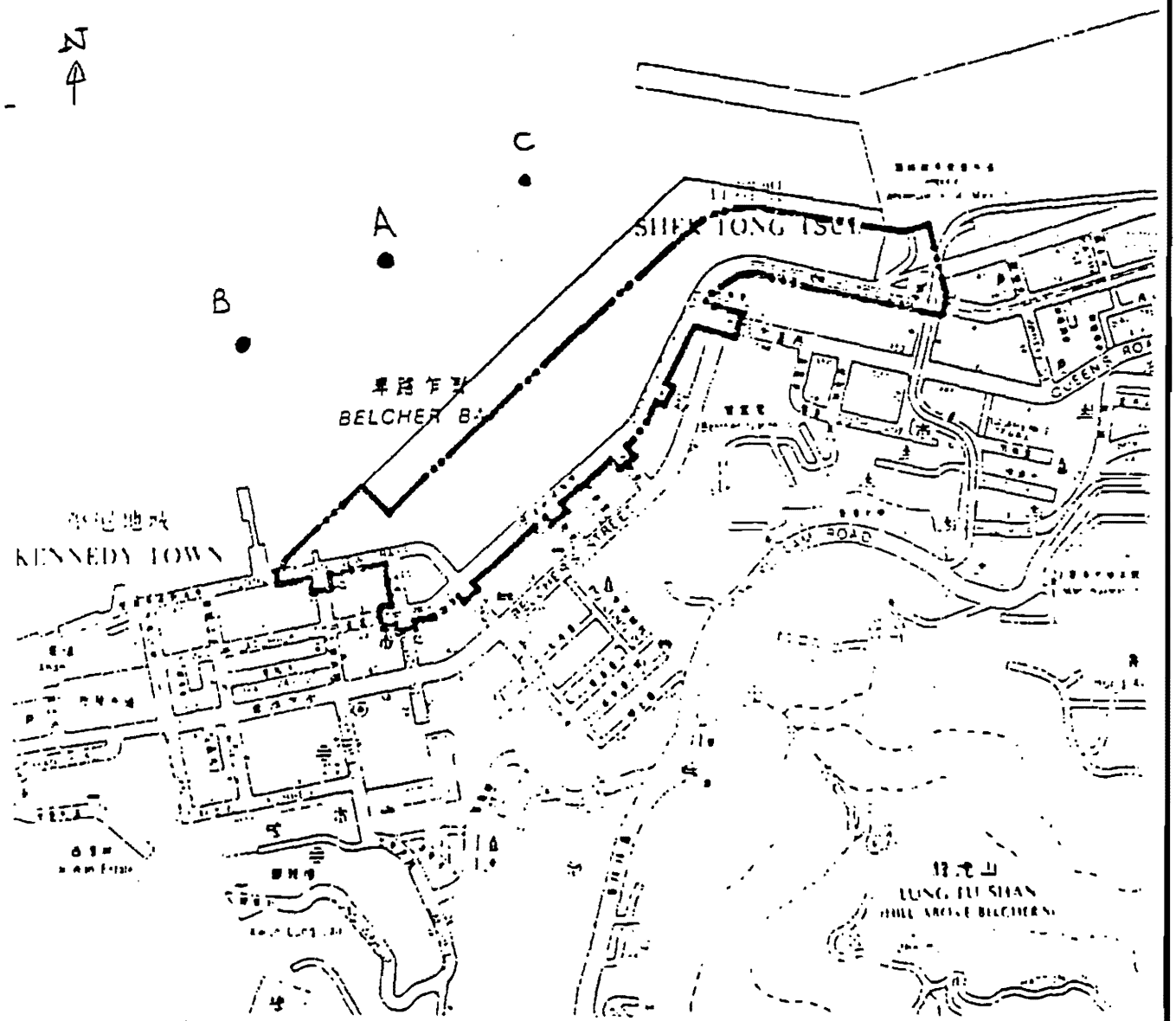
- Upon completion of all marine works on site, the Contractor shall take samples and measurements in the same locations as specified for a further period of two weeks measurements shall be made daily on mid-flood and mid-ebb tides.



CREMER & WARNER
CONSULTING ENGINEERS & SCIENTISTS
Member of The Robertson Group plc

TITLE: WATER QUALITY MONITORING LOCATIONS

SCALE	DRAWN BY	CHECKED	APPROVED
NTS	JW		
DRAWING NO. L 4289			DATE 25/6/91



CREMER & WARNER CONSULTING ENGINEERS & SCIENTISTS Member of The Robertson Group plc	TITLE: WATER QUALITY MONITORING LOCATION (DETAILS)	SCALE	DRAWN BY	CHECKED	APPROVED
		DRAWING NO. L 4289			DATE 25/8/94
FIGURE 8A	PROJECT: BELCHER'S BAY	REVISION			

5.2.3 Reporting of Monitoring Data and Actions

The results of all Water Quality Monitoring shall be provided by the Contractor to the Engineer, in an agreed format, no later than 24 hours after the sampling, except for the results for the suspended solids which shall be reported no later than 48 hours after sampling.

A monthly summary report including any measures taken to minimise the effect on water quality shall also be provided by the Contractor. This monthly summary report should be forwarded to the EPD for information and dissemination to other interested parties. In a similar way monitoring results from other reclamation projects should be made available to the Engineer.

Should the monitoring results of turbidity, DO or DOS at any monitoring station indicate that, in the opinion of the Engineer, a significant deterioration in water quality, monitoring shall be repeated daily at each monitoring station until such time as considered appropriate by the Engineer. In the meantime, the Contractor shall implement improvements to his working methods in order to reduce water quality impacts.

Should the situation persist and, in the opinion of the Engineer, the Contractor has not take appropriate and reasonable means to improve the situation, the Engineer may instruct the Contractor to take immediate and effective measures to curtail excessive sediment release and dispersal. No claim for extension of time and/or any additional costs incurred by the Contractor by reason of such measures imposed by the Engineer shall be entertained. Such measures may be relaxed when, in the opinion of the Engineer, the water quality within the Site and around the monitoring stations has improved.

5.3 Air Quality

Reclamation and construction activities have been identified in Hong Kong as major sources of fugitive dust. Dust emissions can be generated by two basic physical phenomena - the entrainment of dust particles by the action of turbulent air currents and the pulverisation and abrasion of surface materials by the application of mechanical force.

In order to estimate the impact of fugitive dust, emission factors, developed in the United States, can be used to predict the quantities of dust that might be generated by a variety of activities. In conjunction with the size characteristics of the dust and meteorological data it is possible to predict the dispersion of dust and its potential atmospheric concentration and deposition rate. This will give an indication of the need for and extent of dust control measures during the work programme.

5.3.1 Reclamation

The reclamation material will, for the most part, be marine sand, and as such, will not produce a potential dust source. Above 2.5 mPD, CDG will be used. Once the surface is able to dry out and is formed by earth moving equipment however, this new land surface will become a dust source.

It is assumed that once Phase I is in place (July 1992), the main potential for fugitive dust commences. There will however be some dust generated when the construction site office/storage compounds are established.

Experience shows that the most significant fugitive dust source is likely to be vehicle travel on unpaved roads. Dust from this source is generated according to the following equation:

$$E = K(1.7)\left(\frac{S}{12}\right)\left(\frac{S}{48}\right)\left(\frac{W}{2.7}\right)^{0.7}\left(\frac{W}{4}\right)^{0.5} \quad \text{kg/Vehicle km (dry day emission)}$$

where k varies according to particle size
s = silt content of parent material %
S = vehicle speed km/h
W = vehicle weight tonnes
w = number of wheels.

If it is assumed that only vehicles associated with land formation are allowed access to the new land area then the dust load for dry days that could be generated is 3.5 kg per vehicle kilometre travelled.

This overall potential load might result in a worst case in a_3 worst case uncontrolled downwind concentration of some 18 $\mu g/m^3$ per vehicle kilometre travelled. Some 8 μg of this load would be particulates in the respirable fraction. These calculations are based on the closest downwind receptor receiving dust from a narrow source width (i.e. wind blowing from the North East across the reclamation toward Kennedy Town new Praya).

Dust will also be produced from the reclamation area due to wind activity across unprotected dry surfaces. For a worst case day (winds in excess of 5.4 m/s and no natural dust suppression) dust generation could amount to 45 kg/d from each of the three areas of reclamation resulting in a downwind concentration of about 60 $\mu g/m^3$.

Taken together with the existing background level of atmospheric particulate concentration (approximately 100 $\mu g/m^3$), this analysis shows that it will be necessary to control the work operations to minimise dust potential and to maintain the AQO.

The analysis shows that there is benefit to be derived by controlling dust emissions from the new land surface.

This would be particularly important once the surface had dried out and during the months October to March when there is a natural rainfall v evaporation deficit. Ensuring that the surface does not completely dry out will prevent the majority of fugitive emissions from this source. This can be achieved by water sprays alone but a more stable surface can be achieved by proprietary additives. Once such a surface coating is applied site management should ensure that the area remains undisturbed. Any disturbance that does occur will require the reapplication of the sealing coat.

Assuming that surface treatment is effective in suppressing dust from open areas - the road source becomes potentially significant. Road emissions can be successfully reduced by about 50% by frequent application of water (by spray bowser or pipeline) but vehicle speed and routes must be well controlled. Contract conditions will be needed to enforce this.

5.3.2 Construction

Construction activity (i.e. associated with construction of the pewa and road infrastructure) will be a source of fugitive dust emissions.

Construction activities can have substantial temporary impact. Estimates (from the US) suggest that a figure of 3000 kg/ha/month may be generated by various activities related to a period of heavy construction activity. This is a general figure based on the types of activities that are associated with heavy construction. This figure suggests that for the Belcher's Bay Link, uncontrolled construction activities could produce dust levels that would exceed the Air Quality Objectives at the nearest sensitive receiver.

Control measures will need to be included in construction contracts. These control measures will need to include:

- good housekeeping - rapid spill cleanup
- best practice dry material storage
- best practice dry material handling
- water available for damping down dusty areas
- specific controls for specific dusty activities (e.g. cement batching).

It may also be necessary to be able to implement controls as the situation demands on a day-to-day basis. The most important feature in the control of fugitive emissions is awareness amongst contractors and management of the potential for problems.

6.0 OPERATIONAL EFFECTS

6.1 Water Quality

Once the pcwa and road networks proposed by the study become operational there will be the potential for adverse water quality impacts.

The activities of the pcwa have the potential for cargo spills into harbour waters. Improved facilities for handling introduced by the proposals, will limit the risk of spills however, and it is not expected that the additional cargo handling that will occur as a result of the proposals will pose a significant impact. Licence conditions for use of the pcwa should nevertheless include clauses which require due diligence to the prevention of pollution.

DLO/HK Environmental protection clause

The road network constructed will include adequate provision of drainage services to prevent spills and losses of oil or fuel that might occur from discharging to storm drains directly to the harbour. Grit traps will also be required. Such facilities will require cleaning at adequate frequencies for them to remain efficient.

It is not expected that the new roads will have an unacceptable impact on harbour water quality.

6.2 Air Quality

With regard to the operational phase the most potential for adverse impact relates to atmospheric pollutants emitted by vehicles using the new road network.

Vehicle emitted pollution has been predicted using Caline 4 methodology.

In interpreting these results it should be remembered that the basic assumptions made in the calculations are designed to illustrate worst case conditions, and that the actual case is likely to be an improvement in the figures shown.

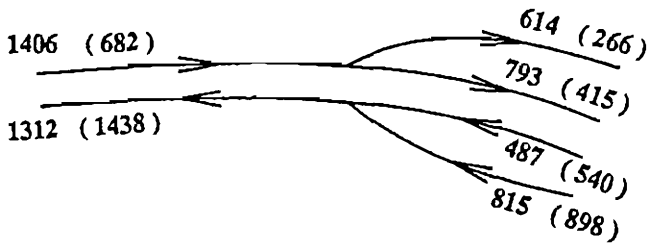
Predictions have been made to establish the worst case condition with peak hour traffic congestion and low speeds. Traffic flows used to generate the concentration predictions are shown in Table 6.

A wind speed of $2ms^{-1}$ has been used in calculations. This speed was chosen to represent the open location of the road, being influenced by slightly higher wind speeds than those that might be experienced in sheltered streets surrounded by buildings.

TABLE 6

TRAFFIC FLOWS

1996 Flows - am (pm) peak pcu's



2006 Flows

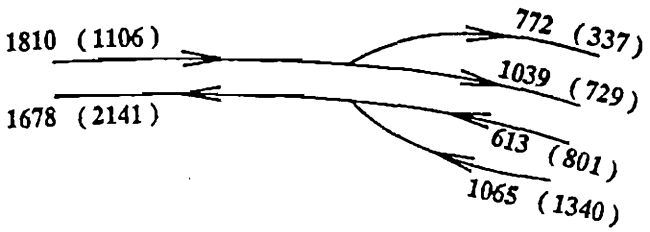


Table 7 gives the results of the predictions. Predictions were made for the receptors 1, 6 and 11m from the carriageway at three locations: 20m west of the intersection, at the intersection and 30m east of the intersection adjacent to Queens Road East.

These locations and receptor points were chosen to give representative answers for the worst case situations. Values in the table refer to carbon monoxide, hydrocarbons and oxides of nitrogen. Lead emissions have not been predicted due to the uncertainties on the extent of the use of unleaded fuel by the prediction dates. Lead levels are not expected to represent problems however.

The predicted carbon monoxide levels are all well within the standards set by the air quality objectives and it is not anticipated that there should be any problems from the proposed road in this regard.

The air quality objectives give values for nitrogen dioxide. The oxides of nitrogen emitted by vehicles consist mainly of nitrogen monoxide. This oxidises in the atmosphere to the more toxic nitrogen dioxide. The oxidation rate is dependant on a variety of factors including NO_x concentration, ambient temperature and sunshine. A conversion rate of 20% is the rate usually applied to roadside situations such as the one being modelled here.

TABLE 7

CALINE 4 PREDICTION RESULTS

YEAR	Receptor Position	Distance from Roadside	CO μgm-3	HC μgm-3	NOx μgm-3
1996	20m West of intersection	1m	4309	291	446
		6m	3727	251	386
		11m	2679	181	277
	At intersection	1m	3378	228	350
	30m East of intersection	1m	3727	251	386
2006	20m West of intersection	1m	6056	408	627
		6m	5241	353	543
		11m	3727	251	386
	At intersection	1m	4659	314	483
	30m East of intersection	1m	5357	361	555

Traffic Numbers : as shown in Table 6 (converted from pcu's by conversion factor of 1.37)

Windspeed : $2ms^{-1}$

Stability Class : D

Vehicle Speed : 15 kph (congested flow).

Thus - the worst case prediction for congested flows of 627 $\mu g/m^3$ nitrogen oxides represents a concentration of 125 $\mu g/m^3$ nitrogen dioxide. This figure is a prediction relating to an averaging time of ten minutes and is thus well within the air quality objective for NO^2. When added to a representative figure for existing NO_2 concentrations of approximately 70 $\mu g/m^3$ the air quality objective is still met.

When traffic speeds increase the emission rate of nitrogen oxides also increases. Predictions for a free flowing traffic situation at the design speeds of 50 kph for Belcher's Bay Link and 70 kph for Route 7 indicates that the concentrations of nitrogen dioxide that could be generated are within the air quality objectives.

At lower wind speeds the natural dispersive capacity of the atmosphere is reduced. At wind speeds of 1 m/s levels of nitrogen dioxide that when added to a background NO_2 level of about 70 $\mu g/m^2$, approach the air quality objective are predicted for the year 2006 close to the road side (i.e. at 1m from the roadside). At distances greater than 6m from the roadside, levels are diluted to acceptable levels.

This means that pedestrians should not be allowed to gain close access to busy major highways. To prevent unacceptable exposure to pedestrians it is suggested that pedestrian footways are located away from the roadside, particularly at intersections. Alternative pedestrian access and routes should also be provided.

It should be pointed out, however, that conditions where AQO are exceeded will be rare as low wind speeds are not likely to be encountered during periods of peak traffic movements.

7.0 CONCLUSIONS

Reclamation projects cannot proceed without some degree of environmental impact. Recognition of the potential problems at an early stage, however, allows mitigation measures to be incorporated into the design of the project and into the management of the project to reduce the level of adverse impact where possible. Where it is not possible to reduce the impact to acceptable standards steps to prevent exposure to the unacceptable water or air quality can be implemented.

In the case of the Belcher's Bay reclamation project, any adverse water quality affects will be detected by the recommended monitoring regime and the appropriate steps to prevent further adverse effects can be taken. Any adverse effects on water quality are not anticipated beyond the construction phase however.

Air quality objectives will continue to be met in the vicinity despite the expected increases in vehicle activity.

It is recommended, however, that pedestrian access to the roadside is limited to prevent adverse impacts of levels of nitrogen dioxide which, in exceptional conditions could increase to levels above those deemed satisfactory.

APPENDIX I

Agreement No. CE 32/88
Belcher's Bay Link
Draft Water Quality and Air Quality Report

Reference	Comments	Consultants' Respons
Air Policy Group		
Page 5, Table 2	The dialy AQO for the Total Suspended Particulates should be 260 ug/m3 instead of 360 ug/m3. The consultant should confirm that the predicted dust impacts have been compared with the corrected AQO.	
Page 9, 1st para. S.3.3	Please give reference of the studies that showed AQOs are exceeded in the Belcher Bay Street area.	
page 11, 1st para. S.4.0	It's agreed that the development of the 90m buffer south of the roadway should be considered in other project (probably the Belcher Bay Reclamation). However, the consultant should set up a guideline of buffer requirement with reference to the HKPSG so that future development along the BBL would not be subjected to bad traffic air quality.	
Page 24 to 26, S.5.3.	The consultant should have included in the report the predic tion method of the dust impacts of the relcamation including details such as model, the meterological conditions, the location of the receptors, emission factors, modelling parameters and etc. Explanations should also be provided for the choice of the meterological conditions and the model.	
Page 26, 2nd para. S.5.3.1.	What's the composition of proposed additives that would be used for dust suppression ? Would these kinds of chemicals cause other environmental problems ? Also, how long can it stay and what is the cost ?	
Page 26, 3rd para. S.5.3.1	At what vehicle speed should construction vehicles be controlled in order to prevent significant dust emissions ?	

f. 2

ference	Comments	Consultants' Responses
olicy Group		
26, S.5.3.2, 2nd para.	The consultant should give the source for the proposed dust emission factor of 500 kg/ha/month. Also, according to the USEPA AP-42, a figure for of 1.2 ton/acre/month (which is equivalent to about 2965 kg/ha/month) is used for construction activities with medium activity level only. Thus, the consultant should justify the above dust emission factor for the assessment.	
26, S.5.3.2, 3rd para.	The consultant should further elaborate the best practice dry material storage and best practice dry material handling.	
30, 1st para. S.6.2	The consultant has suggested that the averaging time of the prediction is 10 minutes. However, for the CALINE4, the averaging time of the prediction depends on the input of the fluctuation of horizontal wind direction to the model. The consultant should submit the value of this parameters for our agreement.	
30, 2nd and 3rd para. S.6.2	The consultant should provide us with the details of the modelling results for the vehicle speed of 50 kph for BBL and 70 kph for Route 7 as stated in the text (2nd para), and with wind speed of 1m/s (3rd para).	
30, 4th para. S.6.2	What is the suggest buffer between the pedestrian footways and the roadside.	
Policy Group		
7, Table 3	Surface Do % in Harbour West is (38.6 - 130.9).	
8, S.3.2	The consultant has measured the velocity of current in that area. More details of the measurements are needed. e.g. depth, equipments used.	

Reference	Comments	Consultants' Response
Water Policy Group		
Page 10, S.4.0	Phase 3 reclamation is an embayment which would trap all coastal discharges and filled materials during the phase 1 reclamation stage. How long does it last? Any mitigating measures would be taken in that period?	
Page 15. S. 5.1.4	Temporary site drainage at the perimeter of the reclamation site should be connected to special settling tanks/grease traps/interceptors so as to control silty/oil spilt contaminated water being wash into the stormdrain/foul sewers.	
Page 16 Last para. of S.5.1.6)	The report indicates that predictions of flow patterns were made by the consultants. Could they supply more details?	
Page 17, 1st para sub-item 5, §2.1)	Besides Dissolved Oxygen, the contractor should also prevent an unacceptable level of turbidity generation.	
Page 18, Sub-item (a), S.5.2.2)	This item should be replaced by the attached sheet App. I for turbidity measurements	
Page 18. Sub-item (c), S.5.2.2.	This item should be replaced by the attached sheet App. II for suspended solids measurements.	
Page 20, para.4	All monitoring instruments shall be recalibrated at bi-monthly interval.	
Waste Management Group		
Page 13, S.5.1.2	Special requirements may be imposed on the mud disposal works if the marine mud is found to be contaminated.	

App I

b) Turbidity Measurement Instrument

Turbidity measured on site could be done using either of the following two methods :

(i) In-situ measurement with the probe totally submerged in the water column; or

(ii) With 0.25 litre of water sample collected at the specified depth and shaked well when a measurement is being taken on board.

The contractor is free to choose either method. However, once he has chosen one method, he must apply the same method throughout both Baseline Monitoring and Routine Monitoring Periods. The same method will also have to apply to all monitoring/control stations.

The instrument shall be a portable, weatherproof turbidity-measuring instrument complete with cable, sensor and comprehensive operation manuals. The equipment shall be operable from a DC power source, it shall have a photoelectric sensor capable of measuring turbidity between 0-100 NTU and be complete with cable with at least 25 meters long. (HACH Turbidimeter Model 16800 or similar approved).

e) Suspended Solids measurements

A 12 volt DC powered peristaltic pump equipped with a Tygon tubing of at least 25 m long shall be used for sampling water. Samples should be collected in high density polythene bottles, packed in ice(cooled to 5°C without being frozen), and delivered to the laboratory as soon as possible after collection. Upon arrival to the laboratory, samples should be well-mixed and then filtered (with a vacuum of less than 381 mm of Hg) through pre-weighed Millipore matched pair filters (for <5 mg/L) or preweighed Whatman GF/C filters (for >5 mg/L) immediately. A Millipore hand-operated filtration assembly (with a vacuum of less than 15 inches of Hg) shall be used to filter the water samples. Particulates collected on the filter papers should be stored at 5°C and be dried within 48 hours in a drying oven at 103°C until constant weight is reached on two consecutive weighings. Filter papers taken from the drying oven shall be cooled to room temperature in a dessicator prior to being weighed. An accurate electronic balance shall be used to give a precision level of 0.01 mg.

All monitoring instruments shall be checked, calibrated and certified by an approved accredited laboratory before use on the Works and subsequently re-calibrated at bi-monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use.

ence	Comments	Consultant's Responses
olicy Group		
, Table 2	The daily AQO for the Total Suspended Particulates should be 260 ug/m^3 instead of 360 ug/m^3. The consultant should confirm that the predicted dust impacts have been compared with the corrected AQO.	This is a typographical error, the consultants can confirm predicted dust impacts were compared against the correct figure of 260 ug/m^3.
, 1st para. S.3.3	Please give reference of the studies that showed AQO are exceeded in the Belcher Bay Street area.	The study referred to is Green Island Reclamation Feasibility Study and refers to the general situation rather than any particular location.
1, 1st para. S.4.0	It's agreed that the development of the 90m buffer south of the roadway should be considered in other project (probably the Belcher Bay Reclamation). However, the consultant should set up a guideline of buffer requirement with reference to the HKPSG so that future development along the BBL would not be subjected to bad traffic or air quality.	The guidelines given in HKPSG would be suggested as the basis for planning land use in this area. Sensitive uses such as nurseries, or schools should not be considered for the entire zone, but it may be possible to develop the area further than say 30m from the road edge for residential use or recreational activities.
4 to 26, S.5.3	The consultant should have included in the report the prediction method of the dust impacts of the reclamation including details such as model, the meteorological conditions, the location of the receptors, emission factors, modelling parameters and etc. Explanations should also be provided for the choice of the meteorological conditions and the model.	The prediction of potential dust impact is not a precise science and the methodology use should only be used to indicate the potential scale of the problem. At this stage of the project it is necessary to make several assumptions to predict the potential for dust production. The section indicates that quite broad generalisations have been used to identify the potential for problems but "worst case" situations are looked at. In this instance this means high dust loads, short source length and a sensitive receiver closest to the potential source. Worst case meteorological conditions include low wind speeds and winds blowing directly form the source to the receiver. The section does not set out to predict the precise nature of the potential dust impact but to indicate whether or not the potential exists. In this instance the potential for adverse effects on air quality objectives and on the nuisance capacity of dust fall exists and so it is justifiable to require dust controls to be implemented as part of the environmental management of the site.

Reference	Comments	Consultant's Responses
		A very simple box model was used to predict the scale of impacts, based on sou strength (from Emission Factor Calculation) source length cloud mixing patte downwind from a ground level source, deposition velocity speeds were used calculations referred to 'dry day' (i.e. no rainfall) uncontrolled situations.
Page 26, 2nd para. S.5.3.1	What's the composition of proposed additives that would be used for dust suppression? Would these kinds of chemicals cause other environmental problems? Also, how long can it stay and what is the cost?	Surface coatings that can be used to control fugitive dust include coatings based either bitumen, salts or adhesives. Table 1 lists these chemicals depends on degree of disturbance the treated area is subject to. Application rates may vary the initial dilution rate of the stabilizer in water for application purposes may vary. Guidance from the manufacturers for rate of application, cost and durat are being sought. In general terms the likely excess environmental impact fr utilizing such stabilisation techniques is unlikely to be significant.
Page 26, 3rd para. S.5.3.1	At what vehicle speed should construction vehicles be controlled in order to prevent significant dust emissions?	The quantity of dust produced by vehicles travelling over unpaved surfaces directly proportional to vehicle speed. Therefore, the lower the speed, the sma the quantity of dust produced. If possible vehicle speeds should be controlle those as low as can be reasonably enforced. Speeds of 25-30 mph or below ar be preferred.
Air Policy Group		
Page 26, 2nd para. S.5.3.2	The consultant should give the source for the proposed dust emission factor of 500 kg/ha/month. Also, according to the USEPA AP-42, a figure for of 1.2 ton/acre/month (which is equivalent to about 2965 kg/ha/month) is used for construction activities with medium activity level only. Thus, the consultant should justify the above dust emission factor for the assessment.	Agreed, the emission factor should read approximately 3000 kg/ha/mo However, the statements concerning the potential for adverse impact to be cau by construction activity remain valid.

nce	Comments	Consultant's Responses
6, 3rd para.	The consultant should further elaborate the best practice dry material storage and best practice dry material handling.	Dry material storage methods to minimise the dust potential would include the use of covered areas for small particle sized material, orienting the piles to minimise the action of wind, providing dust filters and local extraction systems where fine particles are handled, providing wind shields for medium sized particles etc. Best practice dry material handling methods, include, but are not limited to, for example: o minimisation of drop height o use of dedicated handling areas with paved surfaces to aid clean up o handling areas to be kerbed also to aid clean up o handling areas to have boards or enclosure arrangements to maximise efficient transfer o maintenance of equipment to ensure efficient closure of grab jaws and bucket transfer efficiency.
0, 1st para.	The consultant has suggested that the averaging time of the prediction is 10 minutes. However, for the CALINE4, the averaging time of the prediction depends on the input of the fluctuation of horizontal wind direction to the model. The consultant should submit the value of this parameters for our agreement.	In modelling the predicted emissions from the development, the worst case situation has been utilised to give an indication of the worst air quality conditions that might occur. In practice this may occur only for very short periods when all worst case assumptions combine. We have used a combination of worst case meteorological factors and peak hourly traffic figures and hence the real time horizontal fluctuation of wind direction has not been included in our use of the model. We are unsure as to whether the meteorological data available for the area would provide a good indication of the fluctuation that might be experienced at the location of the development. The predictions referred to in the report are worst case average hourly concentrations with no reduction in value that might occur if wind fluctuations were taken into account. They are thus likely to be conservative.
0, 2nd and 3rd 3.6.2	The consultant should provide us with the details of the modelling results for the vehicle speed of 50 kph for BEL and 70 kph for Route 7 as stated in the text (2nd para), and with wind speed of 1m/s (3rd para).	(see response to comments on Page 30, 4th para. S.6.2)

Reference	Comments	Consultant's Responses
Page 30, 4th para. S.6.2	What is the suggested buffer between the pedestrian footways and the roadside.	The values calculated are presented below :

Table 2 : Air Quality Predictions

Year	Receptor Position	Vehicle Speed	Wind Speed	Distance from Roadside	CO ugm^{-3}	HC ugm^{-3}	NO_x ugm^{-3}
1996	20m west intersection	70kph Rt.7 50kph BBL	$1ms^{-1}$	1m	1980	219	763
				6m	1398	154	538
				11m	1281	142	493
	At Inter-section			1m	1630	176	846
	30m east of Intersection			1m	1514	163	786
2006	20m west of Intersection			1m	2795	309	1076
				6m	1980	219	763
				11m	1747	193	673
	At Inter-section			1m	2096	226	1133
	30m east of Intersection			1m	2213	239	1150

Rt7 = Route 7
BBL = Belcher Bay Link

At distances from the carriageway greater than 6m the modelling indicates level pollutants are diluted to acceptable levels. It would appear that the buffer coul set at 6m. However, it must be recognised that the modelling predicts worst situations from a combination of conditions that only infrequently occur and only for short periods when all the worst case assumptions combine. The abs of a footway adjacent to the road in an urban situation means a loss of benefits. benefits in an urban situation outweigh the risks predicted by this conserva modelling. It is recommended that footways of 2.75m to 3.0m as required by Traffic Planning and Design Manual (TPDM) are to be constructed. This repres a 1m buffer and the remaining width provides opportunity for pedestrians to incr the distance between himself and the source.

ıce	Comments	Consultant's Responses
Policy Group		
, Table 3	Surface Do % in Harbour West is (38.6 - 130.9).	Noted this is a typographical error.
, S.3.2	The consultant has measured the velocity of current in that area. More details of the measurements are needed. e.g. depth, equipments used.	The results discussed in this section refer to current measurements extracted from the WAHMO physical model and provided to the present study team by Civil Engineering Office.
Policy group		
0, S.4.0	Phase 3 reclamation is an embayment which would trap all coastal discharges and filled materials during the phase 1 reclamation stage. How long does it last? Any mitigating measures would be taken in that period?	Noted. This condition would last for about 12 months. However, while the cargo handling activities along the existing Kennedy Praya are maintained, it is expected that the resulting frequent vessel movements will help in providing water exchange. This issue has been addressed in S.5.1.5 with relevant mitigating measures elaborated.
5. S.5.1.4	Temporary site drainage at the perimeter of the reclamation site should be connected to special settling tanks/grease traps/interceptors so as to control silty/oil spilt contaminated water being wash into the stormdrain/foul sewers.	Noted. It is stressed that the phases I and II reclamation will be paved up as soon as practicable. The Phase I reclamation will be paved up to form the Public Cargo Working Area and the access road while the Phase II also have similar arrangements. It is believed that the possibility of getting silty water after the reclamation has reach the proposed formation level of 4.0 mPD is limited to the very edge of the reclamation. In this case the water will seep through the riprap protection along the perimeter of the reclamation but filtered by the marine sand which is being used as filling material. Phase III will complete the reclamation and by then the proper reclamation drainage system will be provided. It would be more effective to minimise the possibility of oil spilt by restricting the oil storage and filling point to designated area with impervious surface and bunded to prevent spills. The Contractor shall be required to provide a perimeter drainage for the designated area with grease trap for discharging.
6 Last para. .1.6	The report indicates that predictions of flow patterns were made by the consultants. Could they supply more details?	WAHMO predictions have not been made for the Belcher Bay Link. The studies referred to in the final paragraph of this section refer to work carried out in connection with GIRFS and Port Peninsula Development which indicate that these much more extensive development projects do not generally affect the main flow regime in the harbour waters.

Reference	Comments	Consultant's Responses
Page 17, 1st para. sub-item 5, 5.2.1.	Besides Dissolved Oxygen, the contractor should also prevent an unacceptable level of turbidity generation.	Turbidity should be taken as read from sub items 1, 2, 3, 4, 6.
Page 18, sub-item (a), S.5.2.2.	This item should be replaced by the attached sheet App. I for turbidity measurements.	Noted.
Page 18. sub-item (c), S.5.2.2	This item should be replaced by the attached sheet App. II for suspended solids measurements.	Noted.
Page 20, para. 4	All monitoring instruments shall be recalibrated at bi-monthly interval.	Noted.
Waste Management Group		
Page 13, S.5.1.2	Special requirements may be imposed on the mud disposal works if the marine mud is found to be contaminated.	Noted.

TABLE 1 : DUST SUPPRESSION CHEMICALS

A. Type : Bitumens

Product	Manufacturer
AMS 2200, 2300	Arco Mine Sciences
Coherex	Witco Chemical
Docal 1002	Douglas Oil Comapny
Pencprime	Utan Emulsions
Pecro Tac p	Syntech Proudcts Corporation
Resinex	Neyrs Industrie, Inc.
Retain	Dubois Chemical Company

B. Type : Salts

Product	Manufacturer
Calcium chloride	Allied Chemical Corporation
Dowflake, Liquid Dow	Dow Chemical
OP-10	Wen-Don Corporation
Dust Ban 8806	Nalco Chemical Company
Dustgard	G.S.L. Minerals and Chemicals Corporation
Sodium silicate	The PQ Corporation

C. Type : Adhesives

Product	Manufacturer
Acrylic DLR-MS	Ronm and Haas Company
Bio Cat 300-1	Applied Natural Systems, Inc.
CPB-12	Wen-Don Corporation
Curasal AK	American Hoechst Corporation
OCL-40A, 1801, 1803	Caigon Corporation
OC-859, 857	Betz Laboratories, Inc.
Dust Ban	Nalco Chemical Company
Flamoinder	Flambeau Paper Company
Lignosite	Georgia Pacific Corporation
Norlig A, 12	Reed Lignin. Inc.
Orzan Series	Crown Zellerbach Corporation
Soil Gard	Walsh Chemical

Reference	Comments	Consultant's Responses
Volume I - Noise	No comment.	
Volume II		
Air Quality	Some typographical errors have not been amended:	
Table 2, page 5	The daily AQO for the Total Suspended Particulates should be 260 $\mu g/m^3$ instead of 360 $\mu g/m^3$.	Noted.
Page 26, S.5.3.2	The dust emission factor proposed by USEPA AP-42 should be about 3000 kg/ha/month instead of 500 kg/ha/month.	Noted.
Water Quality		
Item 2.1, 2nd para.	Should be : The Victoria Harbour zone is scheduled to be gazetted in 1993	Noted.
	Leachate from public dumping ground in Phase III which would affect the water quality was not addressed in the report.	The Phase III reclamation will be constructed with marine sand and CDG top
Table 5 A	2 lots of 5 consecutive days sampling is not sufficient to provide 'baseline' for the subsequent monitoring works.	Noted, the sampling frequency is revised to 4 sampling per week, at mid-floo mid-ebb, for 4 consecutive weeks within 6 weeks of commencement of work