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Agreement No. CE 45/93

Lantau Port Development - Stage 1

Reclamation for Shipyard at To Kau Wan

North Lantau

FINAL ENVIRONMENTAL IMPACT ASSESSMENT

September 1994

Binnie Consultants Limited
香港賓尼工程顧問有限公司

in association with

Norwegian Geotechnical Institute

Agreement No. CE 45/93
Lantau Port Development - Stage 1
Reclamation for Shipyard at To Kau Wan, North Lantau
Environmental Impact Assessment

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Executive Summary

1. A site for a new shipyard has been chosen within the Lantau Port and Western Harbour Development area. This site lies along the north east shore of Lantau Island, at To Kau Wan.

2. The purpose of the EIA was to address the key environmental issues arising from the reclamation and associated site formation. Sensible and cost-effective mitigation measures have been recommended and where possible these have been incorporated into the design of the works. An environmental monitoring and auditing programme has been formulated to ensure that the potential environmental impacts from the construction of the To Kau Wan reclamation are kept within acceptable limits.

3. Baseline conditions have been established for each potential impact. Lantau is currently experiencing a great deal of construction activity associated with the development of the Chek Lap Kok Airport and the Lantau Port and Harbour Development. Marine water in particular is affected by these construction projects which involve extensive dredging and reclamation activity. The construction of the Toll Plaza on the hill south of To Kau Wan has the most potential for raising background dust levels at the To Kau Wan reclamation site.

4. The marine muds underlying the proposed reclamation site have been examined for the presence of heavy metal contamination. In the first study all measured metals were acceptably low with the exception of mercury for which highly variable analytical results have been recorded both within the same sample and within different samples. The second study showed low mercury levels and Class C cadmium levels in each of the four samples tested. Further sampling and testing is now being considered.

5. The site has been designed to cause as little as possible disturbance to the ecology. The rock wall built for the Western revetments will provide habitat for some forms of marine life. Indeed the rock wall was planned and designed to replace rocky foreshore lost under the reclamation. Randomly placed rock will form a wall with a slope of 1 on 2.5 providing a variety of niches for the inhabitants of the rocky foreshore. The potential loss of fish nursery grounds or fishing area is considered small and possibly negligible. The woodland behind the site will remain largely undisturbed. Ecological field surveys of the surrounding area are described in the EIA report.

6. The small number of nearby residences have been resumed under the PADS projects. The Yiu Lian Dockyards are currently being constructed adjacent to the reclamation site. Staff quarters will be established within this complex but are not considered as a true noise sensitive receiver since the building is situated inside an industrial undertaking. Construction noise levels due to the To Kau Wan project have been calculated. They are only of any concern for occupational health reasons for construction workers at To Kau Wan.

7. The reclamation will be filled hydraulically with marine sand. The site will therefore be wet for much of the construction period. Potential dust generation has been modelled using a worst case scenario approach for the Fugitive Dust Model (FDM). Dust generation will reach a maximum when marine fill stockpiled to speed consolidation on the main site area is shifted shoreward. Provided moisture levels are high enough in this material, very little dust will be generated. It may be necessary however, to dampen the fill material in order to ensure dust levels remain low.

8. In conclusion, the principal environmental impacts arising from the construction of the To Kau Wan reclamation fall into two categories:

1) permanent; and

2) short term.

The construction of the site inevitably leads to the permanent loss of about 8 ha of sea-floor and a small area of North Lantau coastline. Both marine water quality and ambient dust levels will be adversely affected for a very short period of time and within a limited zone. Water quality and air impacts will be carefully monitored during the construction period and event/action plans have been formulated to ensure that these impacts have minimal effect on the surrounding environment.

1. INTRODUCTION

Background to the EIA

1.1 Cheoy Lee Shipyards Limited currently leases land at the head of Penny's Bay on Lantau. This shipyard will be affected under Phase I of the Lantau Port and Western Harbour Development.

1.2 A site for the possible reprovisioning of Cheoy Lee Shipyard has been chosen within the Lantau Port and Western Harbour Development area on the north-west shore of Tsing Chau Tsai peninsula in the vicinity of To Kau Wan as shown in Figure 1.1. This is consistent with a principal recommendation of the Port and Airport Development Strategy that the majority of Hong Kong's future port requirements would accommodate at northeast Lantau and in the Western Harbour of the east coast of Lantau Island.

1.3 The reprovisioning of the Cheoy Lee Shipyard if approved will form a very small part of the Lantau Port and Western Harbour (LAPH) Development. A report has been issued by APH Consultants as Addendum C examining the implications and feasibility of the move as part of a Supplementary Study for LAPH developments[1].

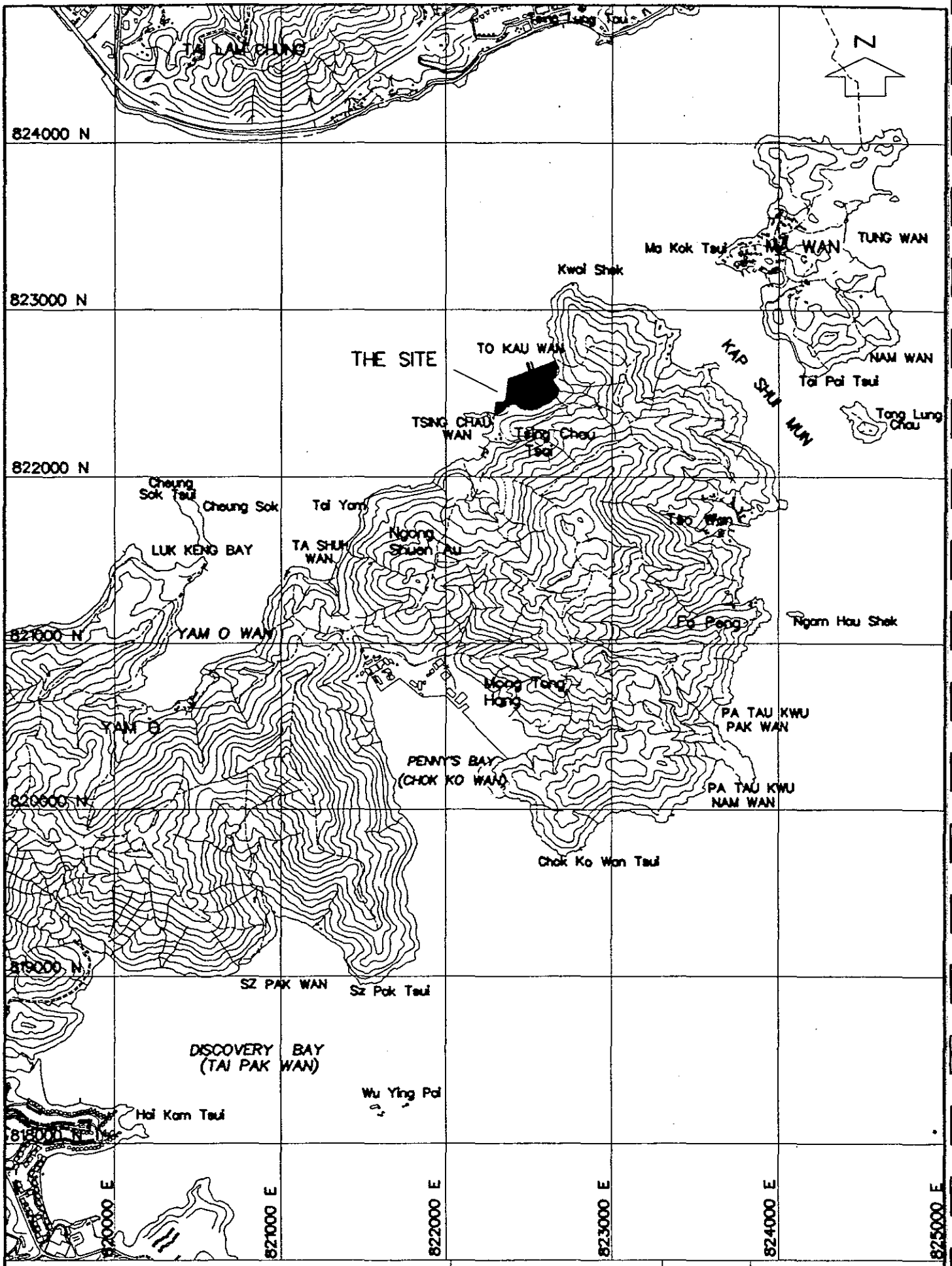
1.4 Design and construction of the new shipyard will be undertaken in two separate stages:

- reclamation and site formation of the 6 ha site; and
- construction of the shipyard facilities.

1.5 An Environmental Impact Assessment will be undertaken separately for the construction of the operational facilities and the operational phase of the shipyard.

Purpose of the EIA

1.6 The purpose of the EIA is to address the key environmental issues arising from the reclamation and associated site formation works and recommend suitable and cost-effective mitigation measures which, where possible, can be incorporated into the overall design of the works. The assessment will also include identification and recommendations for environmental monitoring and audit requirements which will be undertaken throughout the course of the project to ensure environmental impacts are kept within acceptable limits.



TO KAU WAN RECLAMATION EIA

LOCATION OF THE SITE

BAHIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS

土木工程署 Civil Engineering Department

Date	Scale
FEB 94	1 : 30000
Initial	Drawing No
WYC	FIGURE 1.1

Scope of the EIA

1.7 The scope of the EIA includes detailed assessment of the following potential environmental impacts that could arise from the proposed reclamation and site formation works at To Kau Wan:

- Air Pollution;
- Noise Pollution;
- Water Pollution;
- Waste Disposal; and
- Ecological Impact.

For each potential impact, the baseline conditions are established, sensitive receivers identified and the magnitude and significance of potential impacts assessed. Appropriate and cost-effective mitigation measures to reduce the potential impacts identified are recommended. This is followed by detailed recommendations for a monitoring and audit programme for use during construction to ensure compliance with current environmental legislation.

Overview of Concurrent Development

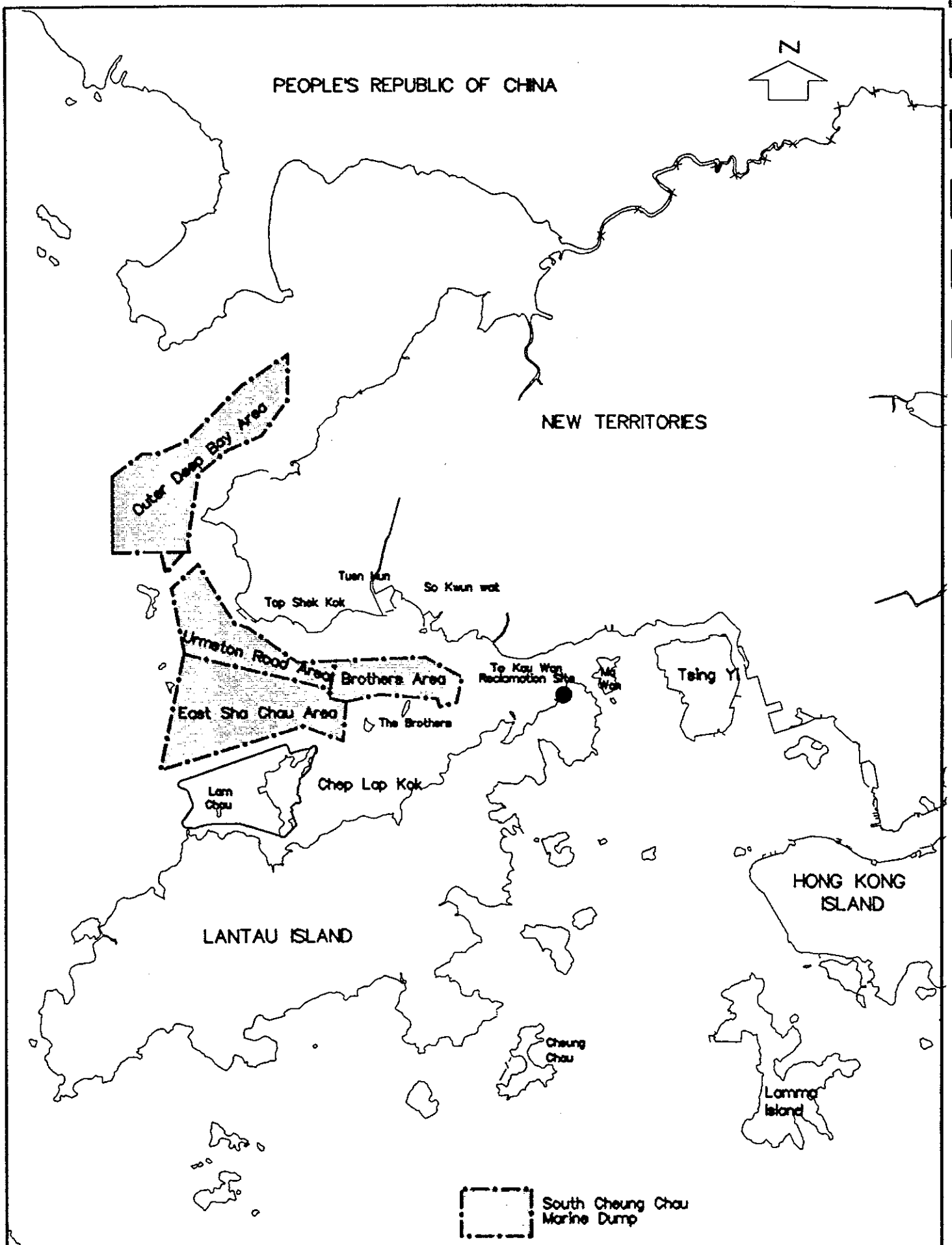
1.8 Lantau is currently experiencing a great deal of construction activity associated with the development of the Chek Lap Kok Airport and the Lantau Port and Harbour Development. A number of the contracts could affect the background environmental conditions at To Kau Wan, particularly water quality.

1.9 The Chek Lap Kok Airport site is over 1,000 hectares in area, ¾ of which will be reclaimed land[2]. Dredging for marine fill has taken place at a number of marine borrow areas and these are illustrated on Figure 1.2. Dredging for marine fill has taken place extensively in the *Brothers Marine Borrow Area*, as close as 4 km west of To Kau Wan.

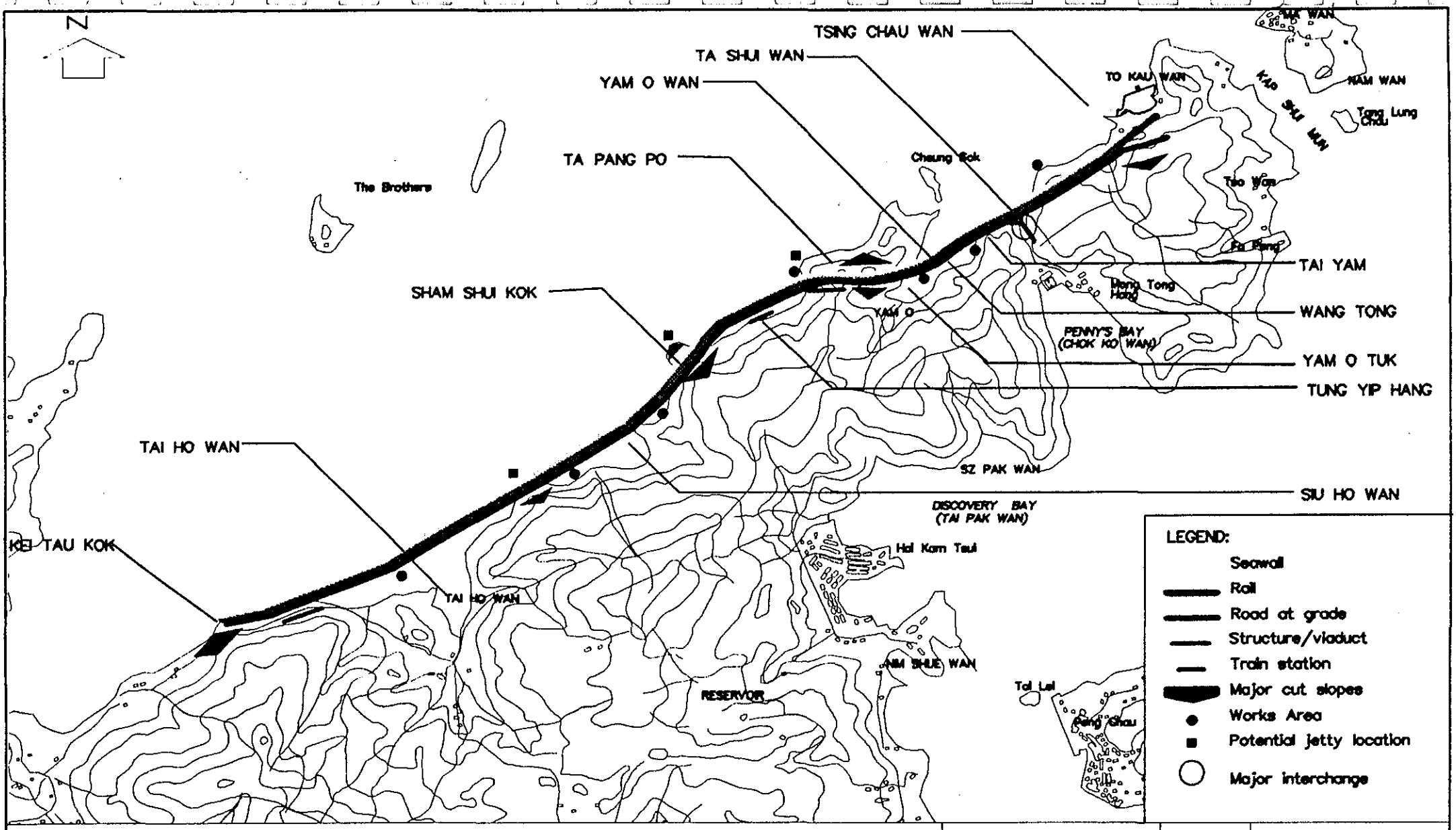
1.10 The road and rail access to the Airport is currently under construction along the northern coast of Lantau. The major length of road is known as the North Lantau Expressway. This together with the Airport Railway are commonly known as the NLE. The NLE is divided into three sections:

- Chek Lap Kok and Tung Chung to Kei Tau Kok (Tung Chung Section);
- Kei Tau Kok to Sham Shui Kok (Tai Ho Section); and
- Sham Shui Kok to Tsing Chau (Yam O Section).

The Airport Railway runs to the north of the Expressway and a service road will be constructed to the south. The major features of the Yam O and Tai Ho sections of the project are shown on Figure 1.3.



TO KAU WAN RECLAMATION EIA	BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 200000
BORROW AREAS FOR CHEK LAP KOK AIRPORT	土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 1.2



TO KAU WAN RECLAMATION EIA

MAJOR FEATURES OF YAM O AND TAI HO SECTIONS OF NLE

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼		Date FEB 94	Scale 1 : 50000
土木工程署 Civil Engineering Department		Initial WYC	Drawing No FIGURE 1.3

1.11 For the Yam O Section of the NLE approximately:

- 2 million m^3 of marine mud is being removed;
- 6 million m^3 of backfill is required for reclamation;
- 3.5 million m^3 of which is being excavated from Yam O Tuk;

  the 2.5 million m^3 remainder will probably be marine sand; and
- about 250,000 m^3 of armour rock will be placed.

There will be major culverts, bridges and viaducts constructed as part of the construction activities[3].

1.12 The construction of the Tai Ho section of the NLE should have little effect on the To Kau Wan area. However, the Tai Ho contracts include the *North of Lantau Borrow Area*. Very recently the western side of this Borrow Area has been ceded for the construction of submarine connections of essential utilities. Dredging for marine fill will continue on the eastern side as close as 800 metres to To Kau Wan until the middle of 1994.

1.13 The NLE abuts the Lantau Fixed Crossing (LFC). The *Toll Plaza* is being constructed under the LFC contracts. This stretch of road and rail is only about 1 km long and feeds the Kap Shui Mun Bridge between Lantau and the eastern edge of Ma Wan. The Ma Wan Viaducts crosses Ma Wan and the Tsing Ma Bridge spans the Ma Wan Channel to Tsing Yi. The Toll Plaza lies just south of To Kau Wan on the first ridge above the bay.

1.14 Contract 514 of the Lantau and Airport Railway Project will comprise the East Lantau tunnels linking the Lantau Fixed Crossing to the Lantau Viaducts. Twin concrete lined tunnels with a horseshoe-shaped bore of 5.2 m internal diameter will run approximately 900 m under the Toll Plaza. The tunnels will be driven through rock by drill and blast methods from the western portal for 24 hours per day, six days per week. There will be up to six explosions per day. The total spoil removed will be about 65,000 m^3. The main construction activities will also include mucking out and provision of shotcrete and concrete (in-situ) tunnel linings. The construction of the East Lantau tunnels and the Toll Plaza, because of their close proximity, will have most direct effect on the To Kau Wan area.

1.15 The *Toll Plaza* contracts commenced in November 1993 and will continue for 66 weeks. They involve approximately:

- 1,600,000 m^3 of earth and rock excavation;

- reclamation at Tsing Chau Wan to 5.5 mPD using 410,000 m^3 of fill material and 250 m of seawall; and
- 1,050,000 m^3 of embankment construction[4].

Dredging was completed at Tsing Chau Wan by early March 1994. The extent of the area to be reclaimed under this project and it's relation to To Kau Wan are shown on Figure 1.4.

1.16 The *Yiu Lian Dockyard reclamation and building* is currently under construction. As from March 1994 as many as 76 people may be working at the shipyard. There will be Staff Quarters as part of this complex. The main working hours will be 8 a.m. to 7 p.m. with occasional overtime continuing no later than 11 p.m. The Yiu Lian Shipyard consists of an area of reclaimed land with several (4 in May 1994) floating docks. Their location is shown on Figure 1.5. Some activity has already begun at the floating docks.

1.17 The site foundation at To Kau Wan can potentially impact on the Yiu Lian Shipyards in the three main ways:

- noise;
- dust affecting painting activities; and
- overlapping use of navigation channels.

1.18 The coastal area north of the airport links as far west as the Yam O Interchange has been zoned for other specified uses:

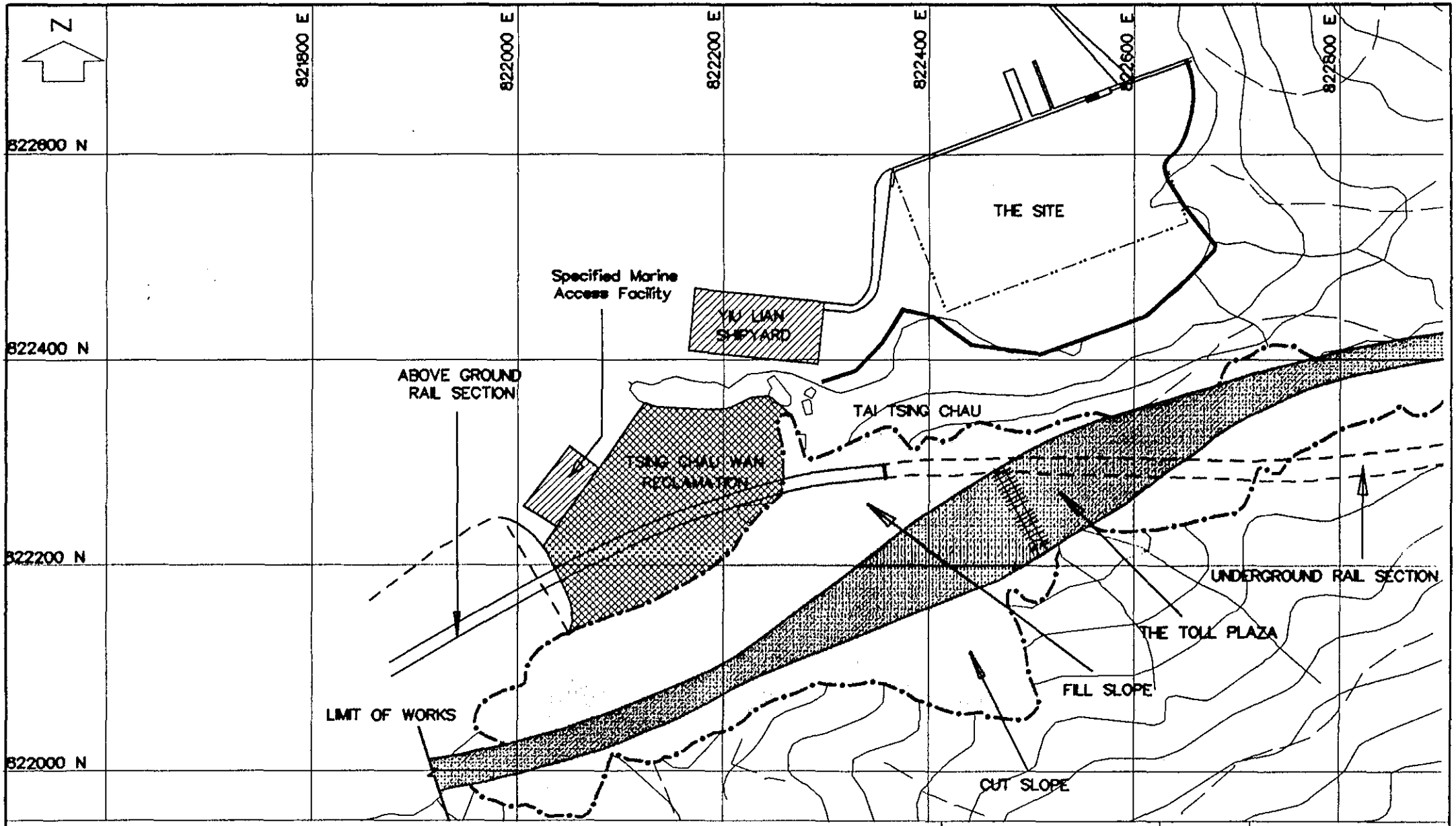
- boatyard, marine oriented industrial uses and marine services support area; and
- river trade cargo terminal and back-up area as part of the North-East Lantau Port - Outline Zoning Plan.

Much of this area will be reclaimed.

Environmental Legislation and Guidelines

Noise

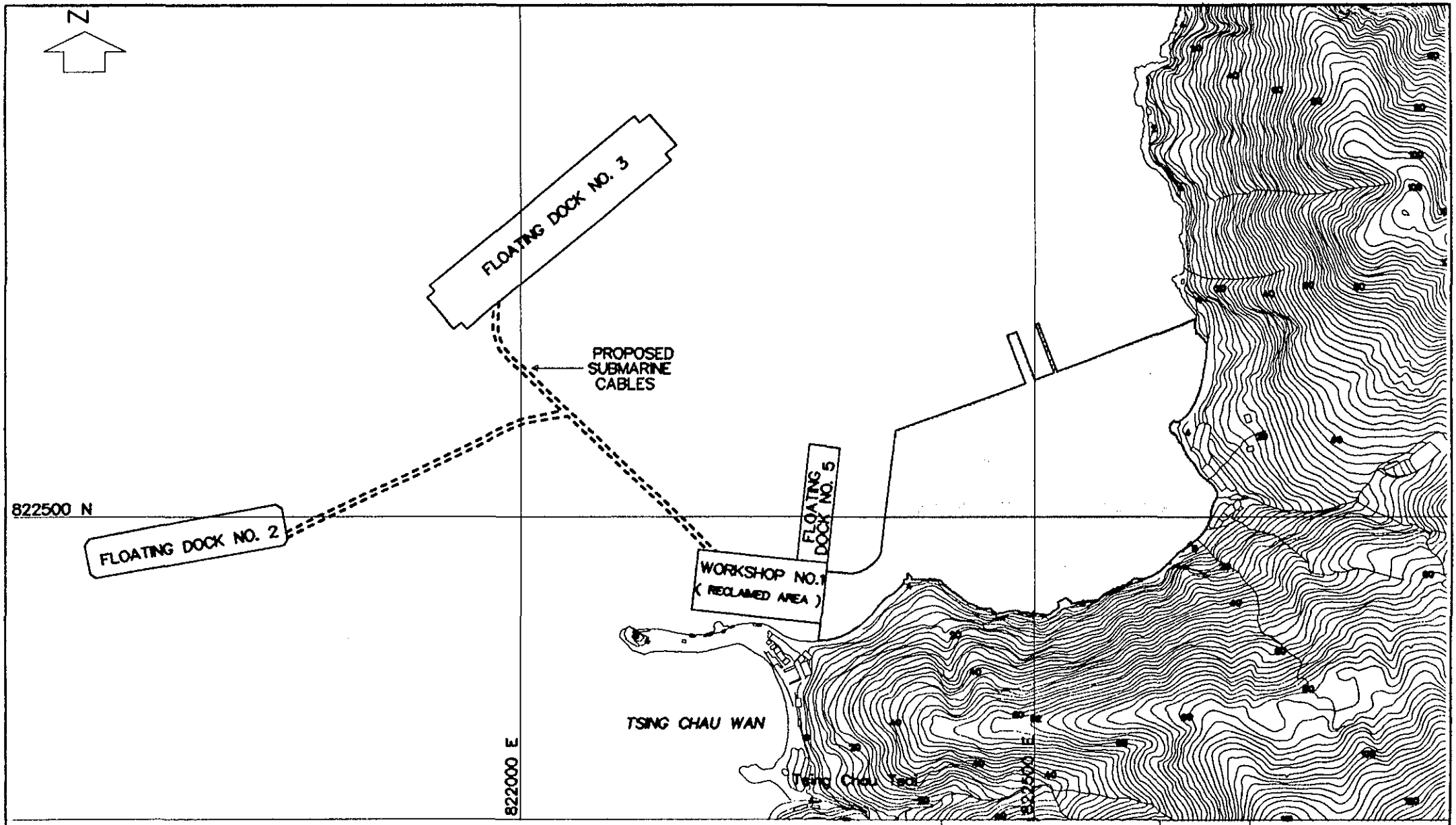
1.19 The Noise Control Ordinance (Cap. 400), NCO, was gazetted in 1988 and specific sections relating to percussive piling and general construction work were implemented in 1989. Ordinance No. 2 of 1994 will amend the NCO and provides for larger penalties for offenses under the Ordinance.



TO KAU WAN RECLAMATION EIA

THE TOLL PLAZA WORKS

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 5000
土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 1.4



TO KAU WAN RECLAMATION EIA

YIU LIAN DOCKYARDS

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 5000
土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 1.5

1.20 Percussive piling can only be carried out from 7 a.m. to 7 p.m. and provided a relevant construction noise permit is in force. Percussive piling is not permitted at any time on Sundays and general holidays.

1.21 General construction work using powered mechanical equipment is restricted between the hours of 7 p.m. and 7 a.m. and on Sundays and general holidays.

1.22 The standards and limits for noise emanating from construction sites are set out in Technical Memoranda issued by the Secretary from time to time. The current standards are shown below.

Table 1.1 Area Sensitivity Ratings (ASRs)

Type of Area Containing NSR / Degree to which NSR is affected by IF	Not Affected	Indirectly Affected	Directly Affected
(i) Rural area, including country parks or village type developments	A	B	B
(ii) Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
(iii) Urban Area	B	C	C
(iv) Area other than those above	B	B	C

Source : Technical Memorandum on Noise from Construction Work other than Percussive Piling

Table 1.2 Basic Noise Levels (BNLs) for Construction Noise from Activities other than Percussive Piling in dB(A)

Time Period / ASR	A	B	C
All days during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the day-time and evening (0700 to 2300 hours)	60	65	70
All days during the night-time (2300 to 0700 hours)	45	50	55

Source : Technical Memorandum on Noise for Construction Work other than Percussive Piling

Table 1.3 Acceptable Noise Levels for Percussive Piling

NSR Window Type or Means of Ventilation	Acceptable Noise Level (dB(A))
(i) NSR (or part of NSR) with no windows or other openings	100
(ii) NSR with central air conditioning system	90
(iii) NSR with windows or other openings but without central air conditioning system	85

Source : Technical Memorandum on Noise from Percussive Piling

Air

1.23 The main purpose of the Air Pollution Control Ordinance, APCD, (Cap. 311) is to control the emission of air pollutants (i.e. any solid, particulate, liquid, vapour or gaseous substance emitted into the atmosphere) into the atmosphere of Hong Kong from stationary and mobile sources.

1.24 In subsidiary legislation of Cap. 311, seven widespread pollutant parameters have been identified and limits specified in Hong Kong Air Quality Objectives (AQO).

1.25 The air quality parameters of particular concern in this report are total and respirable suspended particulates otherwise known as dust and respirable dust respectively.

1.26 The AQO specifies that the acceptable dust level as Total Suspended Particulates (TSP) (24 hour average) in the ambient air should be less than 260 $\mu g/m^3$ which is measured at 298 k (25°C) and 101.325 kPA (one atmosphere). This standard should not be exceeded more than once per year. TSP levels averaged over a year should not exceed 80 $\mu g/m^3$.

1.27 Respirable Suspended Particulates (RSP) are defined as particulates of size less than or equal to 10 μm in diameter. The AQO for RSP concentrations averaged over a 24 hour period is 180 $\mu g/m^3$. Over a year, RSP levels should not exceed 55 $\mu g/m^3$.

1.28 It is usually recommended by EPD that dust levels be kept under 500 $\mu g/m^3$ over any one hour period. This standard does not form part of the AQO.

1.29 *The Air Pollution Control (Amendment) Ordinance 1993* has recently been enacted. Under this amendment the Secretary may issue a technical memorandum (TM) setting out:

principles, procedures, guidelines, standards and limits for:

(a) the prediction, measurement, assessment or determination of air pollution caused, or contributed to, by the operation of a polluting process;

(b) the issue of air pollution abatement notices for such pollution; and

(c) the determination of whether or not an air pollution abatement notice is being complied with. (Reg. Air Pollution Control (Amendment) Ordinance 1993).

A TM including mathematical methods to determine the ambient impacts of air pollutants has just been gazetted (January 1994) and deals with stationary sources.

Water Quality

1.30 The Water Pollution Control Ordinance 1980 (WPCO) (Cap. 358) is the principal legislation governing water quality of marine waters in Hong Kong. Under Sections 4 and 5 of the Ordinance Water Control Zones (WCZs) may be declared and Water Quality Objectives (WQOs) established for each zone or a subzone such as a Fish Culture Subzone.

1.31 The site for the To Kau Wan Reclamation lies just within the North Western Water Control Zone (NWWZ) close to the Western Buffer Control Zone. The implementation of the WPCO in NWWZ was declared on 25th February 1992. The NWWZ had been identified as having eight beneficial uses:

- A source of food for human consumption;
- A resource for commercial exploitation;
- A habitat for marine life generally;
- Primary contact recreation - bathing;
- Secondary contact recreation - diving, sailing, windsurfing etc.;
- Domestic and industrial supply;
- Navigation and shipping;
- Aesthetic enjoyment.

1.32 The WQOs for the NWWZ are shown in Table 1.4 below. Table 1.4 also gives the WQO for the Western Buffer Zone relating to dissolved oxygen in Fish Culture Subzones.

1.33 Construction activities at To Kau Wan are included within the definition of Civil Engineering Works (including all building works and reclamation) and are therefore classified as potentially polluting uses by the Hong Kong Planning Standards and Guidelines (HKPSG). As such it is recommended that:

> "care should be taken in planning and implementation of works to avoid, minimise or ameliorate the occurrence of these adverse effects on water bodies, especially those in ..... areas used for commercial fisheries."

1.34 The relevant WQOs for the NWWZ have been taken into consideration when assessing construction impacts and the requirement for mitigation measures. However, whilst it is an offence under Section 8 of the WPCO to discharge polluting matter into a WCZ, discharges made under a Crown lease granted under the Foreshores and Sea Bed Ordinance (Cap. 127) are excluded. Therefore, the WQOs do not technically apply in the case of dredging and reclamation works.

Table 1.4 Statement of Water Quality Objectives (North Western Water Control Zones) - L.N. 39 of 1992 (Cap. 308)

Water Quality Objectives			Part or Parts of Zone
A.	**AESTHETIC APPEARANCE**		
	(a)	Waste discharge shall cause no objectionable odours or discolouration of water.	Whole zone
	(b)	Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c)	Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d)	There should be no recognisable sewage-derived debris.	Whole zone
	(e)	Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f)	Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
B.	**BACTERIA**		
	(a)	The level of *Escherichia coli* should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in a calender year.	Secondary Contact Recreation Subzones
	(b)	The level of *Escherichia coli* should be less than 1 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones

Table 1.4 Statement of Water Quality Objectives (North Western Water Control Zones) - L.N. 39 of 1992 (Cap. 308) (cont'd)

	Water Quality Objectives	Part or Parts of Zone
(c)	The level of *Escherichia coli* should not exceed 1,000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (C) Subzone and other inland waters
(d)	The level of *Escherichia coli* should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive. Samples should be taken at least 3 times in one calender month at intervals of between 3 and 14 days.	Bathing Beach Subzones
C.	**COLOUR**	
(a)	Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
(b)	Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Tuen Mun (C) Subzone and other inland waters
D.	**DISSOLVED OXYGEN**	
(a)	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters
(b)	The level of dissolved oxygen should not be less than 5 mg per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Fish Culture Subzones within the Western Buffer Zone
(c)	Waste discharges shall not cause the level of dissolved oxygen to be less than 4 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones, Water Gathering Ground Subzones and other inland waters
E.	**pH**	
(a)	The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 unit.	Marine water excepting Bathing Beach Subzones
(b)	Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(c)	The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters
(d)	The pH of the water should be within the range of 6.0-9.0 units for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 unit.	Bathing Beach Subzones

Table 1.4 Statement of Water Quality Objectives (North Western Water Control Zones) - L.N. 39 of 1992 (Cap. 308) (cont'd)

Water Quality Objectives	Part or Parts of Zone
F. **TEMPERATURE**	
Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole Zone
G. **SALINITY**	
Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. **SUSPENDED SOLIDS**	
(a) Waste discharges shall neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
(b) Waste discharges shall not cause the annual median of suspended solids to exceed 20 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(c) Waste discharges shall not cause the annual median of suspended solids to exceed 25 mg per litre.	Other inland waters
I. **AMMONIA**	
The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J. **NUTRIENTS**	
(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurement at 1 m below surface, mid-depth and 1 m above seabed).	Castle Peak Bay Subzone
(c) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters excepting Castle Peak Bay Subzone
K. **5-DAY BIOCHEMICAL OXYGEN DEMAND**	
(a) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(b) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 mg per litre.	Other inland waters
L. **CHEMICAL OXYGEN DEMAND**	
(a) Waste discharges shall not cause the chemical oxygen demand to exceed 15 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(b) Waste discharges shall not cause the chemical oxygen demand to exceed 30 mg per litre.	Other inland waters

Table 1.4 Statement of Water Quality Objectives (North Western Water Control Zones) - L.N. 39 of 1992 (Cap. 308) (cont'd)

	Water Quality Objectives	Part or Parts of Zone
M.	**TOXINS**	
	(a) Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
	(b) Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.	Whole zone
N.	**PHENOL**	
	Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 mg per litre as C_6H_5OH.	Bathing Beach Subzones
O.	**TURBIDITY**	
	Waste discharges shall not reduce light transmission substantially from the normal level.	Bathing Beach Subzones

Ecology

1.35 Legislation on ecology in Hong Kong provides protection of various types to both species and areas.

1.36 The Forests and Countryside Ordinance (Cap. 96) gives general protection to vegetation on all Crown Land, while "Country Parks" and "Special Areas" (which may be inside or outside Country Parks) receive additional protection under the Country Parks Ordinance (Cap. 208). The Wild Animals Protection Ordinance (Cap. 170) provides for the designation of "Restricted Areas" to which access is limited (e.g. Mai Po Marshes). This ordinance also provides for the protection of most mammals, (except wild pigs, the Small Indian Mongoose, rats and shrews), selected reptiles, the Birdwing Butterfly, all wild birds, their nests and eggs in Hong Kong, and prohibits hunting and the possession of hunting appliances. The destruction of animals during land formation works requires a Special Permit issued under Section 15 of the Ordinance. The Director of Agriculture and Fisheries is the Authority under this legislation.

The revised Town Planning Ordinance (Cap. 131) provides for the designation of "coastal protection areas, Sites of Special Scientific Interests (SSSIs), green belts or other specified uses that promote conservation or protection of the environment". About 50 SSSIs have been designated and Government Departments are required to consult the Agriculture and Fisheries Department when considering a proposal that may affect an SSSI.

The Forestry Regulations (Cap. 96, section 3) prohibit sale and possession of a number of named plant species, including all native orchids, camellias and rhododendrons. The Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187) prohibits the possession of one additional plant species, *Nepenthes mirabilis*; and also provides for protection of threatened and endangered birds. Import, export and possession of listed species are controlled through a licence system administered by the Director of Agriculture and Fisheries. This legislation enables Hong Kong to meet its obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora - the "Washington" Convention.

Hong Kong is also party to two international conventions which relate directly to conservation of wildlife and wildlife habitat:

(a) The Convention on Wetlands of International Importance Especially as Waterfowl Habitat - the "Ramsar" Convention.

(b) The Convention on the Conservation of Migratory Species of Wild Animals - the "Bonn" Convention.

The "Ramsar" Convention requires parties to promote wetland conservation and their "wise use". The definition of wetland includes "areas of marine water the depth of which at low tide does not exceed six metres", thus a considerable part of the To Kau Wan reclamation falls within this definition.

The "Bonn" Convention aims to protect migratory species, including the safeguarding of habitats used by such species. For species which are considered to be both "migratory" and "endangered" the Convention requires parties to make special efforts to counteract factors that are dangerous or potentially dangerous to those species.

General ecological legislation which applies to marine species includes the Wild Animals Protection Ordinance which protects all cetaceans, and the Animals and Plants (Protection of Endangered Species) Ordinance which provides for protection of threatened and endangered species, and for Hong Kong would include all whales, dolphins and sea turtles.

1.37 In addition, legislation specific to marine ecology includes the The Fisheries Protection Ordinance 1987 (Cap. 171) which is designed to promote the conservation of fish and aquatic life and regulates fishing practices. The Marine Fish Culture Ordnance 1983 (Cap. 353) regulates and protects marine fish culture zones designated under the ordinance. Under this legislation it is an offence to deposit any substance which pollutes or is likely to cause pollution of a fish culture zone.

Waste

1.38 The principal legislation governing the management of waste materials in Hong Kong is the Waste Disposal Ordinance (WDO) (Cap. 354) which was enacted in 1980. This ordinance generally encompasses all stages of waste management. The WDO Waste Disposal (Chemical Waste) (General) Regulations (L.N. 20 of 1992) specifically addresses the storage, collection, treatment, transport and disposal of chemical wastes.

1.39 The Building Ordinance (Cap. 123), administered by the Director of Buildings, contains regulations pertaining to the design, construction and management of oil installations and mandates that all industrial wastewaters are discharged to foul sewers or wastewater treatment plants.

1.40 In more general terms, the *Hong Kong Planning Standards and Guidelines (HKPSG)* provide guidance for proper waste disposal associated with the planning and design of public and private projects.

1.41 Finally, fuel or oil spills on the coastal waters surrounding Hong Kong are currently regulated by the Marine Department under the Oil Pollution Ordinance (Cap. 247). The Fire Services Department is primarily responsible for handling chemical spills on land and is also involved in the design of fuel storage facilities.

2. THE PROPOSED WORKS

2.1 At the time of writing, designs for the reclamation at To Kau Wan have not been finalised. A number of options have already been examined. Environmental considerations have played a major part in the decision-making process. The most important of these have related to minimising potential impacts on:

- marine water quality;
- the local ecology;
- dust levels;
- the waste generated;
- noise generation; and
- marine navigation.

Much work and discussion has centred around the maximum in situ retention of marine muds and clays, the nature of filling materials and the method of placing of these filling materials. The size of the reclamation has been optimised to ensure maximum retention of the natural coastline and protection of the marine water quality. Where functional, open stone revetments have been considered for replacement habitat for coastal organisms.

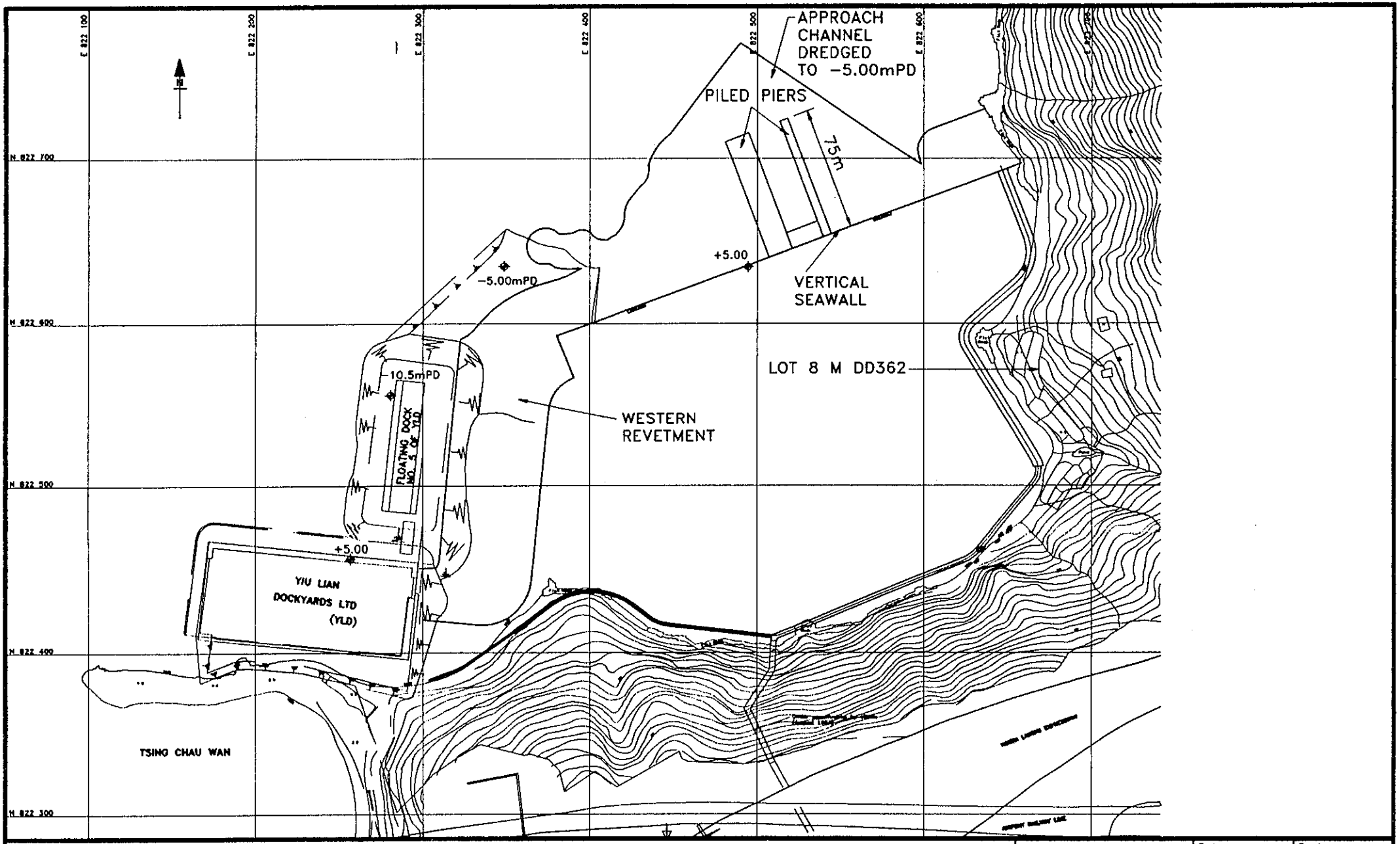
Layout

2.2 The layout for each of the remaining options is the same. This is shown in Figure 2.1. This reduces the area suggested in the LAPH Final Report[1] for reclamation. A rectangular area 250 m x 150 m (37,500 m^2) was identified as necessary for the main site area of the shipyard. The line of the 250 m vertical seawall remains as originally proposed in the LAPH Final Report but the arrangements at the western end of the wall have been modified as shown. There is one set of steps recessed into the seawall together with two piled piers intended to be used to support a travelling crane. The top of the seawall has been set at +5.00 mPD identical to that of the Yiu Lian Dockyard reclamation.

2.3 The Western Revetment has been set at 6.00 mPD including a wave wall. During discussions with representatives of the owner of Yiu Lian Dockyard it became clear that for safety reasons connected with the operation of their floating dock the Western Revetment should be set further east as shown.

2.4 Open rubble used for the construction of the Western Revetment will provide additional 'habitat' for some forms of marine life.

2.5 A marine approach channel will be dredged to -5.00 mPD.



TO KAU WAN RECLAMATION EIA

SITE LAYOUT AND DRAINAGE PLAN

	Date	Scale
寧尼工程顧問有限公司 寧尼	SEP.94	1:300
土木工程署 Civil Engineering Department	Initial YPS	Figure No. 2.1

2.6 The proposed reclamation covers a marine area of about 96,000 m² and a surface area of 65,000 m². It is most likely that the reclamation will be formed by hydraulically placing marine sand.

The Main Options

2.7 These options relate to main seawall design and stem from the desire to minimise dredging requirements and the removal of mud and clays. The final decision has yet to be made and will depend on geotechnical considerations, time constraints for the project and economics. During the feasibility study for this Project[1] it was assumed that a concrete block sea wall would be constructed but this recommendation was based upon the expectation that marine clay would be shallow, in the order of 2 m deep. Subsequent site investigation, which at the time of writing is still not complete, has however indicated that considerable variation can be expected in the depth of marine clay. Along the line of the seawall the depth can be expected to vary between zero and 12 m.

2.8 In the Review Phase of this Project several alternative forms of seawall construction have been identified and evaluated. These can be grouped into two categories, one which require marine clays to be dredged and the other which does not.

2.9 Solutions which depend upon the removal of marine clay are:-

(i) conventional precast concrete block wall as shown in Figure 2.2 built on a prepared sand/rock fill bed; and

(ii) concrete or steel caissons sunk onto a prepared sand/rock fill bed.

2.10 Solutions which do not depend upon the removal of marine clay are;-

(i) deep cement mixing in the marine clay which can subsequently support concrete blocks or a caisson wall;

(ii) interlocked steel pipe piles as shown in Figure 2.3;

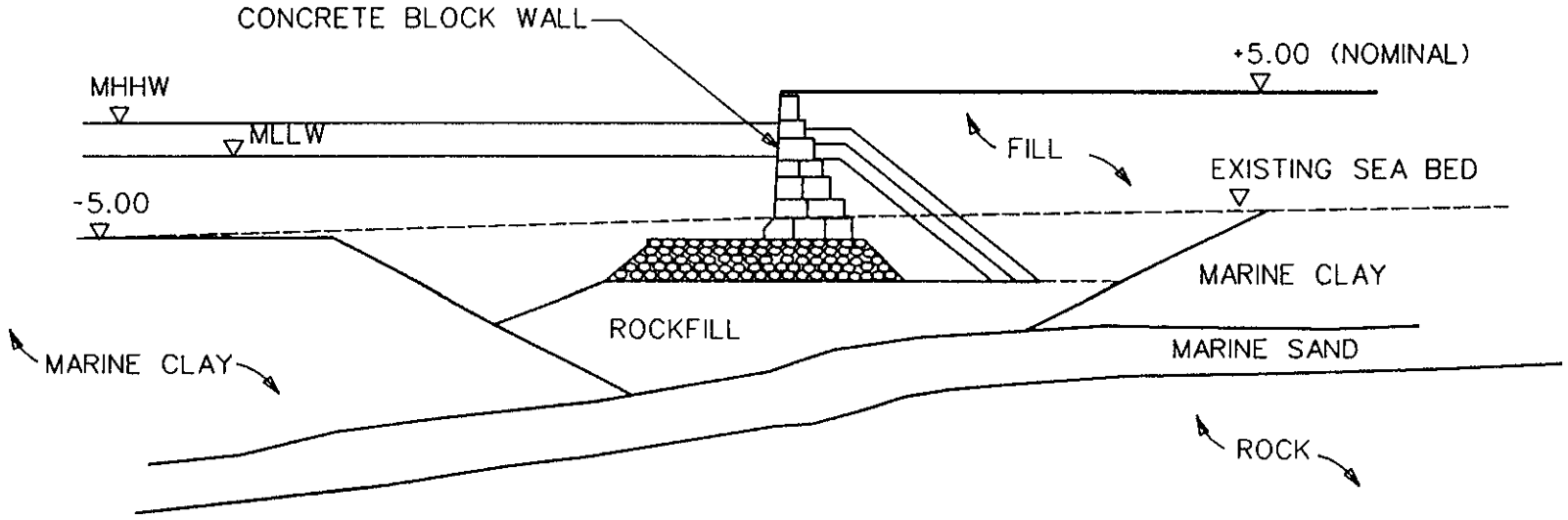
(iii) cellular cofferdams as shown in Figure 2.4;

(iv) straight web sheet piles supported by H section steel panels as shown in Figure 2.5; and

(v) a traditional steel sheet pile wall with horizontal anchors at the top. Initial analysis of the loads involved with marine clay up to 12 m deep has however shown that this is not a viable option and it will not be considered further.

NOTES:

1. MARINE CLAY DREDGED BELOW WALL
2. FACE OF SEAWALL AT 20:1 SLOPE
3. THE MARINE CLAY THICKNESS SHOWN BEHIND THE WALL IS PRIOR TO CONSOLIDATION. IN PLACES THE CLAY WILL BE THICKER THAN THAT SHOWN ON THIS TYPICAL SECTION



SECTION

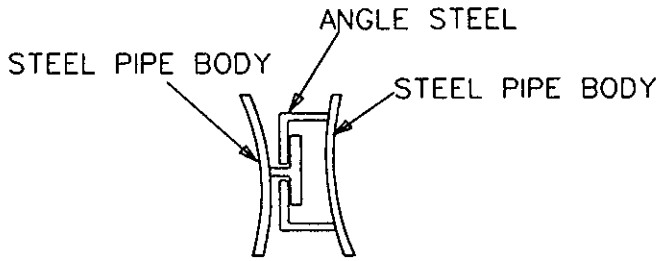
TO KAU WAN RECLAMATION EIA

CONCEPTUAL CROSS SECTION OF VERTICAL SEAWALL
CONSTRUCTED USING CONCRETE BLOCKS
CONVENTIONAL OPTION

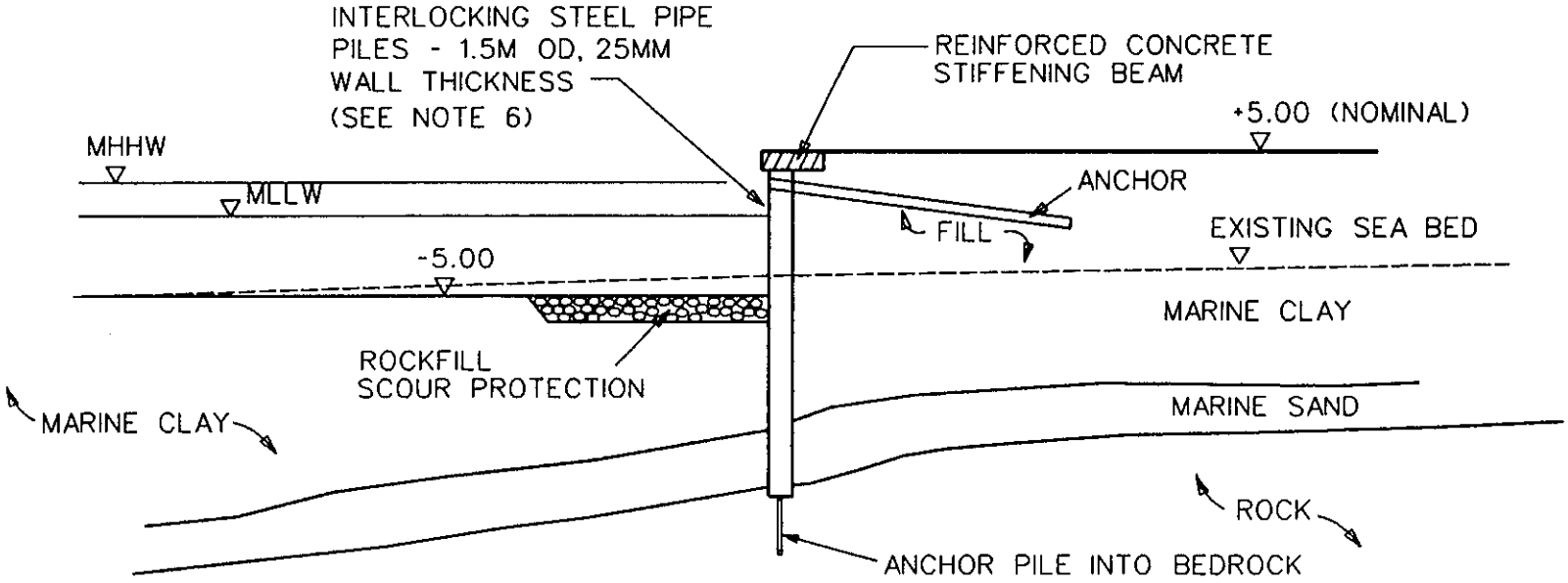
BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date 2/94	Scale 1 : 500
土木工程署 Civil Engineering Department	Initial DCA	Figure No. 2.2

NOTES:

1. NO MARINE CLAY DREDGED FOR WALL
2. THE ANCHOR FORCE ≏ 700 kN/M.
3. THE SHEAR FORCE AT THE PILE TIP IS ≏ 1400 kN/M.
4. THE MARINE CLAY THICKNESS SHOWN BEHIND THE WALL IS PRIOR TO CONSOLIDATION. IN PLACES THE MARINE CLAY IS THICKER THAN THAT SHOWN ON THIS TYPICAL SECTION
5. IF NECESSARY THE PIPE PILES CAN BE FILLED WITH REINFORCED CONCRETE
6. THE WALL THICKNESS GIVEN DOES NOT ALLOW FOR CORROSION.



TYPICAL INTERLOCKING DETAIL



SECTION

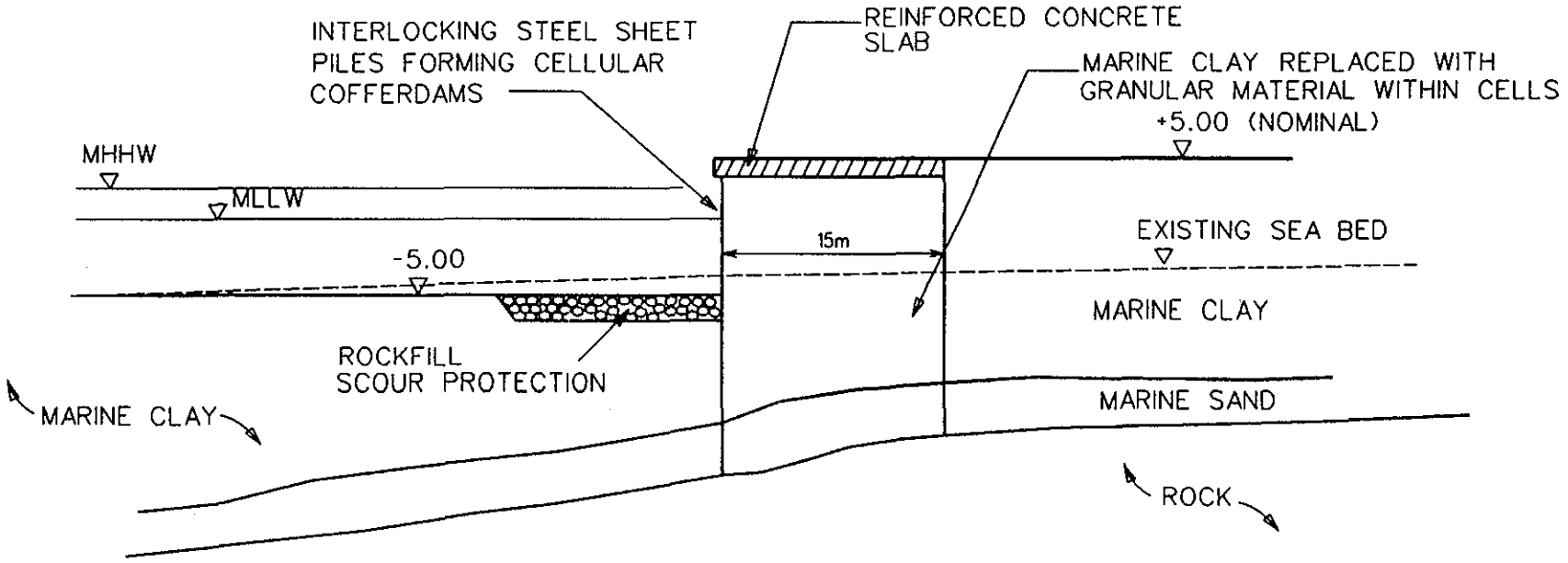
TO KAU WAN RECLAMATION EIA

CONCEPTUAL CROSS SECTION OF VERTICAL SEAWALL CONSTRUCTED WITH INTERLOCKING STEEL PIPE PILES

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date 2/94	Scale 1 : 500
土木工程署 Civil Engineering Department	Initial NGI	Figure No. 2.3

NOTES:

1. NO MARINE CLAY DREDGED FOR WALL
2. THE MARINE CLAY THICKNESS SHOWN BEHIND THE WALL IS PRIOR TO CONSOLIDATION. IN PLACES THE MARINE CLAY IS THICKER THAN THAT SHOWN ON THIS TYPICAL SECTION
3. STEEL SECTIONS MUST ALLOW FOR CORROSION



SECTION

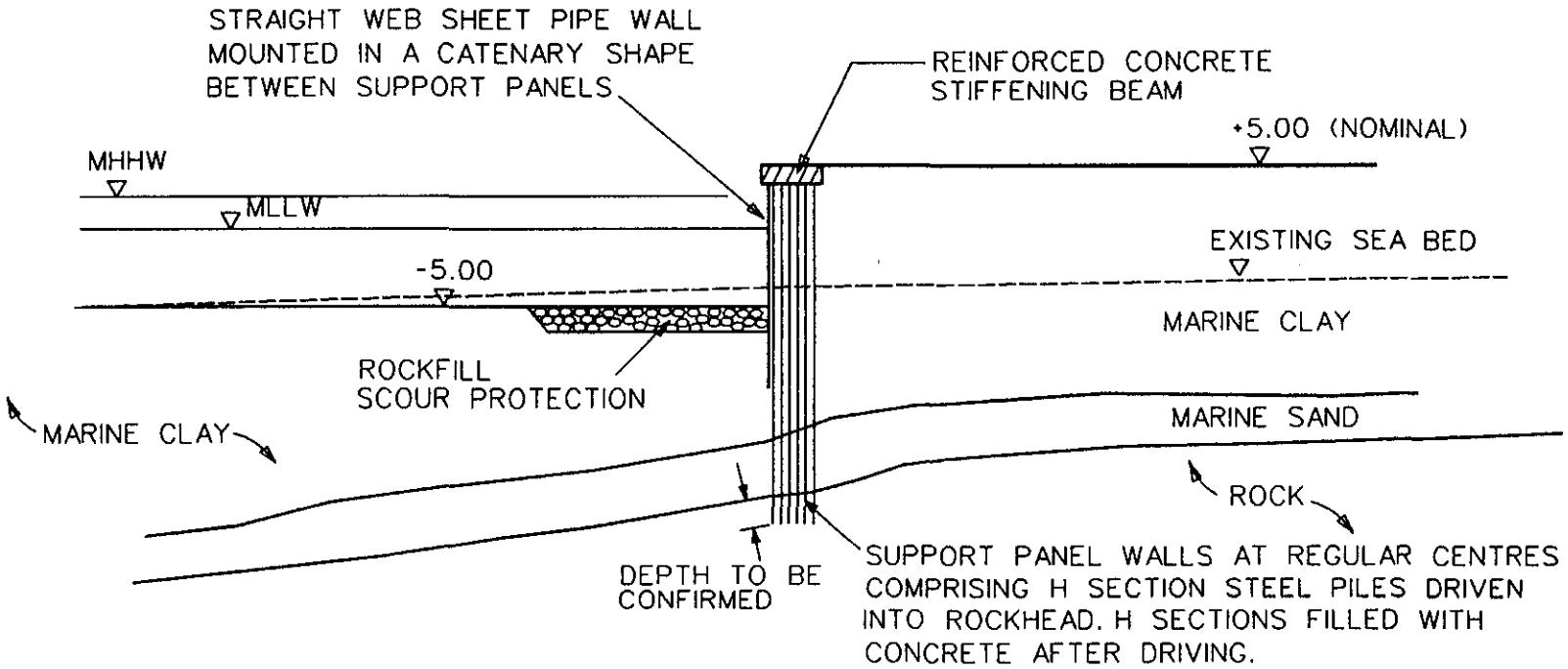
TO KAU WAN RECLAMATION EIA

CONCEPTUAL CROSS SECTION OF VERTICAL SEAWALL CONSTRUCTED AS CELLULAR STEEL PILE COFFERDAMS

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date 2/94	Scale 1 : 500
土木工程署 Civil Engineering Department	Initial NGI	Figure No. 2.4

NOTES:

1. NO MARINE CLAY DREDGED FOR WALL
2. THE MARINE CLAY THICKNESS SHOWN BEHIND THE WALL IS PRIOR TO CONSOLIDATION. IN PLACES THE CLAY WILL BE THICKER THAN THAT SHOWN ON THIS TYPICAL SECTION.
3. ALL STEEL SECTIONS MUST ALLOW FOR CORROISION .



SECTION

TO KAU WAN RECLAMATION EIA

CONCEPTUAL CROSS SECTION OF VERTICAL SEAWALL CONSTRUCTED WITH STRAIGHT WEB SHEET PILES SUPPORTED BY H SECTION STEEL PILE PANELS

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date 2/94	Scale 1 : 500
土木工程署 Civil Engineering Department	Initial NGI	Figure No. 2.5

2.11 The concrete block wall is a conventional design in Hong Kong. Its disadvantage is the necessity to remove marine muds below the wall to achieve stability and minimise settlement. For this project the volume of mud involved is small, certainly less than 0.2 Mm^3.

2.12 The second option of concrete or steel caissons sunk onto a prepared bed has no economic or environmental advantages. This option has now been rejected.

2.13 Deep cement mixing is a technique described fully by Norwegian Geotechnical Institute in their report for Government[5]. Although the technique has many positive attributes it is not considered to be appropriate for this Project for the following reasons:

- The method is not frequently used and not many contractors have the necessary equipment in Hong Kong. The method would only be economically viable for a project involving a seawall which was ≥ 1 km long;
- Tests to determine the strength of cement mixed with mud would be required to substantiate design criteria. These tests have not previously been carried out in Hong Kong and would take too long to organise, carry out and assess; and
- A preliminary assessment of the time for construction has shown that it would take longer than for a conventional wall and it would jeopardize the Project programme.

2.14 Interlocking steel pipe piles driven to form a wall as shown on Figure 2.3 do not require preparatory dredging. There are however two main difficulties that would be expensive to resolve. The sheer force at the toe of the wall is very high and if it was necessary for the piles to be toed into bedrock then there would be significant cost implications. The second problem concerns the design and installation of the lateral anchor. This anchor cannot be installed until consolidation of the marine clay has taken place because settlement in deep clay is expected to be in the order of 3 m. This problem has significant programme implications and bearing in mind the fact that the construction programme has already been accelerated this does not seem to be a feasible solution.

2.15 The option illustrated in Figure 2.4 comprises interlocking steel sheet piles in a cellular pattern to form a continuous wall. Marine clay within the cellular wall would be excavated and replaced with granular material. In order to achieve a stable structure it is estimated that the cells should be about 15 m wide. Of the no-dredge options considered this concept would appear to be the most promising but there are still significant difficulties including consolidation of marine clays immediately behind the wall and creating a recess for the steps.

2.16 The final option considered comprises load bearing steel piled panel walls installed at regular intervals and at right angles to the line of the wall, together with straight web steel piles along the line of the wall, as indicated in Figure 2.5. The horizontal load from the reclamation is transferred into the ground by the panel wall which can develop resistance from soil on the seaward side, side friction and moment if the panel is fixed rigidly into the ground. Preliminary investigations indicate that this design would be technically feasible but not economic for this Project.

2.17 These latter three possibilities have an additional negative impact on the environment as the result of increased noise due to vibratory piling. The possibility that any of these three options may be chosen is now small. However, the additional noise impact due to their implementation has been considered in the chapter on Noise Pollution.

2.18 The most likely option is the conventional block wall method which has greater negative implications for water quality and the amount of marine mud dredged. It is described in more detail below.

Seawall Sequence of Construction

2.19 The sequence of construction of the seawall involves the following:

a. Dredging of trench for foundation

b. Construction of the rubble mound

c. Placing of the seawall blocks and filters

d. Construction of the in-situ concrete coping

Dredging of the marine deposits for the seawall foundation will be carried out in trenches and will be commenced as early as possible. It is envisaged that the dredging work will be completed in less than 3 months.

2.20 The precast seawall blocks would be pre-fabricated in a casting yard either on land allocated by Government as a works area or in another area provided by the contractor. Blocks will be lowered by cranes operated from pontoons. The rockfill behind the wall would be filled at the same time as placing of the seawall blocks to avoid any movement of the seawall by wave action. The construction of the in-situ concrete coping is likely to be carried out as late as possible in the construction programme in order to minimise the effect of wall settlement.

2.21 It is anticipated that the contractor would bring in at least two gangs of dredgers and floating plant for dredging and placing of the rockfill and concrete blocks in order to meet the tight construction programme.

2.22 Marine clay will be dredged under the Western Revetment. This will apply for all options. It has been aligned in order to provide adequate clearance between the Yiu Lian floating dock no. 1 and the reclamation. A conceptual cross section of this revetment is illustrated on Figure 2.6.

2.23 Preliminary assessment of the geology of the eastern end of the seawall indicates that there is only a small amount of marine clay.

The Reclamation

2.24 700,000 m^3 of fill will be required for reclamation. It is planned that marine fill be used. Other sources of fill have been considered and rejected on environmental or practical grounds.

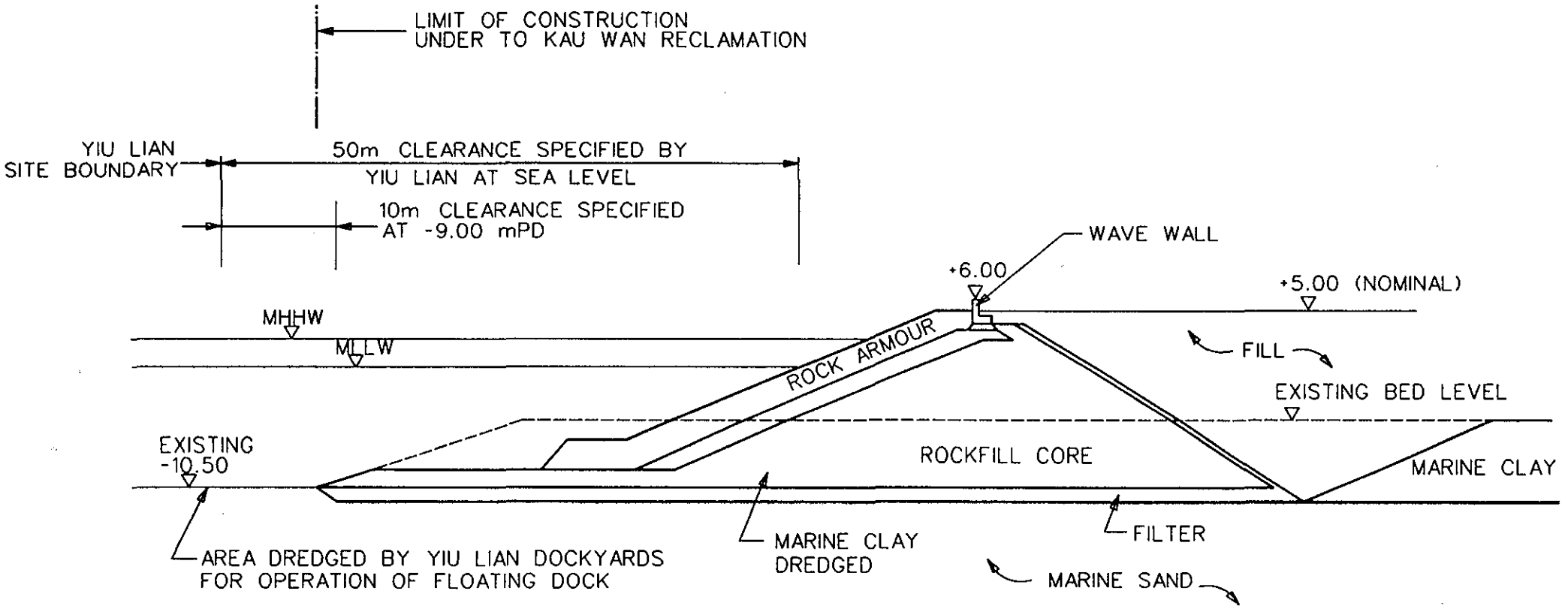
2.25 The current programme indicates that the site or the shipyard should be available for construction of buildings one (1) year after commencement of the reclamation. The available period for consolidation is likely to be about 4 months. To accelerate the consolidation of the marine clay it proposed to use a combination of vertical drains and preloading.

2.26 In order to achieve the construction programme, filling will commence before the seawall is completed. This will be done by forming a beach slope from the southern side of the site and filling toward the seawall. It is important to ensure that mud waves do not occur when forming the reclamation. In this regard the sand fill will initially be placed in thin layers and at a maximum batter of about 1V/30H.

2.27 The southern portion of the site will not be required for development until some time after development of the main site area has commenced. The preload for the main site area (estimated to be about 75,000 m^3) can be used to fill the southern portion of the site to final level after the consolidation period for the main site areas is completed. This will minimise the amount of fill required with economic benefits.

2.28 This "stockpile" of material on the main 250 metre x 150 metre site will be about 2 m high. After consolidation, the excess will be shifted to the southern part of the site during the last part of the proposed construction programme.

2.29 A simple version of the proposed consruction programme is presented in the chapters on Air and Noise Pollution.



SECTION

TO KAU WAN RECLAMATION EIA

CONCEPTUAL CROSS SECTION OF WESTERN BOUNDARY ADJACENT TO YIU LIAN DOCKYARD FLOATING DOCK - THE WESTERN REVENTMENT

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 500
土木工程署 Civil Engineering Department	Initial JHJ DCA	Figure No. 2.6

3. AIR POLLUTION

Scope

3.1 The design and construction of the new shipyard facility will be undertaken in two separate stages :

- reclamation and site formation of the 6 ha site; and
- construction of the shipyard facilities

3.2 This air impact assessment forms part of the EIA being undertaken for this first stage. A second EIA will be undertaken by others for the construction and operation of the shipyard facilities.

3.3 There are no residents in the area. All previous residents have been relocated under various PADS projects.

3.4 The Toll Plaza, part of the Lantau Fixed Crossing contracts, is being constructed south of To Kau Wan on the ridge above the bay. Construction on the Advanced Works contract began in November 1993. Construction of the Toll Plaza will continue throughout the To Kau Wan construction period.

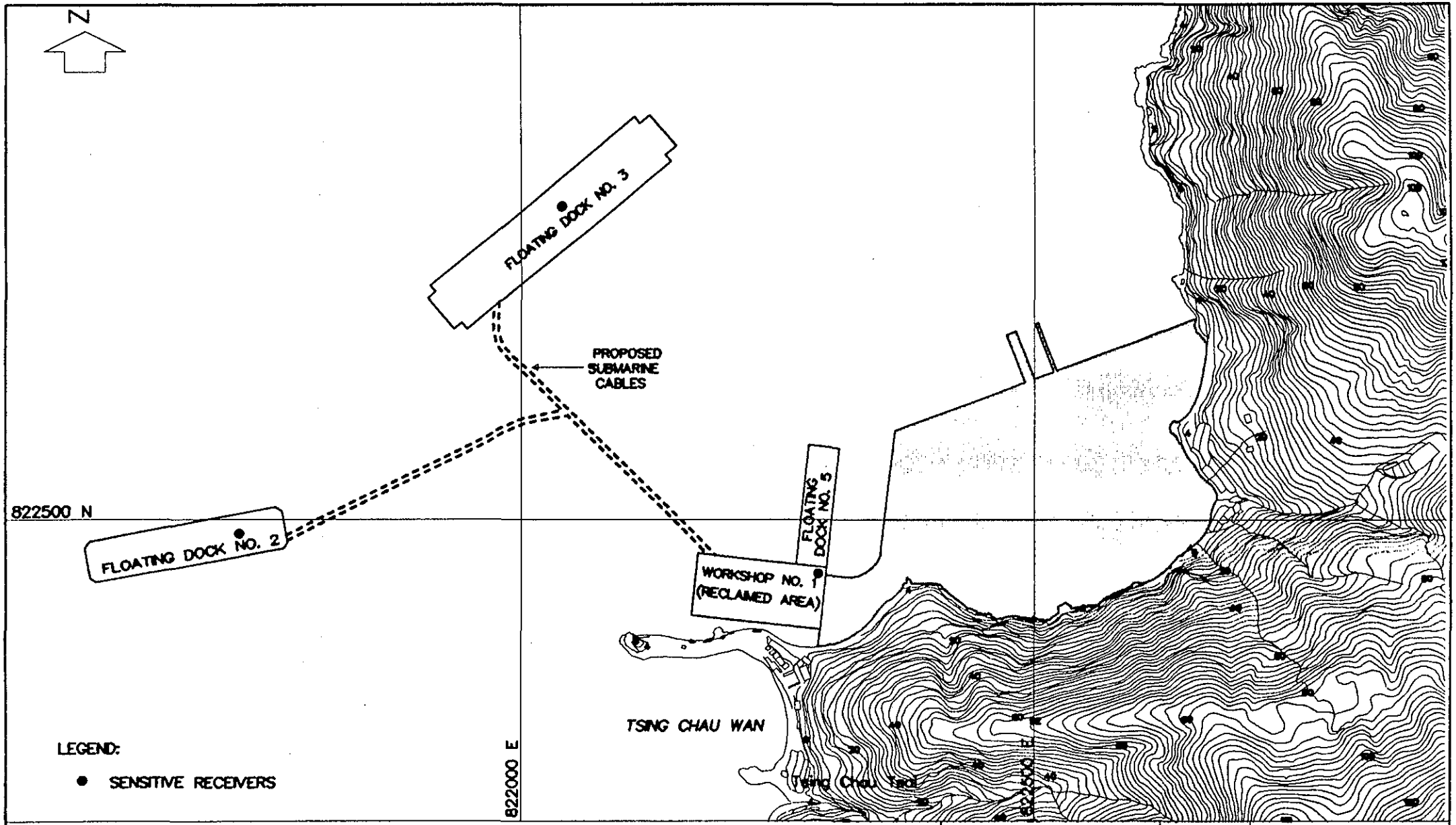
3.5 As next-door neighbour, the Yiu Lian Shipyard will be operational from March, 1994. There is an administration and fixed dock area plus 3 floating docks. These docks are the nearest air sensitive users. They are shown on Figure 3.1. Staff quarters will form part of the complex and this point has been chosen as a prediction point.

3.6 The only source of air pollution generated from the reclamation and site formation works of any possible consequence is dust generation. The worst case scenario for dust pollution has been examined quantitatively using the Fugitive Dust Model (FDM). The results are discussed in the context of the background environment. Mitigation measures have been suggested to minimise dust emissions.

The Background Environment

3.7 Prior to the commencement of the PADS projects, the air quality at North Lantau was excellent. As the NLE tunnel and LFC projects intensify, more and more dust will be generated. Both the construction of the Yam O section of the NLE and the Toll Plaza section of the LFC will raise dust levels considerably in the To Kau Wan area. As described in Chapter 1, considerable quantities of dry materials will be blasted, bulldozed, loaded and unloaded; dust will also be generated by vehicles travelling over many kilometres of unpaved and unmade roads.

3.8 Dust monitoring has been undertaken for the Yam O section of the NLE by Mott MacDonald. These data has been kindly provided to Binnie. However the station YOA-21 is located at Luk Keng Tsuen some 3 km from the site and does not exemplify conditions at To Kau Wan.



TO KAU WAN RECLAMATION EIA

LOCATION OF DISCRETE RECEIVERS

BINNE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 5000
土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 3.1

3.9 Dust monitoring began under the Toll Plaza contracts in January 1994 just beside the To Kau Wan site boundary, on the landward side of the Yiu Lian Dockyards. A high volume sampler capable of measuring dust over a 24-hour period had not yet been installed as of the beginning of February. It will soon be installed at this site as the Yiu Lian Dockyards form the closest sensitive receivers for the Toll Plaza Works. The available data given in Table 3.1 below were measured using small portable equipment.

Table 3.1 TSP Monitoring Data at Yiu Lian Dockyard Measured for the Toll Plaza Contracts

Date	1 hour TSP concentration (micrograms per cubic metre)
5-1-94	90
6-1-94	220
10-1-94	290
12-1-94	85
17-1-94	42
19-1-94	98

3.10 Dust levels could rise significantly above these levels. Figure 3.2 reproduces part of the air assessment work undertaken for the Toll Plaza. Even after full mitigation is undertaken dust levels could reach high levels at times due to the construction of the Toll Plaza and the NLE.

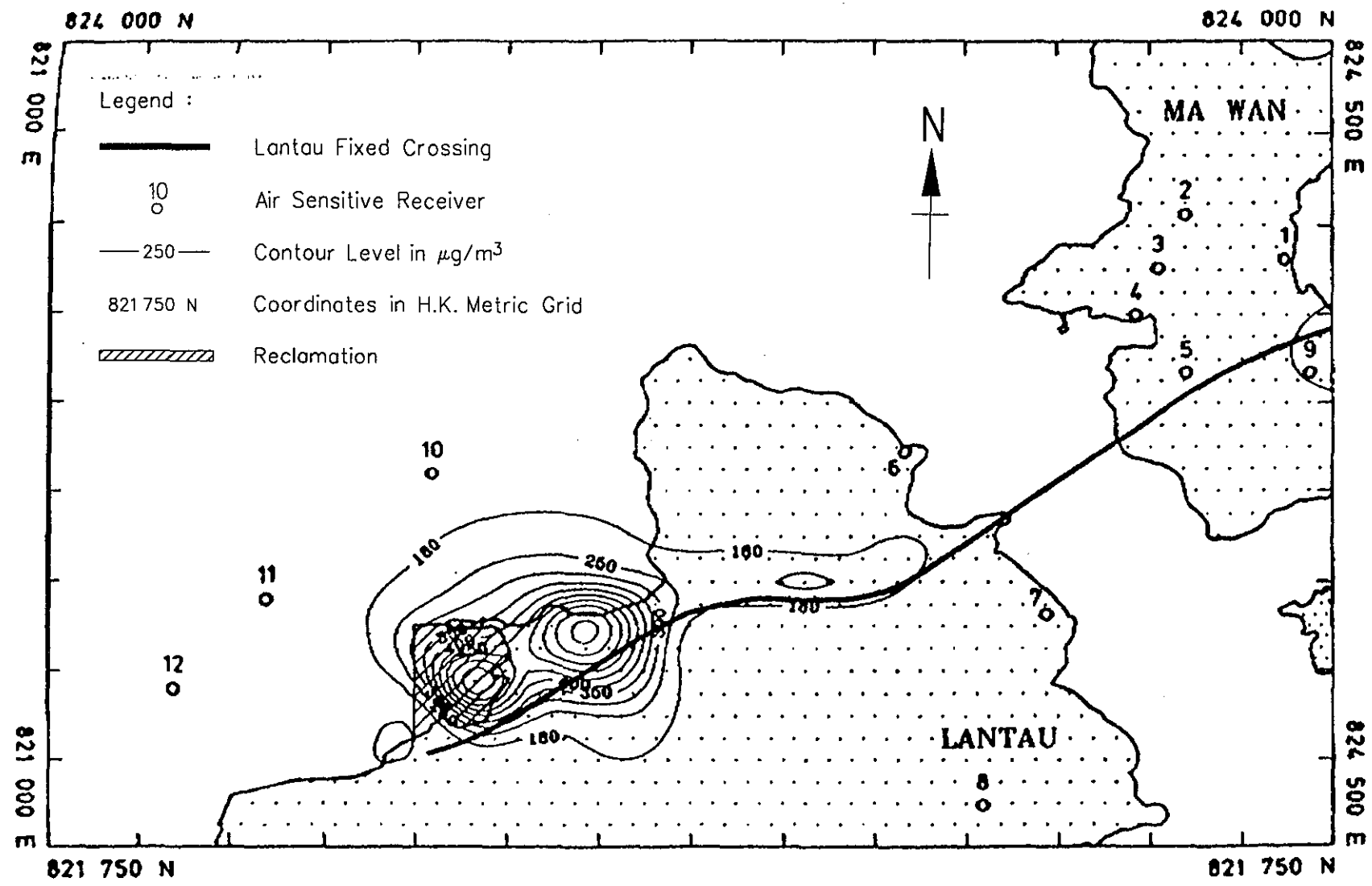
Project Description

3.11 A fuller description of the project was given in Chapter 2. The following description highlights the main factors affecting possible dust generation.

3.12 The main site is 250 metres x 150 metres. It will be reclaimed first by hydraulically pumping marine sand onto the site. At this stage the fill will be wet and will not therefore cause dust problems.

3.13 To speed consolidation, this main area will be stockpiled using additional marine sand to preload the site. After about four months the extra material, in a stockpile about 2 metres above the reclamation, will be shifted to the remainder of the site.

3.14 A simplified version of the construction programme is given on Figure 3.3. It is only during the last phase that dust could be generated. It is this last phase that has been modelled for this assessment.



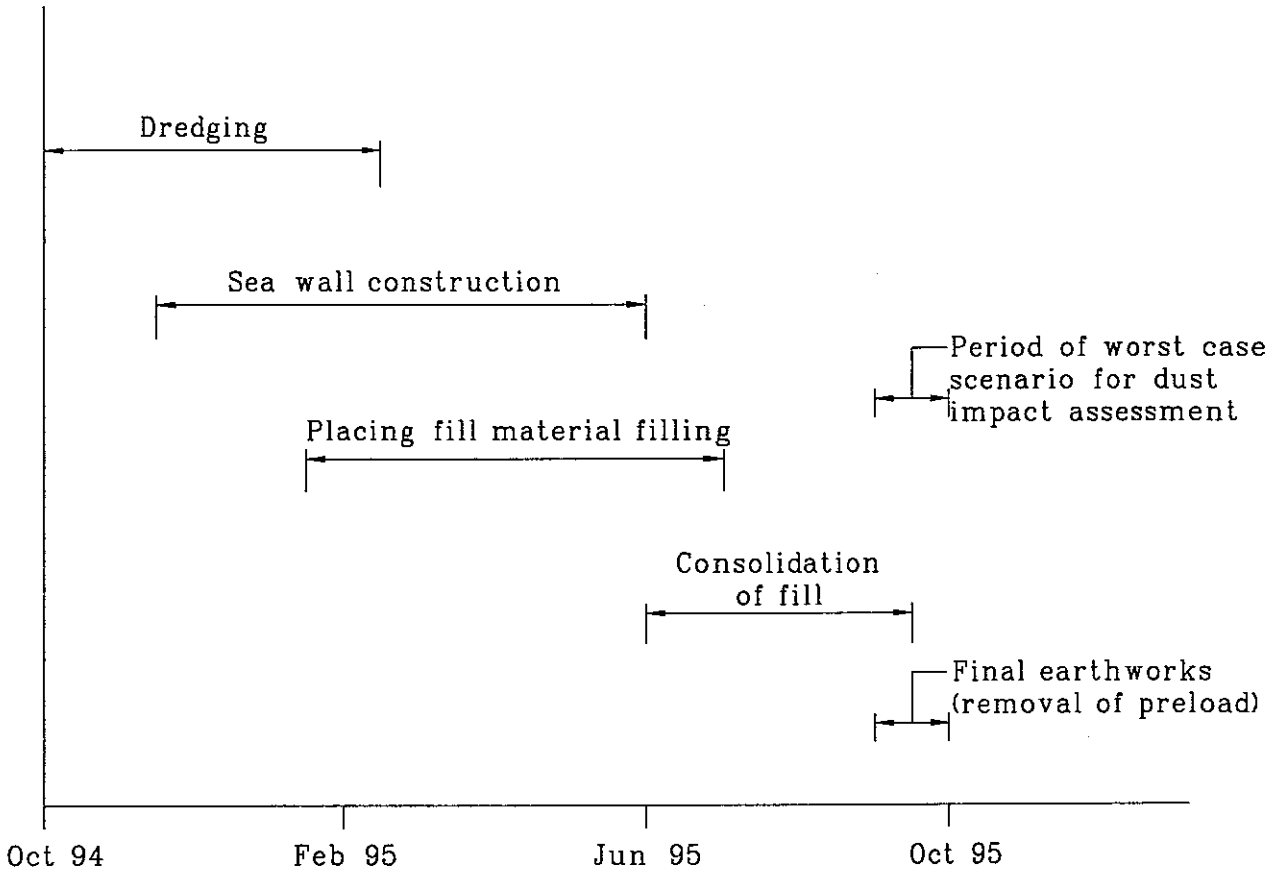
TO KAU WAN RECLAMATION EIA

24-HOUR AVERAGE RSP DISTRIBUTION DURING PERIOD 3 INCLUDING NORTH LANTAU RAILWAY WITH MITIGATION - PART OF AIR ASSESSMENT - LFC EIA.(6)

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼

土木工程署 Civil Engineering Department

Date	Scale
Feb. 94	N.T.S
Initial	Figure No.
SHT	3.2



TO KAU WAN RECLAMATION EIA Title: WORKS SCHEDULE OF RECLAMATION	BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼 土木工程署 Civil Engineering Department	Date Feb. 94 Initial WYC	Scale N.T.S. Figure No. 3.3

Dust Impact Assessment Criteria

3.15 The Hong Kong Air Quality Objectives stipulate maximum acceptable concentrations of dust in air. These concentrations are shown in Table 3.2.

Table 3.2 Hong Kong Air Quality Objectives

Pollutant	Concentration ($\mu g/m^3$)	
	24 hours*	1 year
Total Suspended Particulates (TSP)	260	80
Respirable Suspended Particulates (RSP)	180	55

Notes : Concentrations measured at 298°K (25°C) and 101.325 kPa.

* *24-hour criteria not to be exceeded more than once per year.*

Assessment Methodology

Fugitive Dust Model (FDM)

3.16 Dust emissions due to the construction of the reclamation have been evaluated for TSP and RSP impact using the FDM. The site has been divided into a 9 x 7 grid with a grid size of 50 metres. For modelling purposes, worse case scenarios have been considered. Three (3) discrete receivers have also been chosen as calculation points for FDM, the Yiu Lian Floating Docks Nos. 2 and 3, and the proposed workshop and dock No. 1 where staff quarters will be sited.

3.17 The assessment has been based on 1992 sequential meteorological data at the Mobil Oil Depot, Tsing Yi Station containing the hourly wind direction, wind speed, stability and temperature. The minimum wind speed was set at 1 metre/sec.

Dust Sources

3.18 Dust will be generated when the stockpile of material is moved to the shoreward part of the site. The shifting of the material will probably be undertaken using a bulldozer or possibly a loader. For FDM this is modelled as 'loading and unloading' and transport over unpaved road. This is a very conservative approach. The dust sources have been modelled as follows:

Loading and Unloading

3.19 The dust sources associated with the loading and unloading at reclamation have been considered as area sources.

3.20 The quantity of particulate emissions generated by a batch drop operation, per ton of material transferred, may be estimated, with an emission factor rating of C, using the following empirical expression (AP-42):

where:

E = emission factor
k = particle size multiplier (dimensionless)
s = material silt content (%)
U = mean wind speed, m/s
H = drop height, m
M = material moisture content (%)
Y = dumping device capacity, m^3

$$E = k\,(0.0009)\,\frac{(\frac{s}{5})\,(\frac{U}{2.2})\,(\frac{H}{1.5})}{(\frac{M}{2})^2\,(\frac{Y}{4.6})^{0.33}}\ (kg/Mg) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

3.21 Equation (1) can be rewritten as following:

$$E' = Q_o\,U'^{w} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

where Q_o is the "unadjusted" emission factor which does not consider the change of hourly wind speed and direction, U' is hourly wind speed and w is the wind dependent factor. E is the mean value of E' s.

3.22 Using equation (1) and (2), the emission factors for TSP and RSP can be estimated. The data used for calculation are listed in Table 3.3.

Table 3.3 Physical Data for Evaluation of the Impact of Loading and Unloading

Parameters of Equation (1)	TSP	RSP
Particle Size Multiplier (k)	0.73 (Ref: table 11.2.3-2, AP-42)	0.36 (Ref: table 11.2.3-2, AP-42)
Material Silt Content (s)	21%	21%
Drop Height (H)	1.5 m	1.5 m
Material Moisture Content (M)	4%	4%
Dumping Device Capacity (Y)	5.0 m^3	5.0 m^3

3.23 By the use of equation (I), the "unadjusted" emission factor for TSP becomes:

$$Q_o = 0.73\ (0.0009)\ \frac{(\frac{21}{5})\ (\frac{1}{2.2})\ (\frac{1.5}{1.5})}{(\frac{2}{2})^2\ (\frac{8.3}{4.6})^{0.33}}\ (kg/Mg) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$= 2.58\ x\ 10^{-4}\ kg/T$$

3.24 The "unadjusted" emission factor for RSP becomes:

$$Q_o = 0.36\ (0.0009)\ \frac{(\frac{21}{5})\ (\frac{1}{2.2})\ (\frac{1.5}{1.5})}{(\frac{4}{2})^2\ (\frac{8.3}{4.6})^{0.33}}\ (kg/Mg) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$= 1.27\ x\ 10^{-4}\ kg/T$$

The wind dependent factor, w, in this case is 1.

3.25 Assuming a density of 1.987 x 10^3 kg/m^3 and 12 hour working day, 24 days a month, the material to be shifted is 323.4 T/hr, i.e.,

$$= \frac{93750\ m^3\ x\ 1.987\ x\ 10^3\ kg/m^3}{6\ x\ 4\ x\ 2\ x\ 12\ hr} = 323404.9\ (kg/hr) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

3.26 The unadjusted emission rate for TSP is 0.09 g/sec,

$$Q_o = \frac{2.58\ x\ 10^{-4}\ kg/T\ x\ 323.4\ T/hr}{3.6} = 0.00225\ (g/sec) \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

where 3.6 is the conversion factor for the change of kg/hr to g/sec. The unadjusted emission rate for RSP is 0.045 g/sec.

$$Q_o = \frac{1.27\ x\ 10^{-4}\ kg/T\ x\ 323.4\ T/hr}{3.6} = 0.1125\ (g/sec) \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

3.27 An area 250 m x 150 m has been used as the loading area. Consequently, the unadjusted emission rate per unit area can be calculated from equations (5) and (6) and then substituted into equation (2). The emission rate become:

TSP : $Q_0 = 6.12 \times 10^{-7}$ g/s/m²
RSP : $Q_0 = 3.05 \times 10^{-7}$ g/s/m²

Unpaved Road and Haul Routes

3.28 During the final stage of reclamation (topping of the site formation), the fill materials have been modelled as being transported by trucks that will cause dust emission.

3.29 The emission factor for unpaved road is from AP-42 (equation 1, p11.2.1-1) with emission factor rating A:

$$E = k\,(1.7)\,(\frac{s}{12})\,(\frac{S}{48})\,(\frac{W}{2.7})^{0.7}\,(\frac{w}{4})^{0.5}\,(\frac{365-p}{365})\,(kg/VKT) \quad \ldots\ldots\ldots\ldots (8)$$

where :

E	=	emission factor
k	=	particle size multiplier (dimensionless)
s	=	silt content of road surface material (%)
S	=	mean vehicle speed, km/hr
W	=	mean vehicle weight, Mg(ton)
w	=	mean number of wheels
p	=	number of days with at least 0.254 mm of precipitation per year
VKT	=	vehicle kilometres travelled

3.30 The data for estimating the emission rates of unpaved road and haul routes due to construction are summarised in Table 3.4.

Table 3.4 Physical data for evaluating the impact of Unpaved Road and Haul Routes

Parameters	TSP	RSP
Particle Size Multiplier (k)	0.8	0.36
Silt content of Road Surface Material (s)	15%	15%
Mean Vehicle Speed (S) km/hr	25	25
Mean Vehicle Weight (W) tonnes	20	20
Mean number of Wheels (w)	8	8
Number of Rainy Days in August & September REF: Royal Observatory	30 days	30 days

3.31 The safe speed for the vehicles travelling on the dirt roads at the site should not be greater than 25 km/h, which is thus the maximum speed of the vehicle.

3.32 The maximum distances that the dump trucks travel will be estimated as double the distance on the site that is roughly 0.6 km. The dust sources due to traffic have been identified as line sources.

3.33 VKT can be expressed as vehicle movements per hour. Construction vehicle movements per hour has been calculated by dividing the total material to be moved by 5.0 m^3. This is the average load carried by a small dump trucks. The number of vehicle roundtrips per hr is roughly 32.

3.34 For construction dust, the wind dependent factor is zero. So the emission rate becomes:

$$E = 0.8\ (1.7)\ (\frac{15}{12})\ (\frac{25}{48})\ (\frac{20}{2.7})^{0.7}\ (\frac{8}{4})^{0.5}\ (\frac{1}{2})\ (kg/VKT) \quad \ldots\ldots\ldots\ldots (11)$$

i.e. E = 2.54 kg/VKT

Therefore, the emission rate for TSP is:

$$E = (\frac{2.54}{3.6\ x\ 1000})\ x\ 32 = 0.0226\ g/m/s \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

For RSP, E is 0.00964 g/m/s.

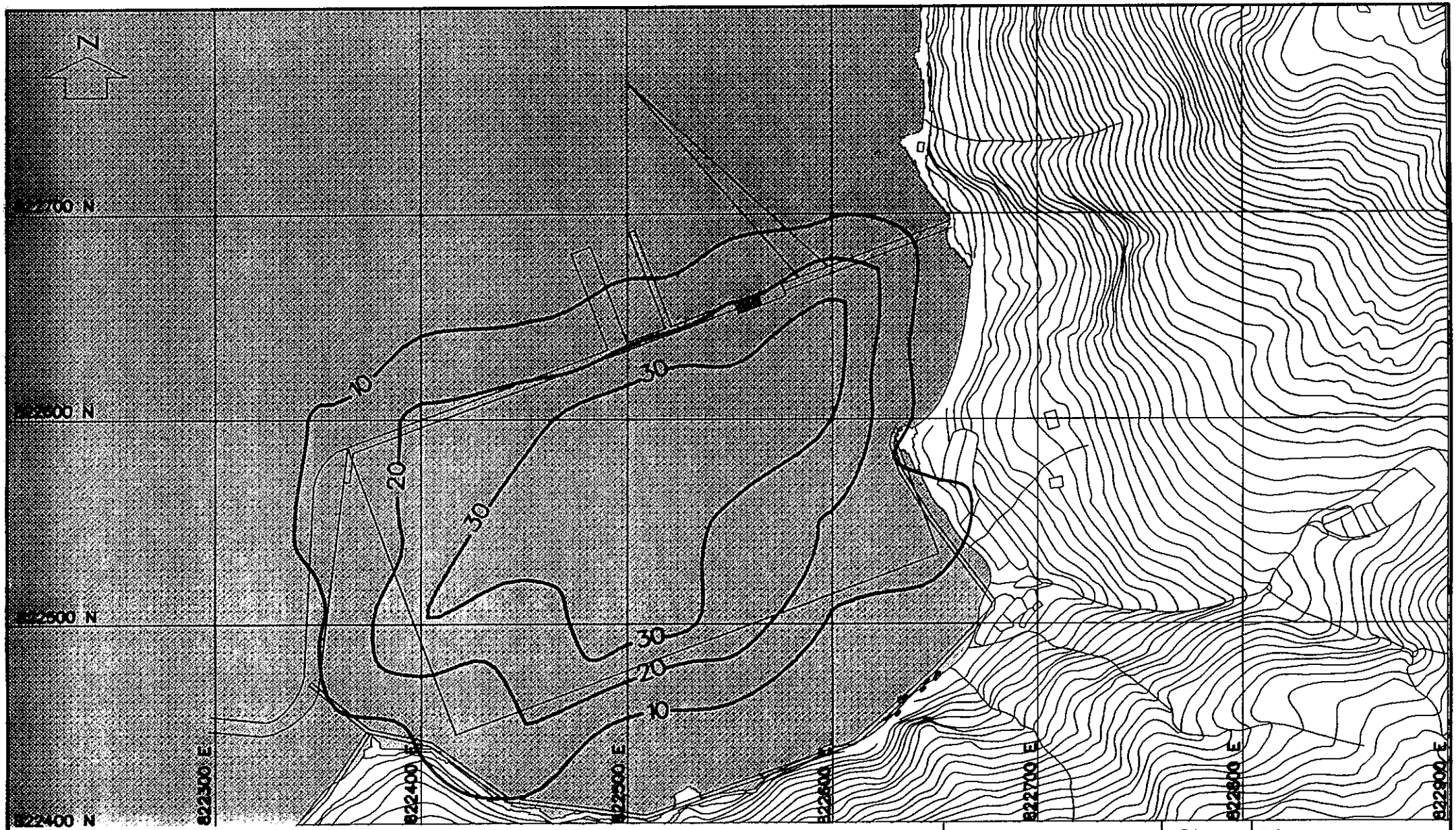
3.35 A second run was undertaken assuming that moisture levels on haul routes were kept equivalent to those which would result if it rained 0.254 mm every working day. The emission factor for loading and unloading remained the same.

Modelled Dust Levels

3.36 The results of the FDM are tabulated and illustrated on the following pages. Traffic moving over dirt roads generates most of the dust.

3.37 It is important to emphasize that the model reflects the worst case scenario.

3.38 The TSP results are presented in Tables 3.5 to 3.7 and Figures 3.4 to 3.9. They suggest that under the worse case scenario conditions it may be necessary to mitigate dust on haul routes. If enough water is applied to haul routes the equation tends to zero and no dust is generated.

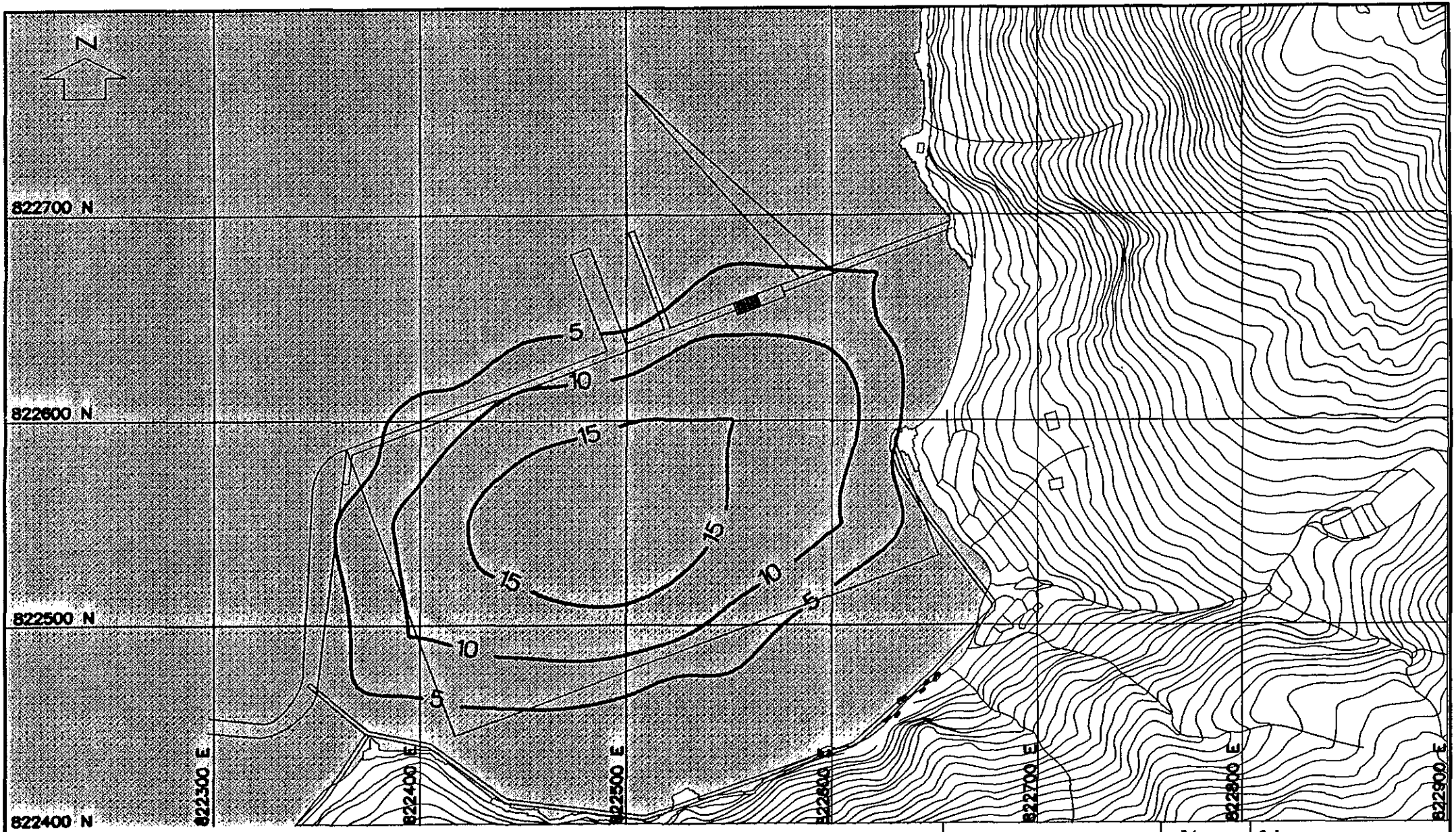


TO KAU WAN RECLAMATION EIA

FDM – WORST CASE SCENARIO

24 – HOUR TSP (LOADING)

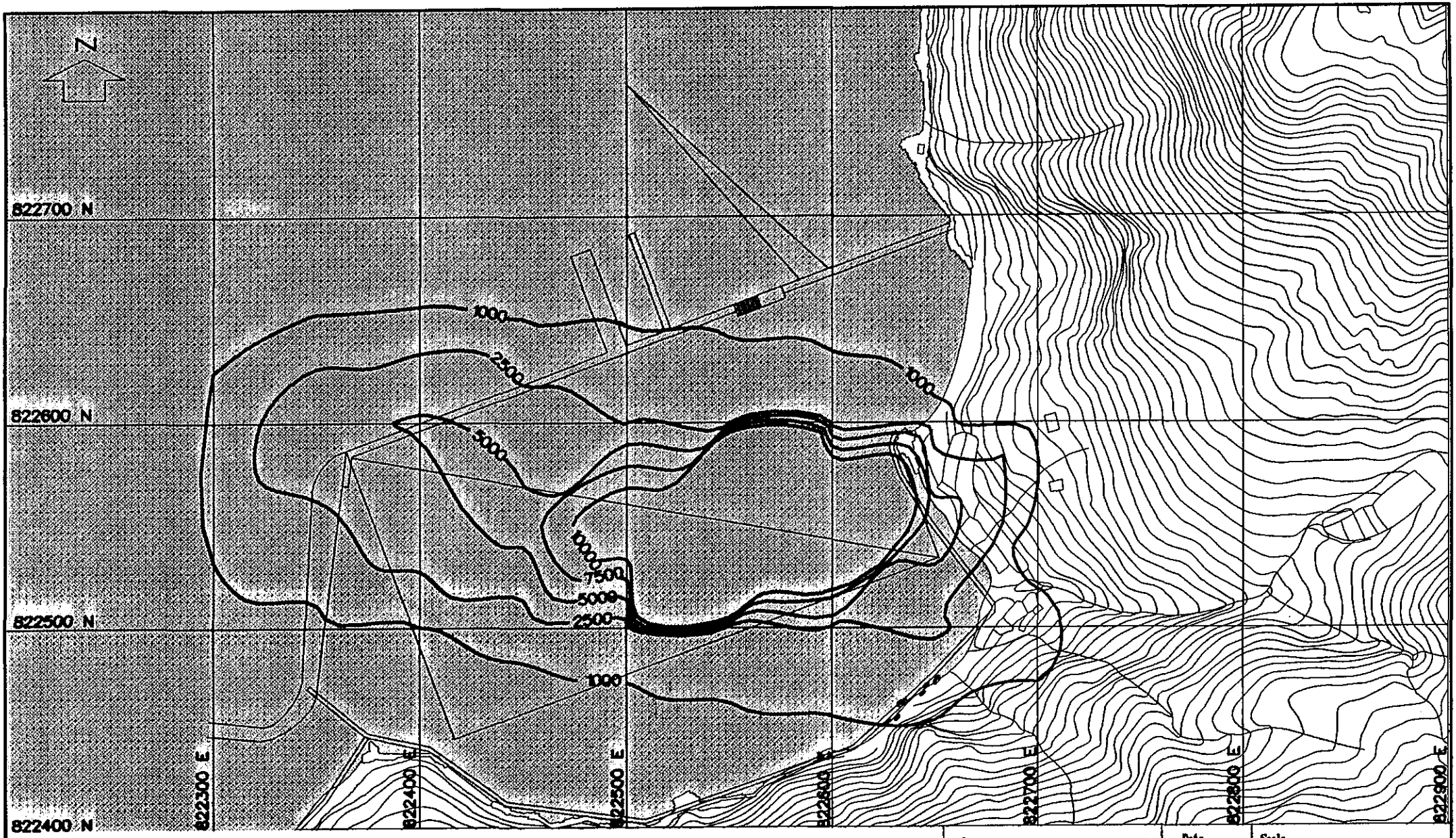
BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 2500
土木工程署 Civil Engineering Department	Initial BH	Drawing No FIGURE 3.4



TO KAU WAN RECLAMATION EIA

FDM – WORST CASE SCENARIO
YEARLY TSP (LOADING)

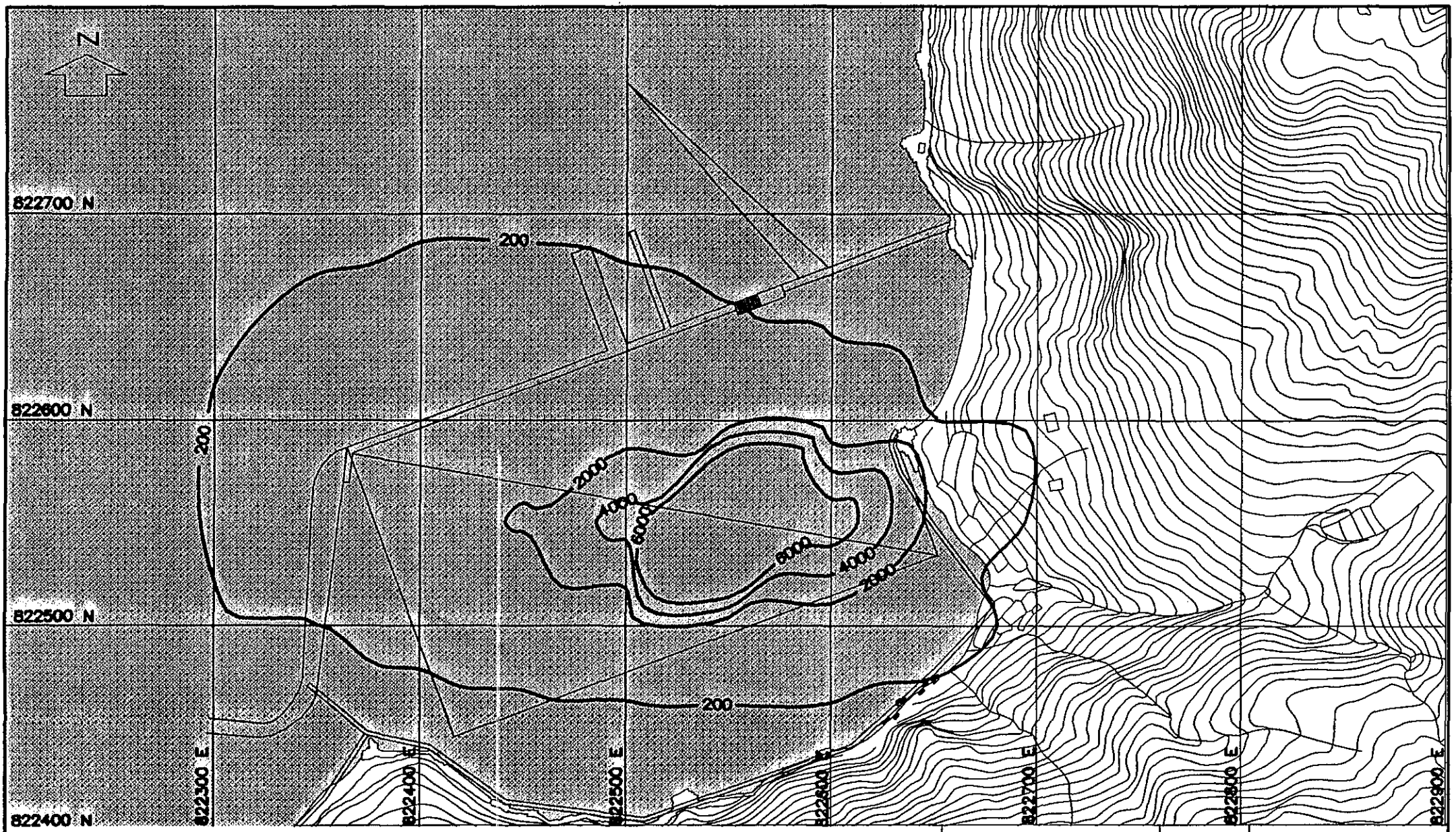
BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 2500
土木工程署 Civil Engineering Department	Initial BH	Drawing No FIGURE 3.5



TO KAU WAN RECLAMATION EIA

FDM – WORST CASE SCENARIO
24 – HOUR TSP (ALL SOURCES)

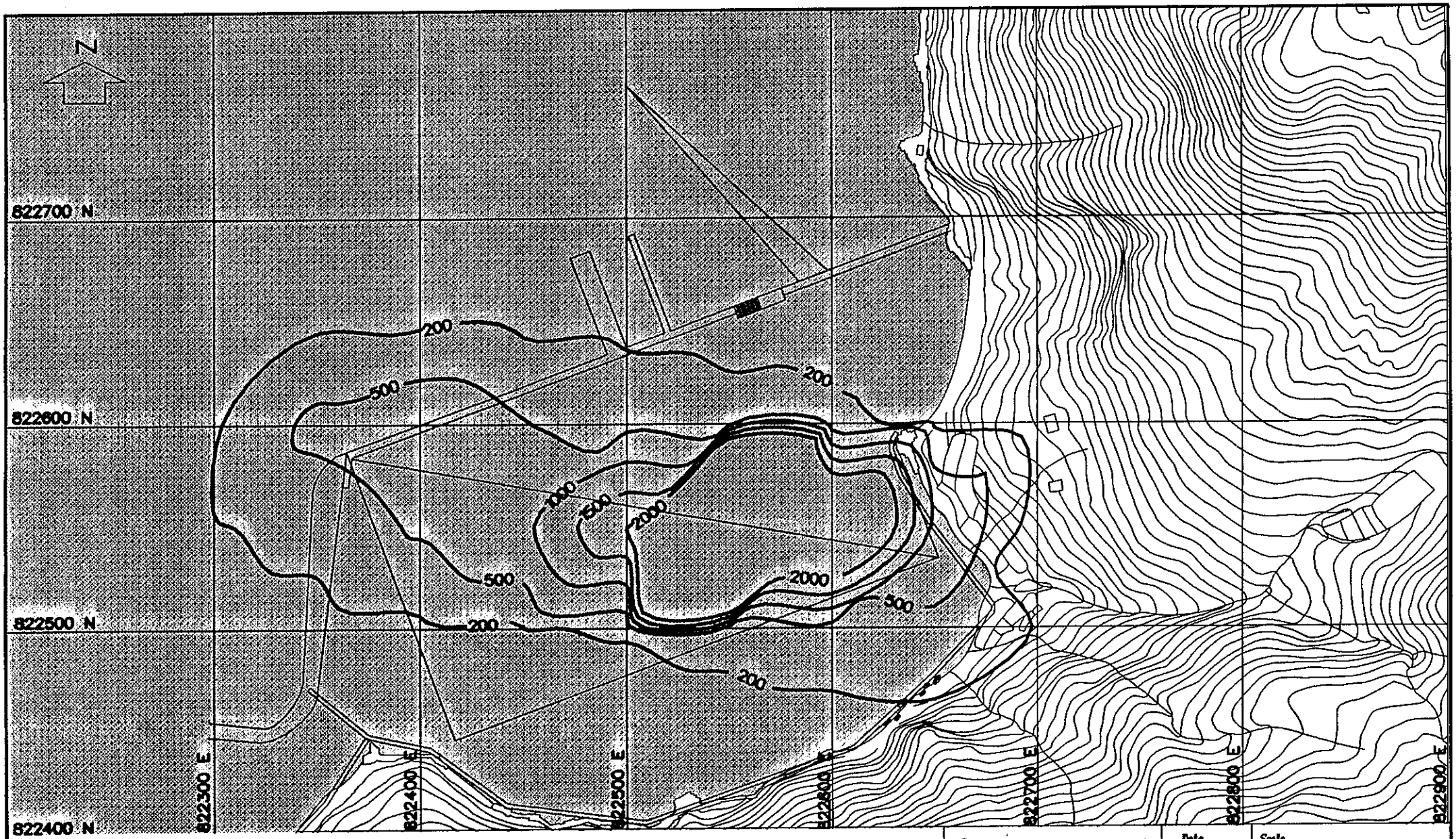
BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 2500
土木工程署 Civil Engineering Department	Initial BH	Drawing No FIGURE 3.6



TO KAU WAN RECLAMATION EIA

FDM – WORST CASE SCENARIO
YEARLY TSP (ALL SOURCES)

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 2500
土木工程署 Civil Engineering Department	Initial BH	Drawing No FIGURE 3.7

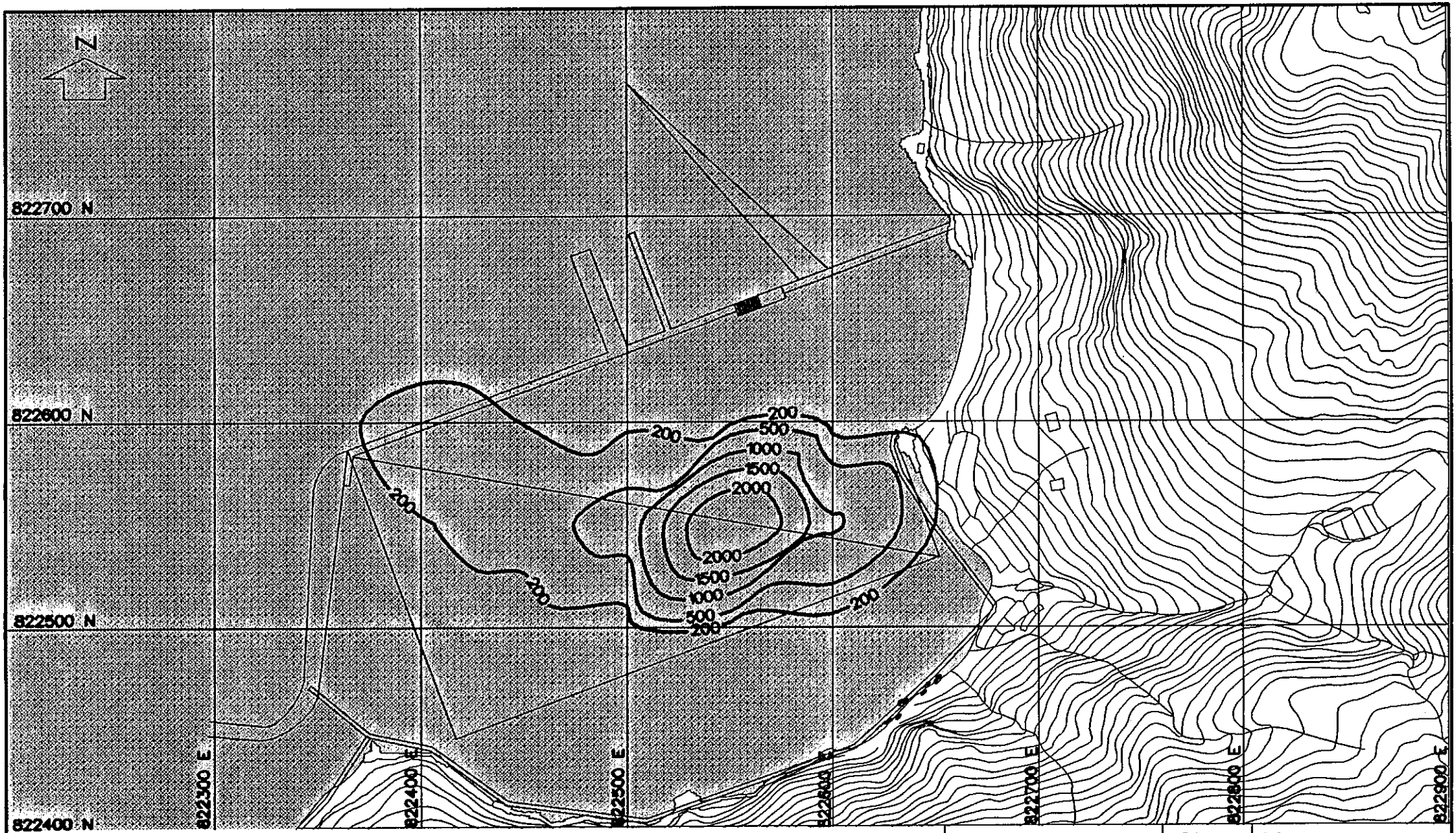


TO KAU WAN RECLAMATION EIA

FDM – WORST CASE SCENARIO

24 – HOUR TSP (ALL SOURCES WITH SOME MITIGATION)

BINNE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 2500
土木工程署 Civil Engineering Department	Initial BH	Drawing No FIGURE 3.8



TO KAU WAN RECLAMATION EIA

FDM – WORST CASE SCENARIO

YEARLY TSP (ALL SOURCES WITH SOME MITIGATION)

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 2500
土木工程署 Civil Engineering Department	Initial BH	Drawing No FIGURE 3.9

Table 3.5 TSP - Yearly Average Concentration ($\mu g/m^3$)

Prediction Points	Loading and Unloading	All Sources (No Mitigation)	All Sources (Some Mitigation)
Dock 1	0.5	54	8
Dock 2	0.1	9	1
Dock 3	0.1	16	2

Table 3.6 TSP - Worst 24-Hour Average Concentration ($\mu g/m^3$)

Prediction Points	Loading and Unloading	All Sources (No Mitigation)	All Sources (Some Mitigation)
Dock 1	2.6	254	38
Dock 2	0.5	60	9
Dock 3	0.8	91	14

Table 3.7 TSP - Worst 1-Hour Average Concentration ($\mu g/m^3$)

Prediction Points	Loading and Unloading	All Sources (No Mitigation)	All Sources (Some Mitigation)
Dock 1	6.1	521	79
Dock 2	1.2	120	18
Dock 3	2.2	296	43

3.39 Background levels of dust could be high. In order to ensure that the AQO are obtained it will be important to add to these levels as little as possible. Tables 3.5 to 3.7 show the effect of undertaking some mitigation.

3.40 The reclamation materials will be very wet initially and will gradually dry out, particularly at the surface. Due to the time of the year when most dirt will be shifted, moisture levels in the material may be relatively high due to the frequent rain expected. However, the Contractor will need to consider dust mitigation as soon as conditions become dry enough for dust to be generated in any quantity.

3.41 There should not be any impact on the painting activities of the Yiu Lian dockyards due to the construction of the To Kau Wan site.

3.42 The following extract is from a letter from the LFC Project Management Office of the Highways Department to the Mass Transit Railways Corporation[8].

Another major concern of the shipyard was the effect dust caused by blasting and earthworks on the painting activities at the shipyard. This office confirmed that the highest 1 hour total suspended particulate (TSP) concentration at Yiu Lian Floating Docks No. 2 and No. 3 resulting from the LFC works and including background levels is calculated to be 1500 $\mu g/m^3$ and 1770 $\mu g/m^3$ respectively. These figures will be reduced by about 10% as a result of the introduction of mitigating measures where possible, but the largest effect is due to rock drilling and blasting work where no mitigatory actions are available. The 24-hour averaged TSP concentrations, which take account of the fact that rock blasting is intermittent and winds variable, are considerably smaller. Nevertheless, it was understood from a meeting with the Yiu Lian paint supplier that the maximum 1 hour TSP levels quoted can be tolerated during painting operations.

3.43 It should be noted that this letter suggests that background level measured at the To Kau Wan site could be very high. It is recommended that careful records be kept in site logbook of any dusty activities occurring near the site.

3.44 Tables 3.8 to 3.10 show the modelled RSP results for the To Kau Wan site.

3.45 No model exactly mirrors the real situation. The particle size distribution data used in the model was simplistic in the absence of measured data. The modelling of shifting the stockpile to the rest of the site assumes the use of trucks when the more likely scenario may be the use of a single bulldozer or loader. It has been assumed for modelling purposes that trucks move from one side of the site to the other. This will happen rarely if at all. By careful planning and noting the wind speed and direction the Contractor can substantially reduce the distance travelled particularly when winds are high.

Table 3.8 RSP - Yearly Average Concentration ($\mu g/m^3$)

Prediction Points	Loading and Unloading	All Sources (No Mitigation)	All Sources (Some Mitigation)
Dock 1	0.5	66	10
Dock 2	0.1	15	2
Dock 3	0.1	18	3

Table 3.9 RSP - Worst 24-Hour Average Concentration ($\mu g/m^3$)

Prediction Points	Loading and Unloading	All Sources (No Mitigation)	All Sources (Some Mitigation)
Dock 1	2.6	359	54
Dock 2	0.5	72	10
Dock 3	0.7	97	14

Table 3.10 RSP - Worst 1-Hour Average Concentration ($\mu g/m^3$)

Prediction Points	Loading and Unloading	All Sources (No Mitigation)	All Sources (Some Mitigation)
Dock 1	4.5	1138	166
Dock 2	0.9	294	43
Dock 3	1.5	715	103

Dust Impact Assessment

3.46 This study has shown that dust need not cause any adverse environmental impacts on the surrounding environment during the construction of the To Kau Wan site. All dust sources are easy to keep under control by increasing moisture levels. Indeed due to the nature of the construction works, it will only be in limited circumstances that dust could reach problem levels even without extra mitigation.

3.47 Due to the potential for high background dust levels, and the close presence of sensitive users, it is recommended that the Contractor pay careful attention to the environmental monitoring and auditing (EM&A) of dust and dust control. These topics are addressed in Chapter 8 *EM&A Manual*.

4. NOISE POLLUTION

The Noise Environment

4.1 As discussed in the Introduction, there are several major civil engineering projects being undertaken adjacent to the To Kau Wan site. Those known to affect the noise environment include the Toll Plaza contracts, a cut slope work for the NLE - Yam O Section, the construction of the Railway Viaduct and the East Lantau Tunnels as well as the Yiu Lian Shipyards which will begin operation in March 1994. At the current time, the noise characteristics of the location are being dramatically altered from that of an undeveloped, unpopulated area.

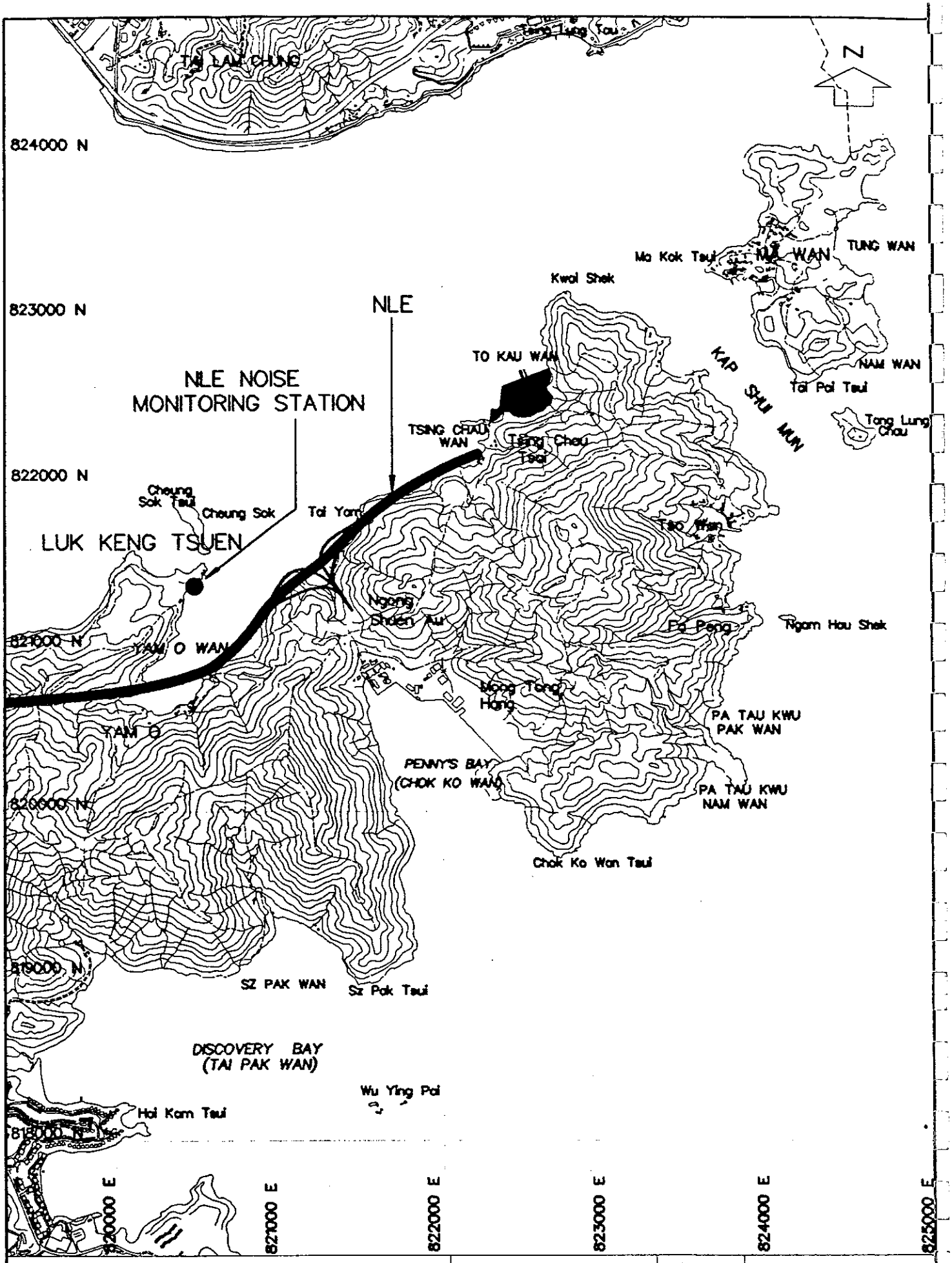
4.2 A number of earlier EIAs have examined the noise environment of North Lantau before development began. The closest monitoring site to To Kau Wan where both baseline and current noise data have been measured is Luk Keng Tsuen. These data have been kindly provided by the NLE - Yam O Project Managers and EPD and was collected by Mott MacDonald.

4.3 The location of Luk Keng Tsuen is shown on Figure 4.1. Baseline data collected here in 1991 have been reproduced from the Mott MacDonald (HK) Ltd. consultancy report on the Yam O and Tai Ho Sections of the NLE on Figure 4.2[3]. This shows the variation in noise levels over a 24-hr period on a typical weekday. However, it is no longer representative of the current noise environment on North Lantau.

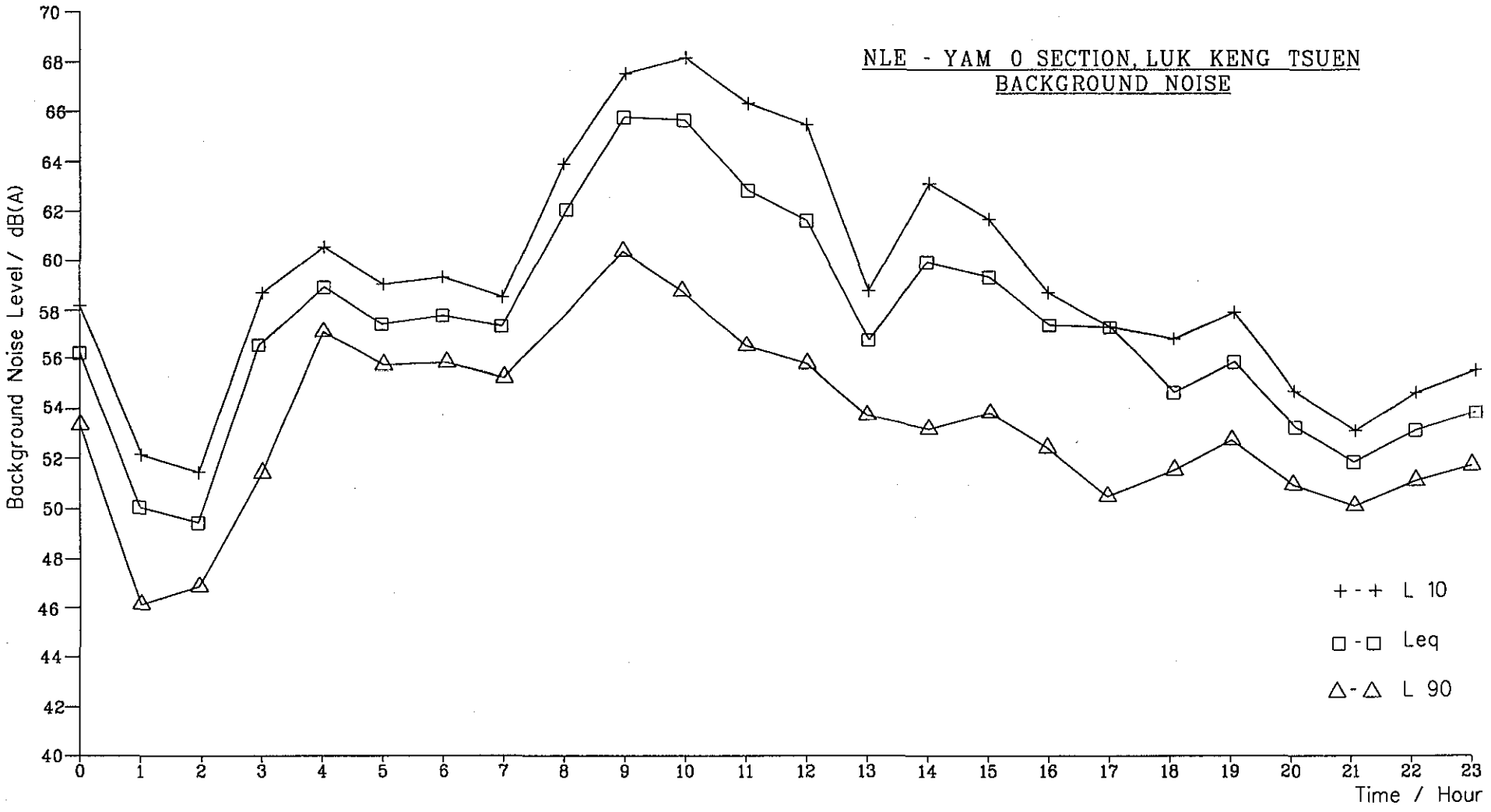
4.4 Recent noise data have been made available from the on-going noise monitoring programme carried out for the NLE - Yam O Section construction by Mott MacDonald (HK) Ltd. (1993) which reflect the amount of noise generated by the development. The raw L_{90} & $L_{Aeq\ 1\text{-}hr}$ dB(A) measurements taken during the year of 1993 were provided on diskette. These data reflect the sort of background that may be found at To Kau Wan due to the ongoing developments in the area.

4.5 The data have been summarised into monthly averages, minimums, and maximums of $L_{Aeq\ 1\text{-}hr}$ and L_{90} dB(A) in Tables 4.1 and 4.2. The average, minimum and maximum of all general holidays of 1993 are summarised in Tables 4.3 and 4.4.

4.6 The noise environment at To Kau Wan will change considerably over the next few months as the work on Toll Plaza intensifies and the construction work at Yiu Lian Shipyard ceases and operation begins. It is considered that the current level of data is sufficient and that no further baseline monitoring is necessary.



TO KAU WAN RECLAMATION EIA	BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 20000
LOCATION OF BACKGROUND NOISE MONITORING STATION	土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 4.1



Reproduction of courtesy of Mott Macdonald (HK) LTD.

TO KAU WAN RECLAMATION EIA

Title:

MEASURED HOURLY NOISE LEVELS AT LUK KENG TSUEN OVER A 24 HOUR PERIOD (1991)

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼

土木工程署 Civil Engineering Department

Date	Scale
Jan. 94	N.T.S.
Initial	Figure No.
WYC	4.2

Table 4.1 **Monthly Minimum, Maximum and Average $L_{Aeq\ 1\text{-}hr}$* data at Luk Keng Tsuen in 1993 (dB(A))**

1993	Average		Minimum		Maximum	
	Day	Evening	Day	Evening	Day	Evening
Feb	62	62	57	52	69	73
Mar	62	61	51	52	74	68
Apr	61	57	56	45	67	62
May	57	53	48	47	62	59
Jun	58	50	49	45	67	58
Jul	55	51	49	47	62	65
Aug	57	49	53	47	62	51
Sep	59	49	51	45	65	52
Oct	60	52	56	46	64	61
Nov	61	52	57	47	65	56
Dec	59	52	52	47	64	56

* $L_{AeqT} = 10 \log_{10} 1/F \int^{T}_{0} (p(t) / p_0)^2 \, dt$
where p is the instantaneous acoustic pressure level, T is the measurement time, and p_0 is the reference acoustic pressure.

Table 4.2 **Monthly Minimum, Maximum and Average L_{90} data at Luk Keng Tsuen in 1993 (dB(A))**

1993	Average		Minimum		Maximum	
	Day	Evening	Day	Evening	Day	Evening
Feb	54	57	53	48	56	68
Mar	55	57	53	50	57	62
Apr	55	47	55	47	55	47
May	NA	56	NA	56	NA	56
Jun	50	49	42	41	56	56
Jul	52	50	46	47	56	60
Aug	52	47	46	42	56	48
Sep	56	46	53	45	59	49
Oct	56	45	55	44	58/	47
Nov	57	50	55	45	58	53
Dec	56	48	50	45	60	51

\# L_{90} is the sound pressure level which has been exceeded for 90% of the measurement time. It is a common factor for expressing the predominant sound environment, or the "background noise".

Table 4.3 **Minimum, Maximum and Average L_{Aeq}-1hr at of all General Holidays in 1993 (dB (A)) at Luk Keng Tsuen**

Average	Minimum	Maximum
54.1	48.1	79.8

Table 4.4 **Minimum, Maximum and Average L_{90} at of all General Holidays in 1993 (dB (A) at Luk Keng Tsuen**

Average	Minimum	Maximum
51.5	46.3	68.9

Noise Assessment Criteria

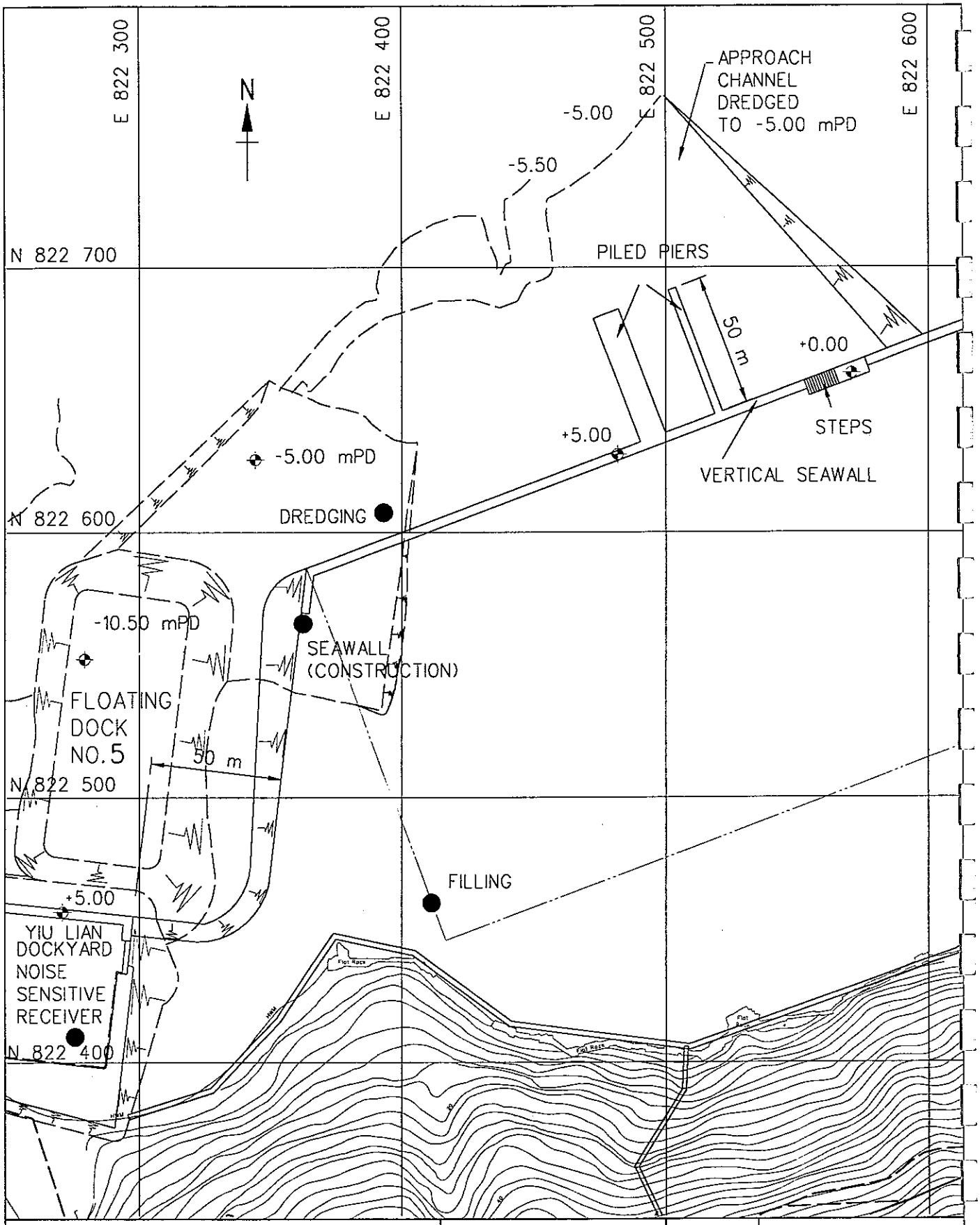
4.7 Before the PADS projects began on North Lantau, the whole area was extremely quiet, with a very low population in traditional village houses and an area rating of 'A' as defined in the TM. This is reflected in the measurements taken at Luk Keng Tsuen.

4.8 The current noise setting is no longer rural, especially after the resumption of all villages in the vicinity.

4.9 The future land use will be decidedly industrial with no noise sensitive receivers foreseen. Once the two shipyards are operational, the nearest noise sensitive area will probably be Discovery Bay 5 km away which is shielded by a range of hills some 100 metres high. There may still be a few residents in the villages of Tso Wan and Fa Peng on the extreme East of Lantau at this time. These villages lie 1,200 m and 1,700 m from To Kau Wan with hills over 200 m high in between.

4.10 The Yiu Lian Dockyards Ltd.'s staff quarters will be the only residential building in the area. However, it is not considered to be a true noise sensitive receiver since it is situated inside an industrial undertaking which emits noise. Its location is shown on Figure 4.3.

4.11 The Occupational Safety and Health Act (OSHA) of 1970 prescribed permissible exposures in industries doing business with the U.S. Federal Government. The permissible daily noise exposure limit recommended by OSHA for industrial noise for an 8-hr working day is 90 dB(A) measured with slow response setting[9].



TO KAU WAN RECLAMATION EIA

LOCATIONS OF NOTIONAL SOURCES AND NOISE SENSITIVE RECEIVER

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼

土木工程署 Civil Engineering Department

Date	Scale
FEB. 94	1 : 2000
Initial	Figure No.
JT	4.3

4.12 Under the *Checklist and Instructions for the Factories and Industrial Undertakings (Noise at Work) Regulation (Cap. 59 sub. leg. T): LN 239 of 1992, LN 229 of 1993, LN 43 of 1994*, three action levels have been set for the protection of workers in Hong Kong:

- a "first action level" - a daily personal exposure of 85 dB(A);
- a "second action level" - a daily personal exposure of 90 dB(A); and
- a "peak action level" - when noise reaches a peak sound pressure level of 140 dB or peak sound pressure of 200 Pa.

4.13 The daily personal noise exposure (taking no account of the effect of using an ear protector) is expressed in dB(A) and is ascertained using the formula:

$$L_{EP,d} = 10 \log_{10} \{ \frac{1}{T_0} \int^{T_e} [\frac{P_A(t)}{P_o}]^2 \, dt \}$$

where:

$L_{EP,d}$	=	level of daily personal noise exposure
T_o	=	8 hours or 28,800 seconds
T_e	=	the duration (expressed in hours if T_o is expressed in hours, and in seconds if T_o is expressed in seconds) of the person's exposure to sound
P_o	=	20 μPa
$P_A(t)$	=	the time-varying value of A-weighted instantaneous sound pressure in pascals in the undisturbed field in air at the atmospheric pressure to which the person is exposed (in the locations occupied during the work day), or the pressure of the disturbed field adjacent to the person's head adjusted to provide a notional equivalent undisturbed field pressure.

4.14 If daily personal exposure, a measure of the average noise levels experienced all day, lies between the first and second action levels, then an employer should supply ear protection if asked to do so by an employee.

4.15 If the second action level is reached, an employer must provide ear protection. In every case, noise levels should be mitigated as much as possible.

4.16 For these reasons noise assessment criteria at the Yiu Lian Dockyards Ltd. used in this assessment is 90 dB(A). However recommendations will be made to minimise the noise levels caused by the reclamation whether the predicted noise levels exceed these criteria or not.

Assessment Methodology

4.17 For modelling purposes, Yiu Lian Dockyards Ltd. staff quarters adjacent to the reclamation site has been chosen as a noise sensitive receiver to assess the construction noise impact of the To Kau Wan reclamation.

4.18 The proposed work programme of the To Kau Wan Reclamation shows that the worst case scenario in terms of noise will happen 5 to 6 months after the commencement of works. At this stage the construction of seawall, filling and the last of the dredging all occur simultaneously. Figure 4.4 shows the timing of this worst case scenario.

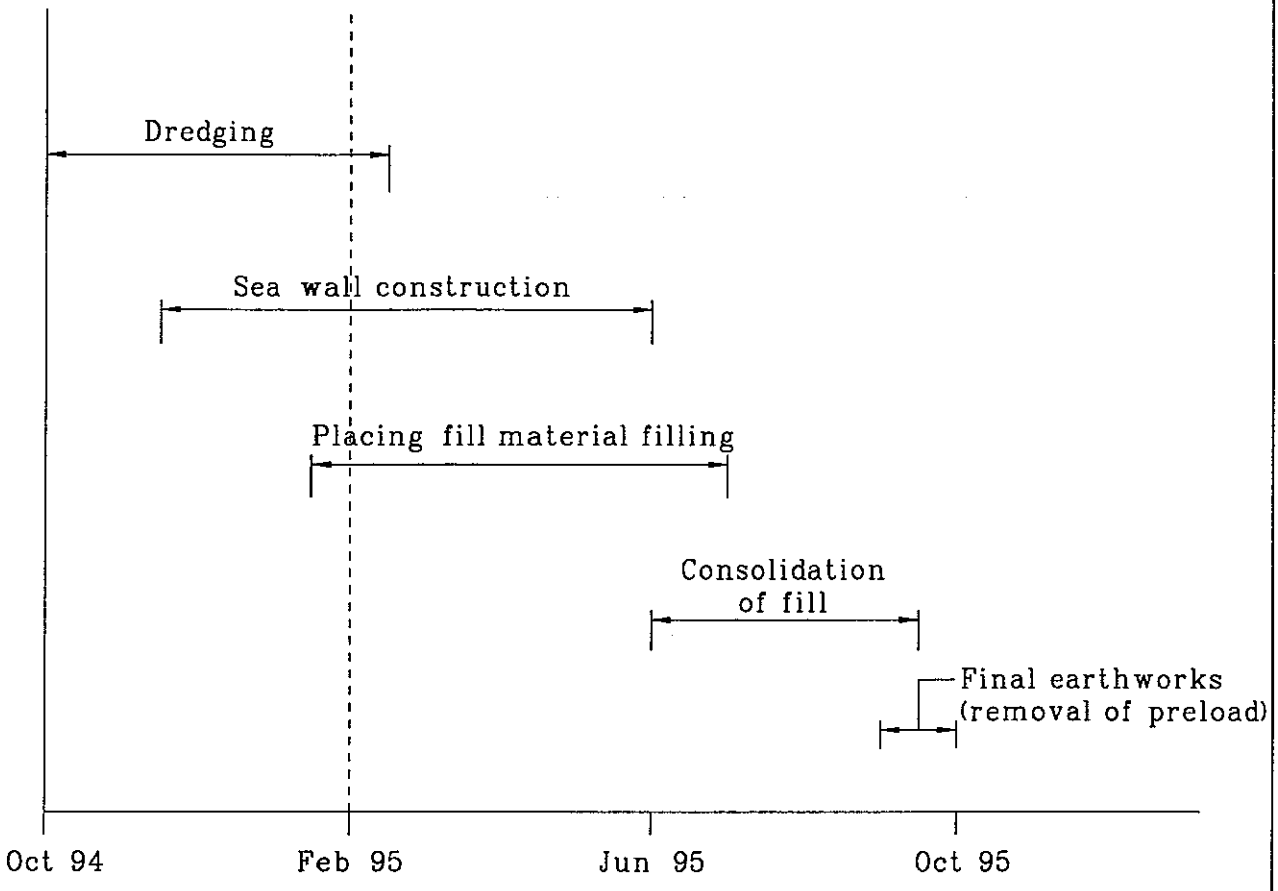
4.19 Under this scenario, all the activities are assumed to occur at points closest to the Yiu Lian Dockyards Ltd. staff quarters. The locations of these points are shown in Figure 4.3.

4.20 The likely types and numbers of the plant and equipment used during each of the major activities at this time is given in Table 4.5. The distances between these points and the Yiu Lian Dockyards Ltd. staff quarters are shown in Table 4.6. For noise assessment purposes, the likely options discussed in Chapter 2 fall into one of two categories, conventional seawall construction and the non-dredging options which involve piling. These latter options still however involve some dredging to be undertaken for the navigation channel and under the Western Revetment.

Table 4.5 Construction Plant and Equipment Required for Reclamation and Site Formation of the To Kau Wan Site

Activity	Equipment	Sound Power Level (dB(A))	No. of Equipment	Sound Power Level for each Activity
Dredging	Grab Dredger	112	2	
	Hopper Barge	104*	2	116 dB(A)
Seawall Construction (Conventional Option)	Hopper Barge	104*	2	
	Diesel, barge mounted crane	112	2	115 dB(A)
Seawall Construction (Piling Option)	Hopper Barge	104*	2	
	Diesel, barge mounted crane	112	2	
	Diesel hammer driving sheet steel pile	132	1	132 dB(A)
Filling	Trailer Suction Dredger	110* ("rainbowing")	1	
	Hopper Barge	104*	1	111 dB(A)

* Estimated figure. All other figures are from Table 3 Source *Sound Power Level for Items of Powered Mechanical Equipment* in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling.*



-------- Time of worst case scenario for noise impact assessment

TO KAU WAN RECLAMATION EIA Title: WORST CASE SCENARIO FOR NOISE IMPACT ASSESSMENT	BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date Feb. 94	Scale N.T.S.
	土木工程署 Civil Engineering Department	Initial WYC	Figure No. 4.4

Table 4.6 Distances between Yiu Lian Dockyards Ltd. Staff Quarters and the Construction Activities (in metres)

Dredging	Seawall Construction	Filling
237	186	144

4.21 The predicted noise levels at the Yiu Lian Dockyards Ltd. staff quarters have been calculated by adding all the sound power levels of the equipment used for each activity logarithmically, minus the distance correction. There is no natural or manmade barriers between the noise sources and receivers hence barrier correction was not considered.

4.22 Total sound power level for an activity
$= 10 \times \{\log_{10} [10^{(P1/10)} + 10^{(P2/10)} + 10^{(P3/10)} + ... + 10^{(Pn/10)}\}$ dB(A)
P1 to Pn are the individual sound power level of each noisy equipment used for that activity, and n the number of equipment used.

4.23 Predicted noise level = {Total sound power level due to each activity - $20 \times \log_{10}(D)$ - 8} dB(A), based on a point source noise propagation model with one reflection surface (hence the -8 dB(A)). D is the distance between the notional noise source for each activity and the Yiu Lian Dockyards Ltd. staff quarters.

Assessment Results

4.24 The predicted noise levels at the Yiu Lian Dockyards Ltd. are presented below in Table 4.7.

Table 4.7 Predicted Noise Levels at Yiu Lian Dockyards Ltd. Staff Quarters

	Predicted Sound Pressure Levels dB(A)			
Seawall Option	Dredging (LD)	Seawall Construction (LS)	Filling (LF)	Total
Conventional	61	62	60	66
Piling Options	61	79	60	79

4.25 Total predicted noise levels (sound pressure levels) for combined activities
$= 10 \times \{\log_{10} [10^{(LD/10)} + 10^{(LS/10)} + 10^{(LF/10)}]\}$
where LD, LS, and LF are the predicted noise levels of dredging, seawall construction and filling respectively.

Implication of the Predicted Noise Levels

4.26 From the assessment results it can be seen that with the piling options, the predicted noise levels are expected to be 13 dB(A) higher than for conventional seawall construction without the need for piling.

4.27 It is expected the overall predicted noise level due to To Kau Wan reclamation at the Yiu Lian Dockyards Ltd. may reach 79 dB(A) with vibrational piling and 66 dB(A) without. These noise levels are acceptable when compared to the proposed noise assessment criteria of 90 dB(A).

4.28 Furthermore, the predicted noise level must be viewed in conjunction with the Yiu Lian Dockyards Ltd. operational noise and many other major construction works in the area to determine its significance in causing noise impact.

4.29 Recommendations for noise mitigation measures are included in Chapter 8.

5. WATER POLLUTION

Scope

5.1 The scope of work undertaken for this EIA in regard to marine water quality has been:

- to collect, assess and interpret existing relevant information;
- to establish an environmental baseline for the study area;
- to assess the potential marine water quality impacts on the existing environment, nearby sensitive uses and the fish culture zone at Ma Wan as a result of the dredging and reclamation works;
- to propose suitable methods for the reduction of any impacts identified to ensure compliance with current environmental standard and guidelines; and
- to minimise any negative impacts upon the nearby environment wherever practicable.

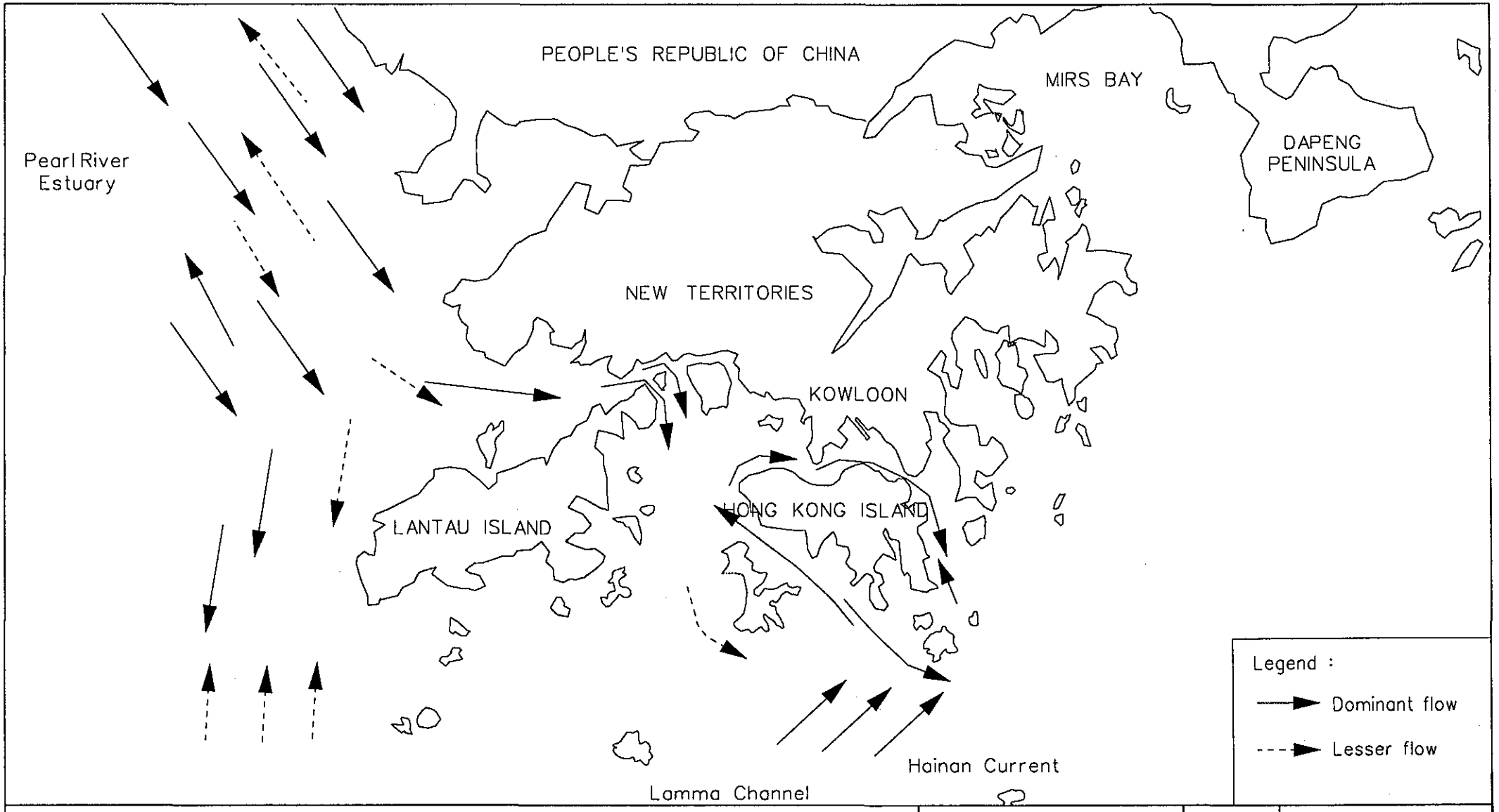
5.2 Chapter 6 *Waste Disposal* reports details of studies undertaken to determine the nature and degree of contamination of the marine muds. In essence, by reducing the impact of dredging as much as practicable the heavy metals in the marine materials on the site will not have substantial adverse impact on the water column.

Introduction

5.3 The coastal waters of Hong Kong are influenced by the fresh water flow of the Pearl River and the ocean currents from the South China Sea. As a result, there is a general shift from estuarine to oceanic conditions in a west to east direction (Figure 5.1 and 5.2)[10]. The influx of fresh water from the Pearl River is more pronounced during the wet seasons.

5.4 Water quality near North Lantau is characterised by pollutant loads transported by the Pearl River.

5.5 Water quality in North Lantau has been and will continue to be affected by all the various construction activities of PADS, as mentioned in Chapter 1. The current vectors in flood and ebb tide with and without the Airport Reclamation have been extracted from the Environmental Impact Assessment report of the New Airport Master Plan[2] and shown in Figures 5.3 and 5.4.



TO KAU WAN RECLAMATION EIA
RESIDUAL FLOWS IN SUMMER

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CONSULTING ENGINEERS

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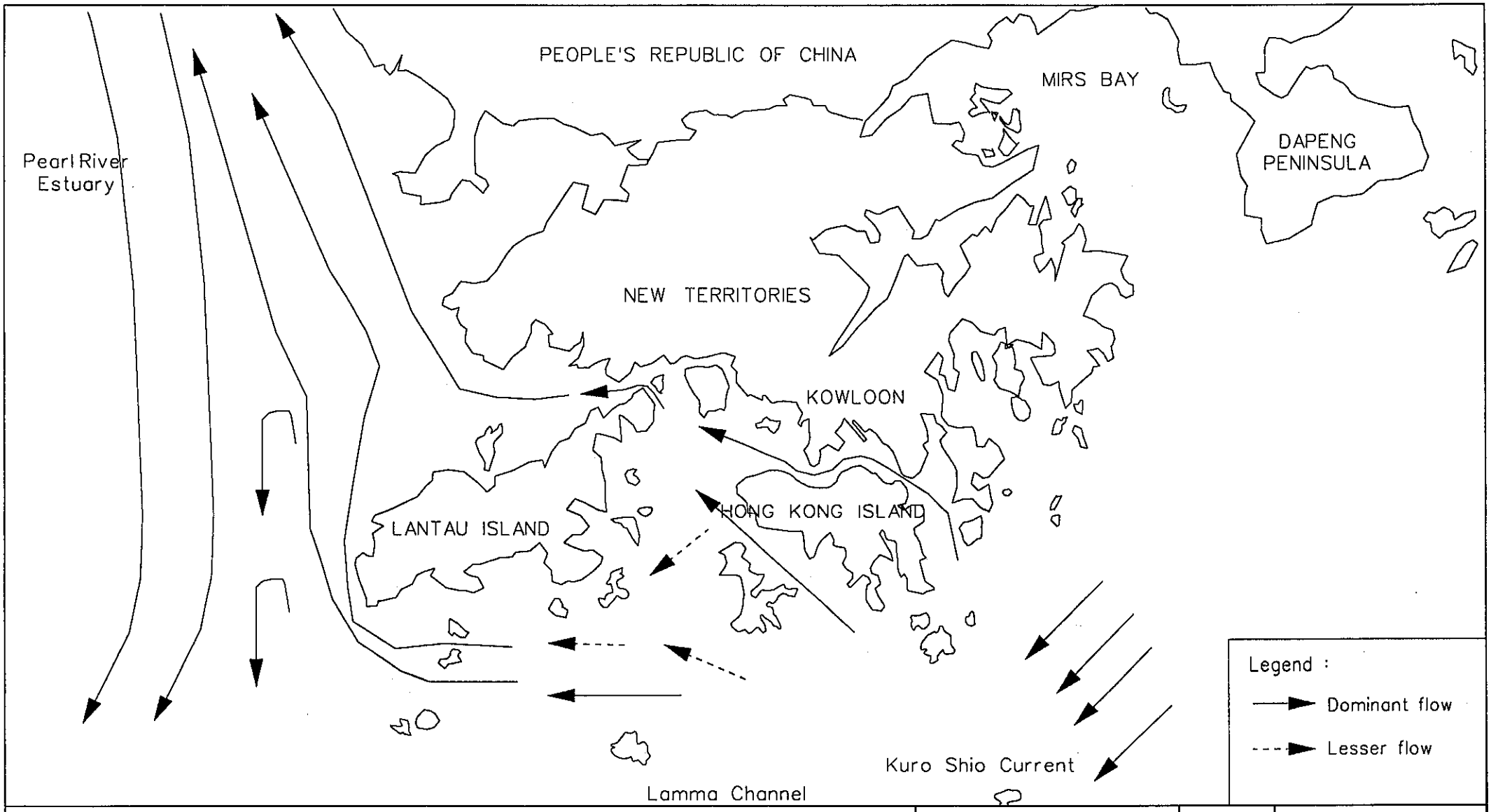
Date	Scale
Feb. 94	N.T.S.
Initial	Figure No.
SHT	5.1



TO KAU WAN RECLAMATION EIA
RESIDUAL FLOWS IN WINTER

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土木工程署 Civil Engineering Department

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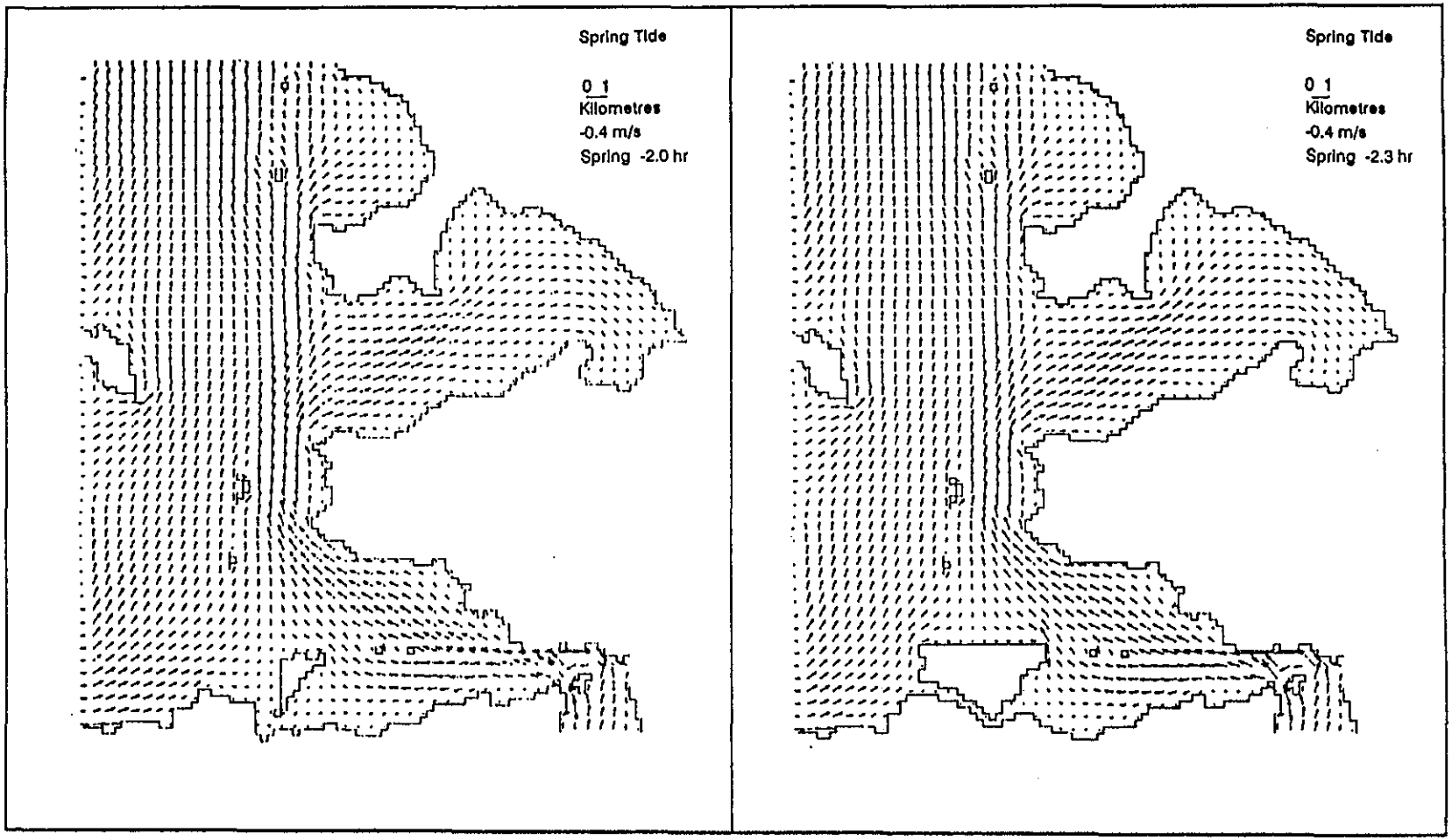
Feb. 94	N.T.S.
Initial	**Figure No.**
SHT	5.2



Wet Season Spring Tide : Peak Flood Velocities with and without the Airport Reclamation Exhibit 6.1

TO KAU WAN RECLAMATION EIA

SOURCE : ENVIRONMENTAL IMPACT ASSESSMENT OF THE NEW AIRPORT MASTER PLAN

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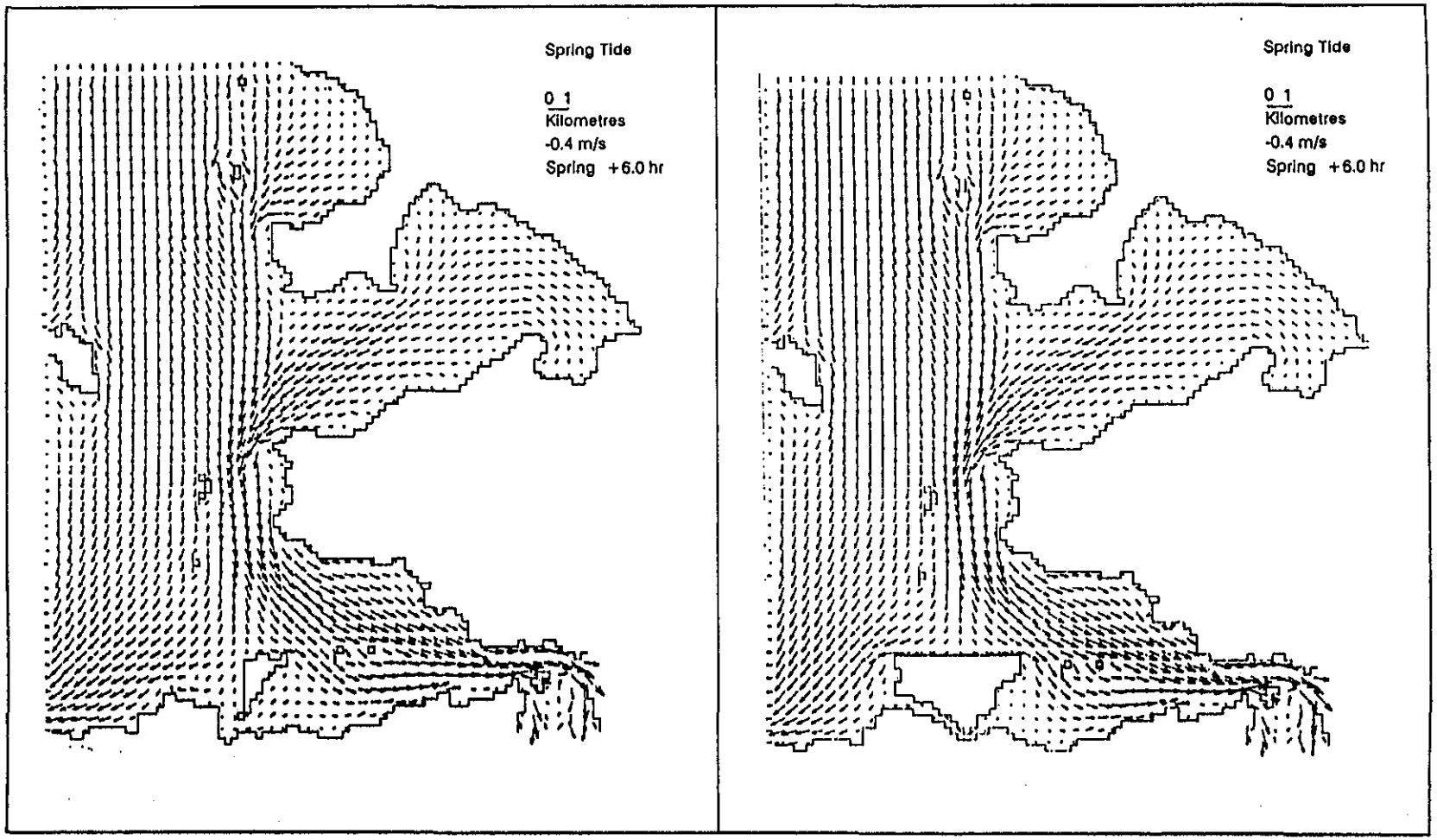
Date	Scale
Feb. 94	N.T.S.
Initial	Figure No.
SHT	5.3



Wet Season Spring Tide : Peak Ebb Velocities with and without the Airport Reclamation Exhibit 6.2

TO KAU WAN RECLAMATION EIA

SOURCE : ENVIRONMENTAL IMPACT ASSESSMENT OF THE NEW AIRPORT MASTER PLAN

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Date	Scale
Feb. 94	N.T.S.
Initial	Figure No.
SHT	5.4

5.6 The Shipyard site at To Kau Wan in North Lantau will be established by reclamation as described in Chapter 1 using marine sand. The major water quality impacts to be assessed under this EIA arise from dredging for the Western Revetment and the seawall (under the conventional option) and increasing the depth of the navigation channel. Marine muds underlying the reclamation area will not be removed and will be covered by the backfilling materials. Up to 0.2 mM^3 may be removed if the conventional seawall option is adopted. At this time this option is the most likely. The dredging period may be as little as two months. Reclamation will be undertaken behind the seawall starting near the coastline.

5.7 The potential impact of dredging may arise from the elevation of suspended solids (SS) levels, depression of dissolved oxygen (DO) levels and the release of contaminants into the water column.

5.8 The water quality impacts of the construction will be assessed in relation to the water quality objectives for North Western Water Control Zone and the Western Buffer Zone as given in detail in Chapter 1.

Sensitive Receivers

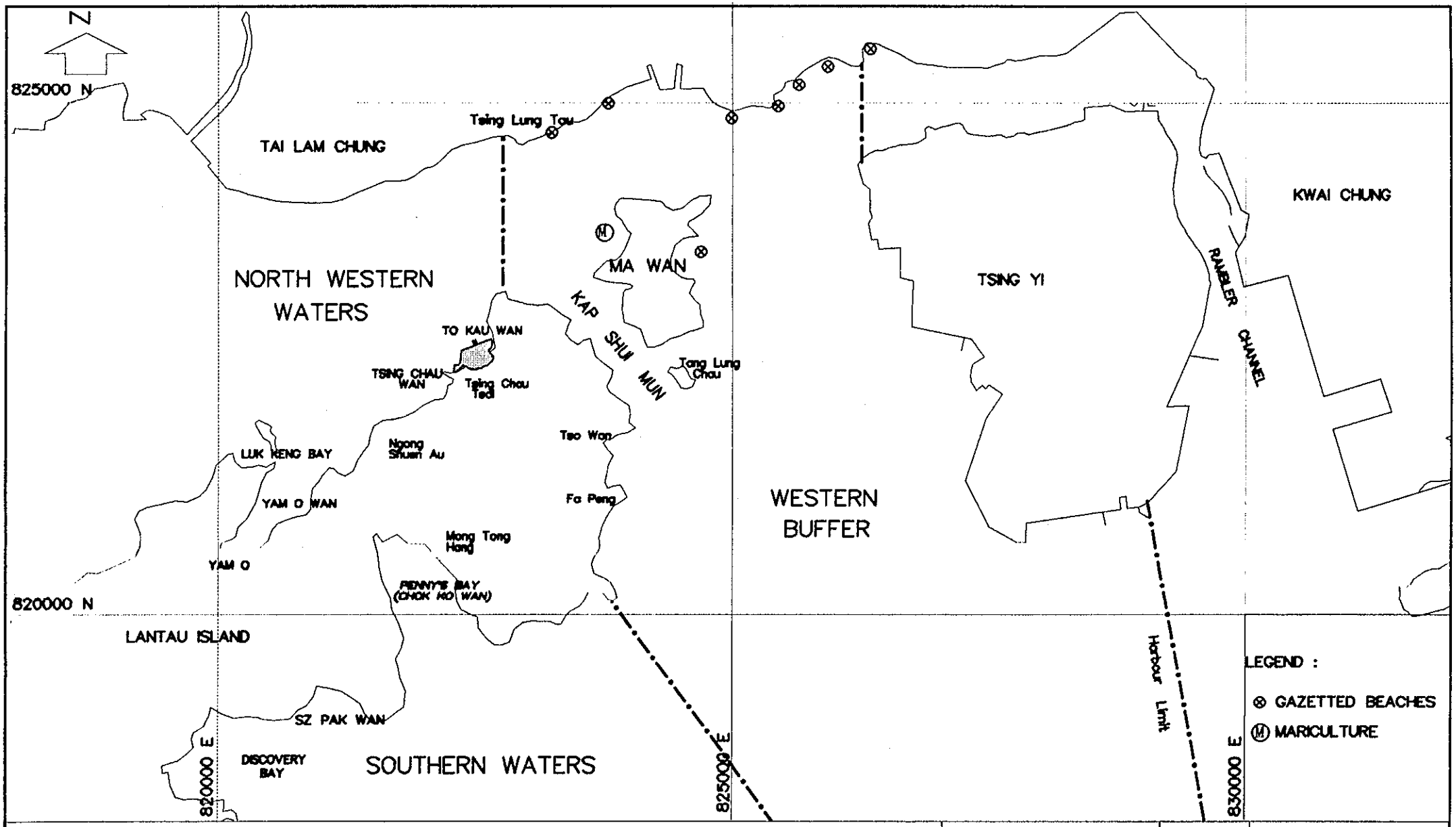
5.9 Sensitive receivers have been identified using definitions given in the Hong Kong Planning Standards and Guidelines[11]. The water quality sensitive receivers are shown in Figure 5.5.

5.10 There are no sensitive biological receivers within the immediate vicinity. The fish culture zone at Ma Wan is regarded as the only potential sensitive receiver of any possible concern. The impact of the project in relation to the local benthic community is discussed in more detail in Chapter 7, *Ecology*.

Background Information Analysis on Marine Water Quality

5.11 Three sets of marine water quality monitoring data relative to the study area have been obtained from three different monitoring and audit programmes in North Lantau:

- "Yam O section of the North Lantau Expressway, Contract No. HY/91/08" (YOW);
- "Kap Shui Mun Bridge & Ma Wan Viaduct of the Lantau Fixed Crossing, Contract No. HY/91/19" (LFC); and
- "Tai Ho Section of the North Lantau Expressway, Contract No. HY/91/07" (MB).



TO KAU WAN RECLAMATION EIA

WATER QUALITY ZONES AND SENSITIVE RECEIVERS

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土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 5.5

5.12 Only the most relevant information from the above three monitoring programmes have been analysed for this study. Data has been evaluated from the following monitoring stations:

- Yam O Section (YOW): Stations YOW21-YOW25 with a corresponding control station YOW31, from March, 1993 to December, 1993;
- Lantau Fixed Crossing (LFC): Stations LFC12, LFC13 and LFC14, from April, 1993 to December, 1993; and
- North of Lantau Marine Borrow Area (MB): Stations MB11 and MB12, from July, 1993 to December, 1993.

The positions of these stations are shown on Figure 5.6.

5.13 The following water quality parameters were measured at the YOW and LFC monitoring stations:

- Dissolved Oxygen (DO) in mg/l,
- Turbidity in NTU,
- Suspended Solids (SS) in mg/l,
- DO saturation (DOS) in %, and
- water temperature in °C

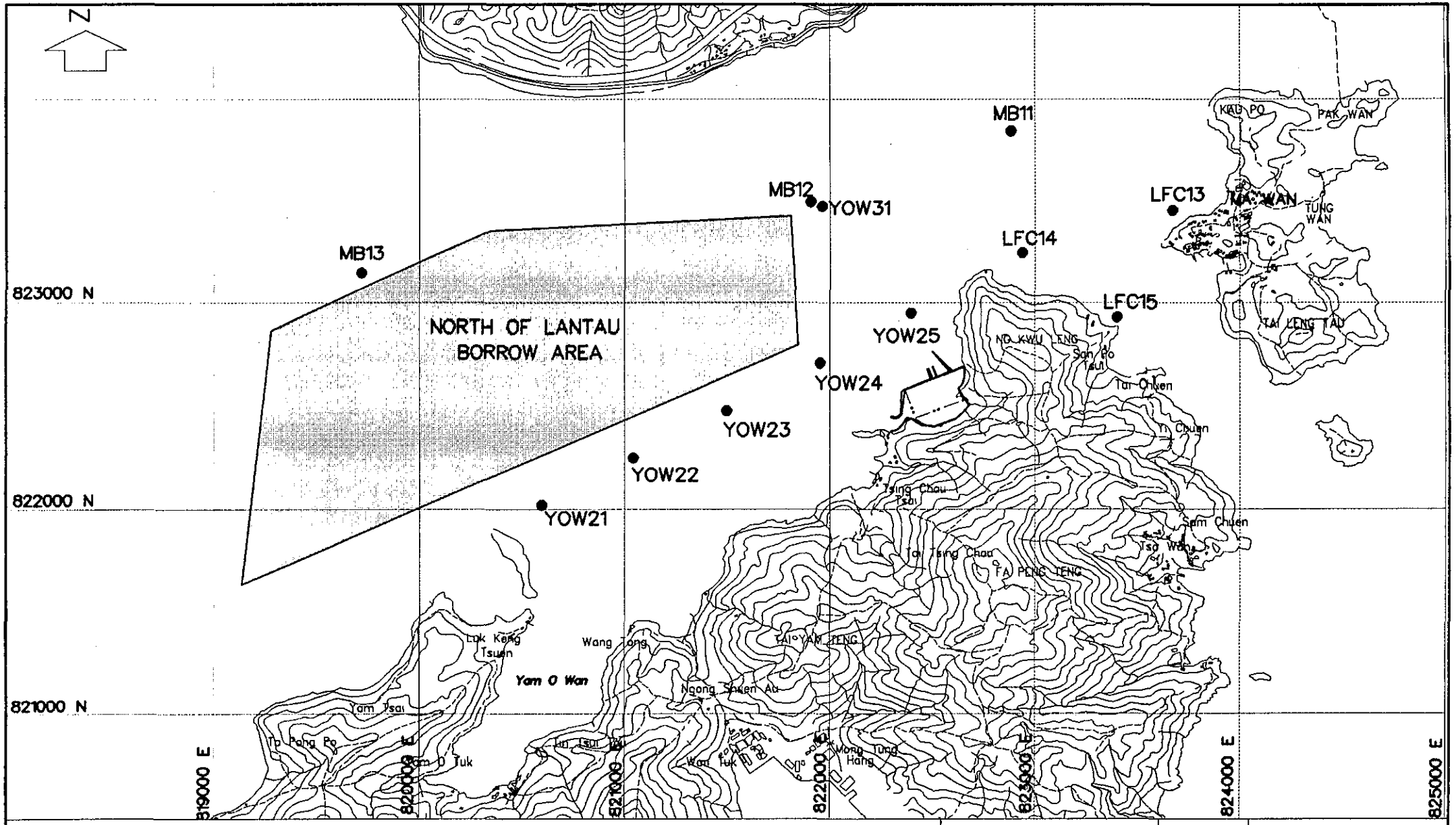
5.14 SS, DO and turbidity data were obtained from the MB monitoring stations. The LFC data was collected during both flood and ebb tides, the YOW data just once on each sampling occasion.

5.15 At each monitoring station (Figure 5.6), the water quality impact monitoring was carried out two sampling days per week, except in March (1 sampling for SS). Measurements were taken at three water depths:

- 1 m below water surface,
- mid-water depth, and
- 1 m above sea bed.

5.16 The background information analysis on marine water quality presented in this report has examined three parameters in detail:

- Suspended Solids,
- Dissolved Oxygen, and
- Turbidity.



TO KAU WAN RECLAMATION EIA

BACKGROUND WATER QUALITY MONITORING STATIONS

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 25000
土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 5.6

5.17 Monthly maximum, minimum and mean depth-averaged values of SS, DO and turbidity for YOW stations and LFC stations have been calculated and are given in Tables 5.1 to 5.3 respectively.

5.18 The monthly mean depth-averaged of SS, DO and turbidity are presented graphically in Graphs 5.1, 5.7 and 5.11 respectively.

5.19 The difference in SS levels between surface and bottom water layers observed at each monitoring station has been plotted:

- monthly surface-level-averaged variation in SS (Graph 5.2);
- monthly bottom-level-averaged variation in SS (Graph 5.3).

5.20 Data obtained from the North of Lantau Marine Borrow Area (MB11 and 12) have been plotted for three different water levels and compared with the control station, YOW31 in order to more fully assess the water quality in this critical area.

- SS - Graphs 5.4 to 5.6;
- DO - Graphs 5.8 to 5.10; and
- Turbidity - Graphs 5.12 to 5.14.

5.21 Individual plots of SS, DO and turbidity for each monitoring station (YOW and LFC) are presented in Graphs 5.15 - 5.22, 5.23 - 5.30, 5.31 - 5.38 respectively. They can be found at the back of this chapter.

Suspended Solids

Data Analysis

5.22 'Total solids' is the term applied to the material residue left in the vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature. That is, 'total solids' refers to all matter in a water sample minus the water (and any other volatile matter). When a water sample is filtered using a nominal pore size of 2.0 μm, some of the 'total solids' is retained on the filter paper. This is known as the '*suspended solids*'. The filtered solution contains the 'dissolved solids'. SS is an indicator of the intensity of dredging activities around the study area.

5.23 Monthly depth-averaged variation in suspended solids for the stations YOW21-YOW25, YOW31 from March, 1993 to December, 1993 and stations LFC13-LFC15 from April, 1993 to December, 1993 are presented graphically in Graph 5.1. There was a significant drop in suspended solids at stations YOW21-YOW25 and YOW31 during March, 1993. There was a peak in September, 1993. An obvious rising trend in SS levels was observed from July to December, 1993.

5.24 At Yam O station (YOW21-25 and YOW31), the depth-averaged suspended solids ranged between 2 and 350 mg/l during March to December, 1993 (Table 5.1, Graph 5.1). All graphs show that suspended solids loading increased with depth as would be expected.

5.25 The depth-averaged SS at Kap Shui Mun stations (LFC13-15) ranged between 2 and 250 mg/l with high levels measured near the bottom (Table 5.1, Graph 5.1).

5.26 Comparatively high levels of SS were generally observed in the LFC monitoring stations. The mean of depth-averaged values ranged between 9 mg/l and 68 mg/l at LFC stations, as shown in Table 5.1 and Graph 5.3, while the mean depth-averaged values at YOW stations ranged between 9 mg/l and 92 mg/l. The corresponding control station, YOW31, showed relatively low SS levels (i.e. less than 30 mg/l, except in December, 1993) throughout the study period.

5.27 Monthly surface-level-averaged variation in SS (Graph 5.2) showed peaks in August, September and December. The LFC stations had higher surface SS levels than the Yam O stations. For the Yam O stations, YOW21 and YOW25 showed higher surface SS levels than the other. There was an obvious increasing trend in SS levels from October to December, 1993.

5.28 Monthly bottom-level-averaged variation in SS (Graph 5.3) had obvious peaks in March and December. The highest level was 160 mg/l in March measured at station YOW25. An increasing trend from October to December was also observed, but the levels in bottom waters nearly two times greater than those in surface waters.

5.29 Comparing the SS levels in the YOW control station, YOW31 (Graph 5.4) and the marine borrow area monitoring stations , MB11 and 12 (Graphs 5.5 and 5.6), the water quality near to the borrow area showed greater variation and higher levels of SS during July to December.

5.30 The individual variation plots (Graphs 5.15 - 5.22 at the back of this Chapter), show higher levels and greater variation in the bottom levels for both YOW and LFC stations. Significant peaks in August and September were observed in all LFC stations. The peak levels were about 250 mg/l at LFC14 in bottom waters.

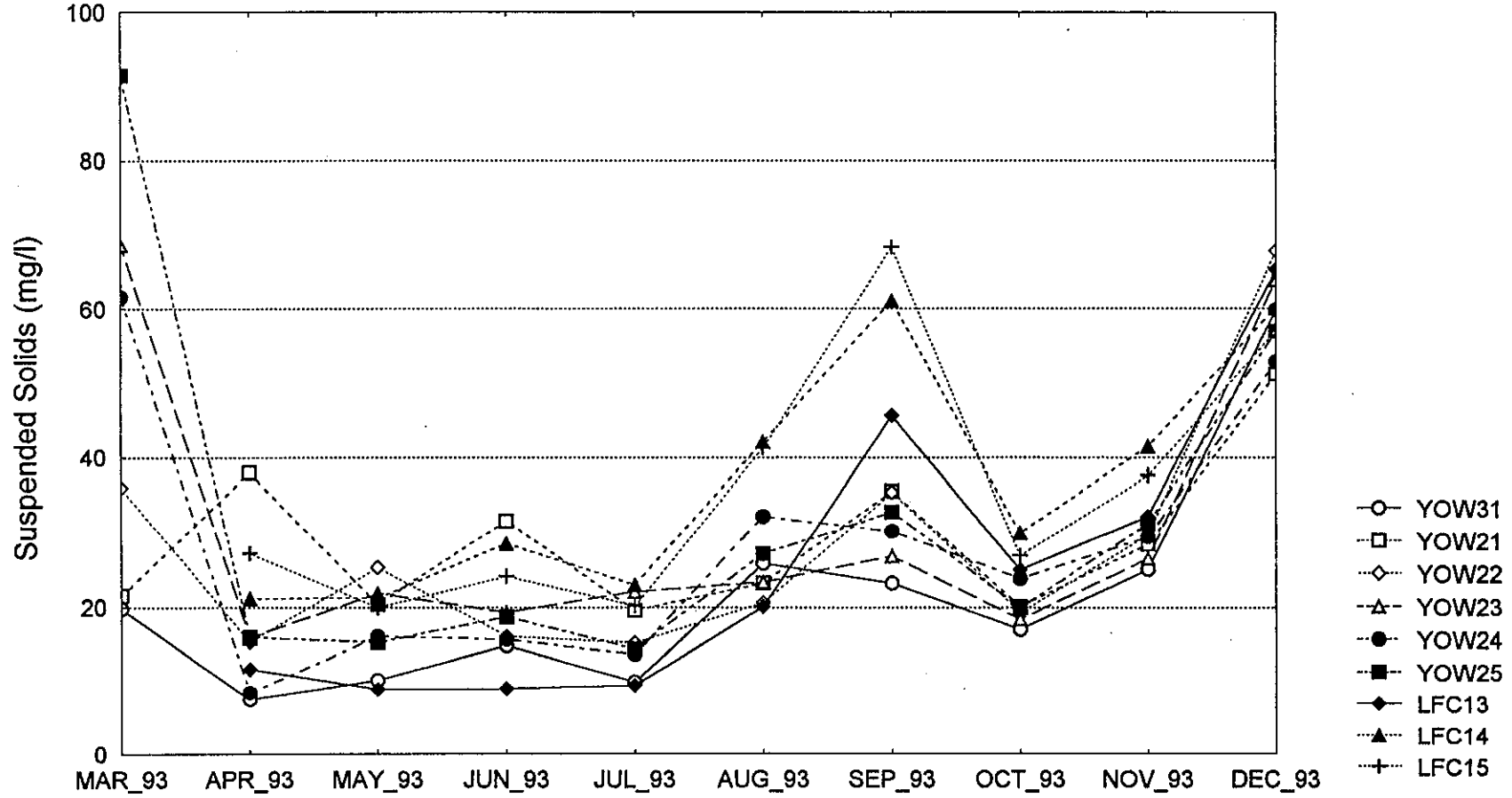
5.31 In the Yam O monitoring data, the peak value of SS was close to 400 mg/l at YOW23 in bottom waters.

Table 5.1 Suspended Solid in Marine Water (YOW and LFC Data) over the period March to December, 1993

Monitoring Station	Suspended Solids Concentration (mg/l)									
	Mar 93	Apr 93	May 93	Jun 93	Jul 93	Aug 93	Sep 93	Oct 93	Nov 93	Dec 93
YOW 21										
Range	--	5 - 18	5 - 57	9 - 79	8 - 52	8 - 37	13 - 83	10 - 33	13 - 78	9 - 107
Mean	22	38	20	32	20	23	36	20	28	51
YOW22										
Range	--	6 - 24	5 - 59	3 - 31	8 - 29	6 - 36	11 - 78	9 - 34	13 - 76	18 - 181
Mean	36	15	25	16	15	21	35	19	30	68
YOW23										
Range	--	5 - 57	4 - 63	6 - 33	7 - 61	6 - 47	8 - 74	7 - 37	12 - 50	18 - 184
Mean	69	16	19	19	22	23	27	18	27	64
YOW24										
Range	--	3 - 19	5 - 36	4 - 43	9 - 35	5 - 50	12 - 81	10 - 59	14 - 66	20 - 100
Mean	62	9	16	16	14	32	30	24	29	53
YOW25										
Range	--	5 - 70	7 - 39	3 - 38	8 - 33	7 - 47	13 - 82	6 - 47	12 - 76	15 - 116
Mean	92	16	15	19	15	27	33	20	31	57
YOW31										
Range	--	3 - 14	4 - 18	2 - 39	7 - 15	5 - 59	10 - 58	6 - 30	10 - 60	18 - 107
Mean	20	8	10	15	10	26	23	17	25	60
LFC13										
Range	N.D.	2 - 51	3 - 32	1 - 38	4 - 57	2 - 216	5 - 182	5 - 94	4 - 147	14 - 128
Mean		12	9	9	10	20	46	25	32	65
LFC14										
Range	N.D.	2 - 62	4 - 66	3 - 77	5 - 141	2- 307	12 - 257	8 - 90	5 - 146	12 - 137
Mean		21	21	29	23	42	61	30	42	60
LFC15										
Range	N.D.	3 - 99	4 - 61	2 - 65	6 - 88	2 - 267	10 - 239	9 - 67	6 - 141	11 - 130
Mean		27	20	24	20	41	68	27	38	57

Note:
1. Only one set of sampling data was obtained from YOW stations in Mar 93
2. N.D. = no data
3. YOW31 is the YOW control station
4. Figures presented are depth-averaged data
5. Surface: 1 m below water surface
   Middle : mid-depth of water column
   Bottom : 1 m above seabed

Monthly Depth-averaged Variation in Suspended Solids during April to December, 1993

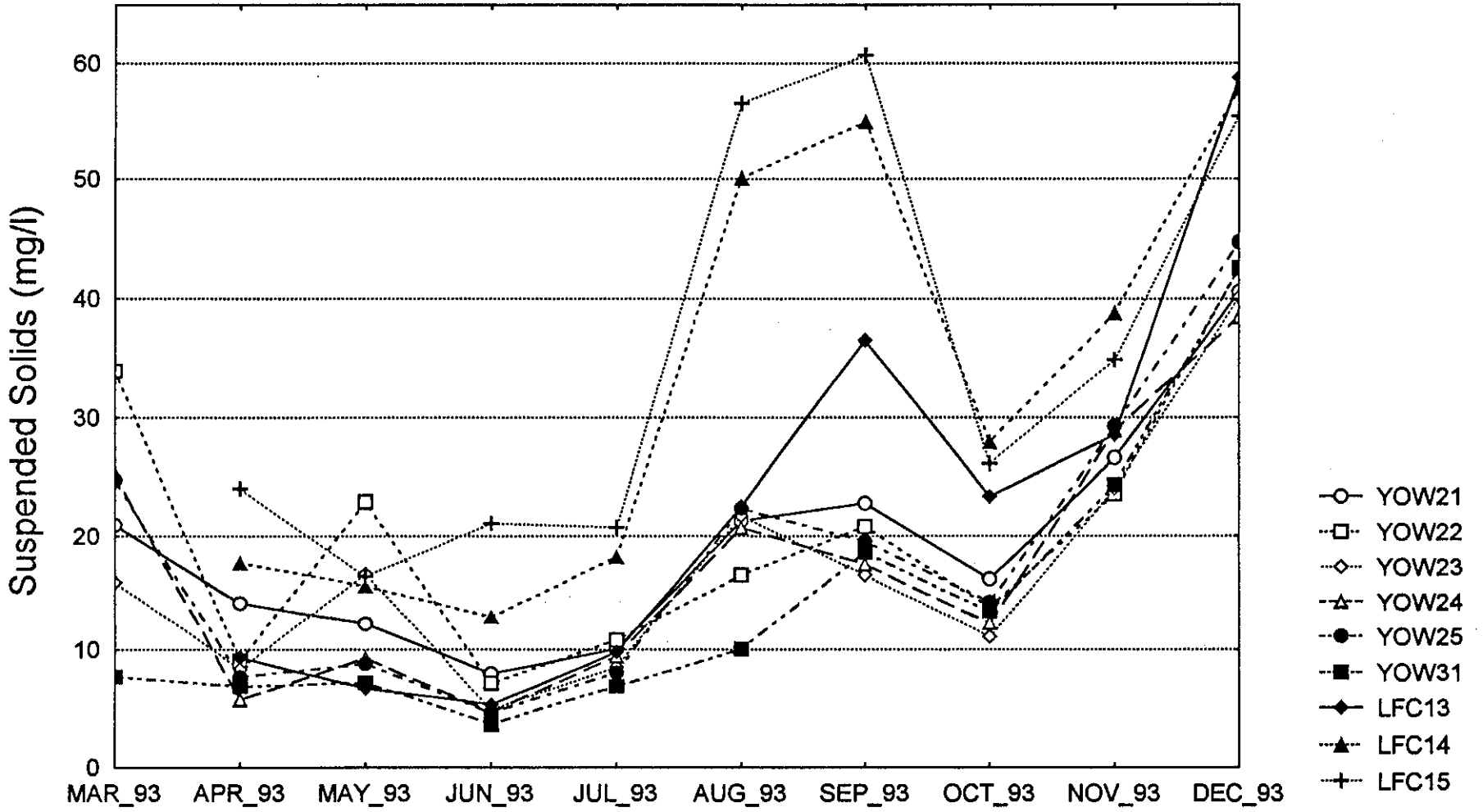


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB. 94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.1

Monthly Surface-level-averaged Variation in Suspended Solids during March to December, 1993



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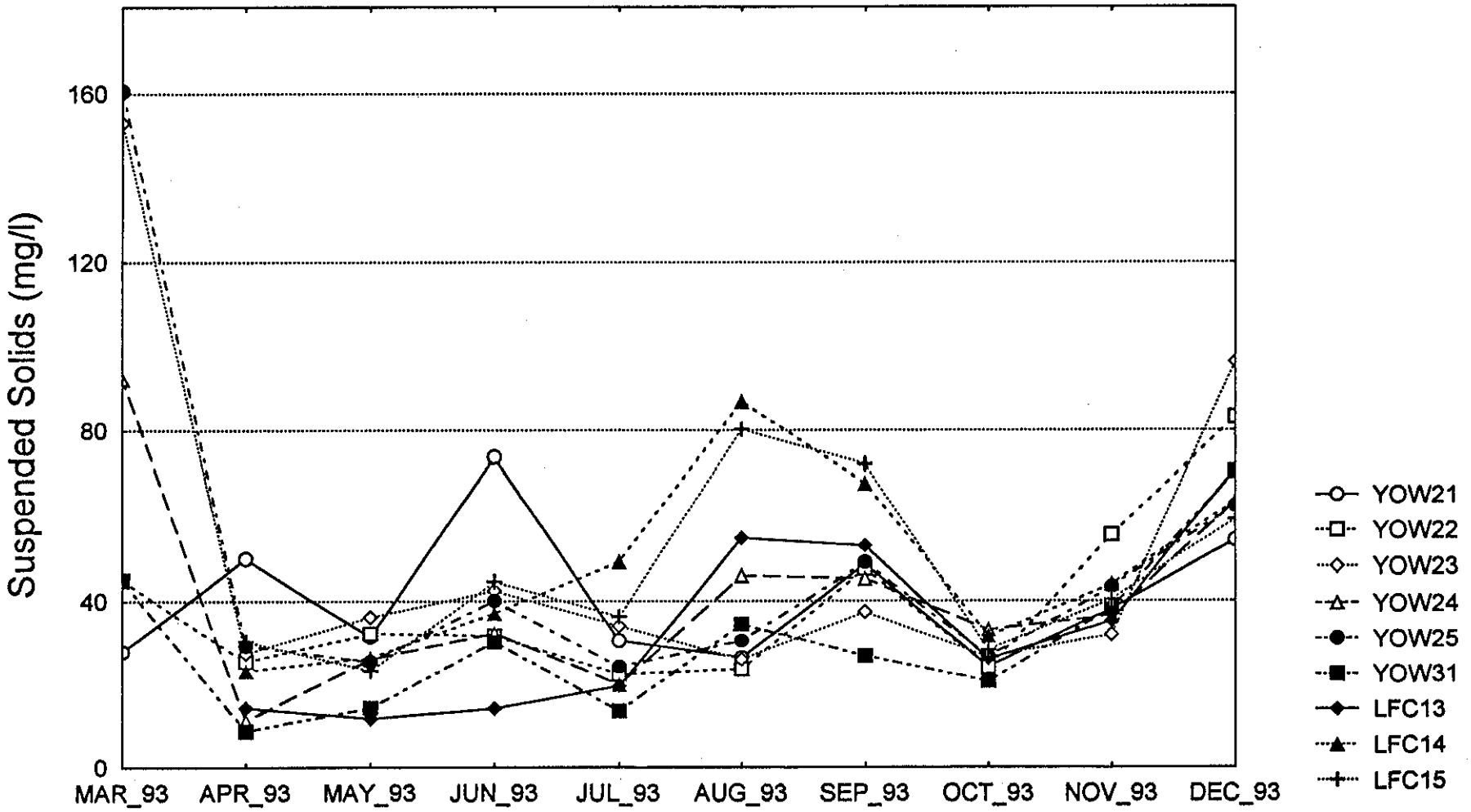
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.2

Monthly Bottom-level-averaged Variation in Suspended Solids during March to December, 1993

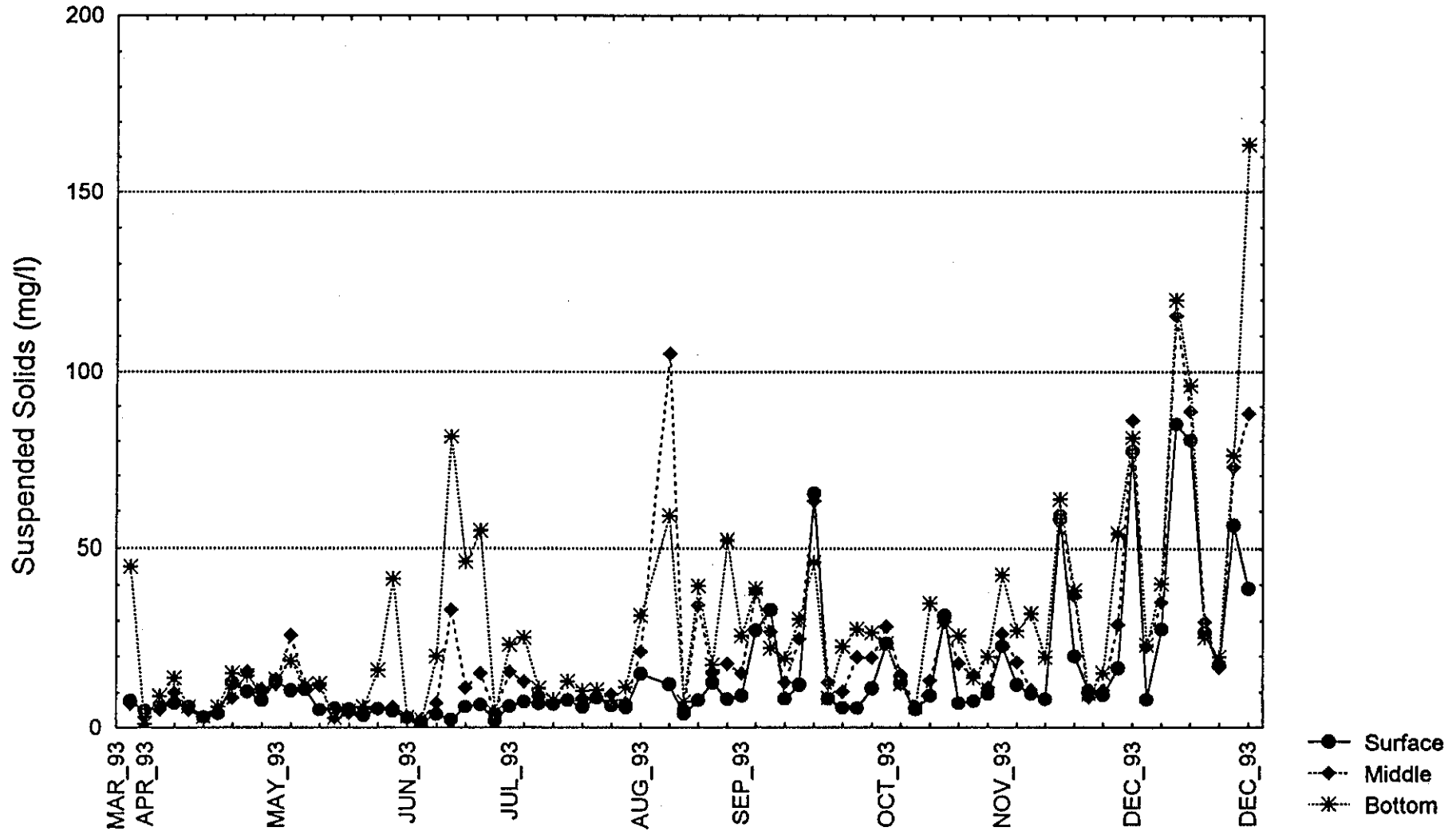


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.3

Variation in Suspended Solids at YOW31 during April to December, 1993

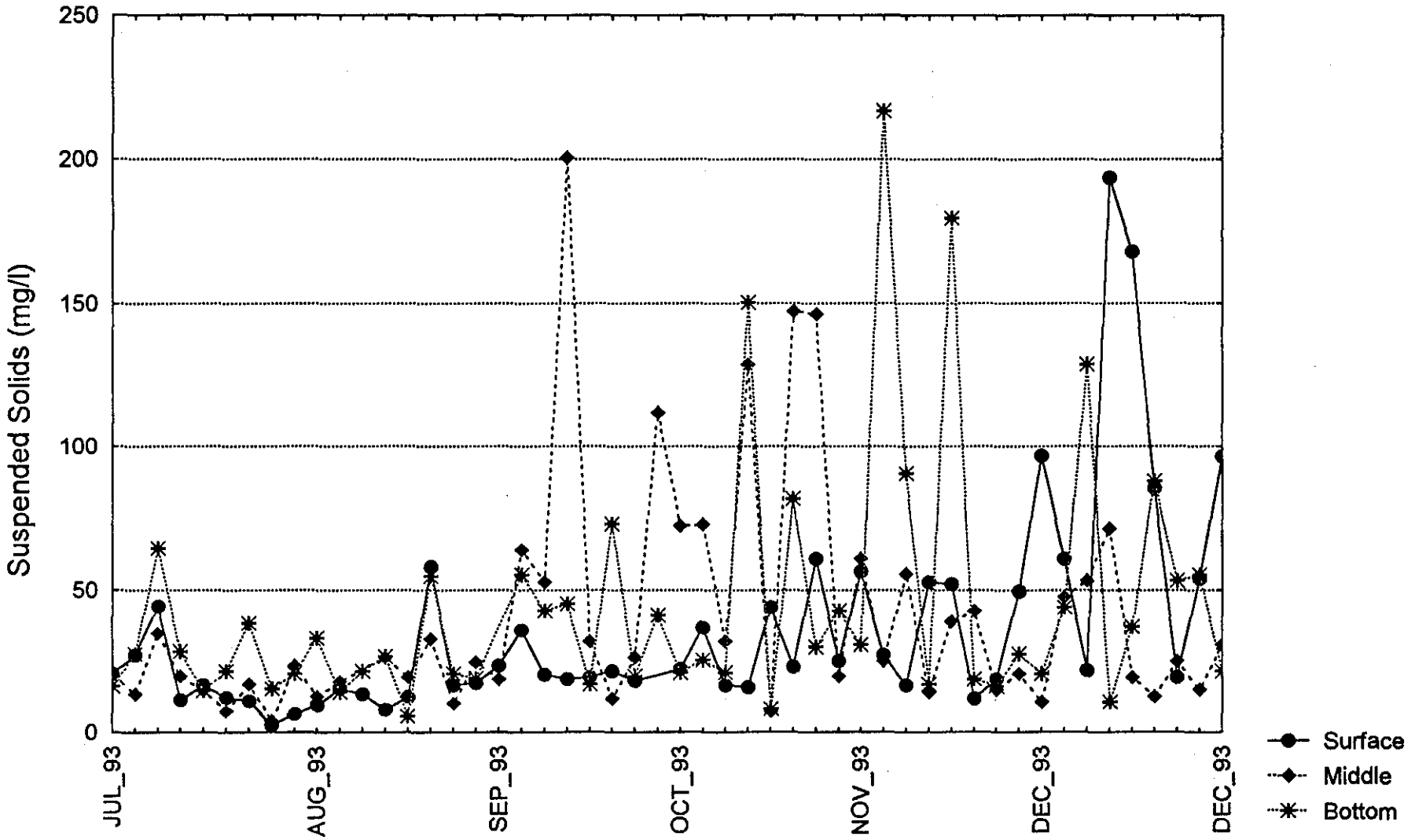


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 寶尼工程顧問有限公司 CONSULTING ENGINEERS 寶尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.4

Variation in Suspended Solids at MB11 during July to December, 1993

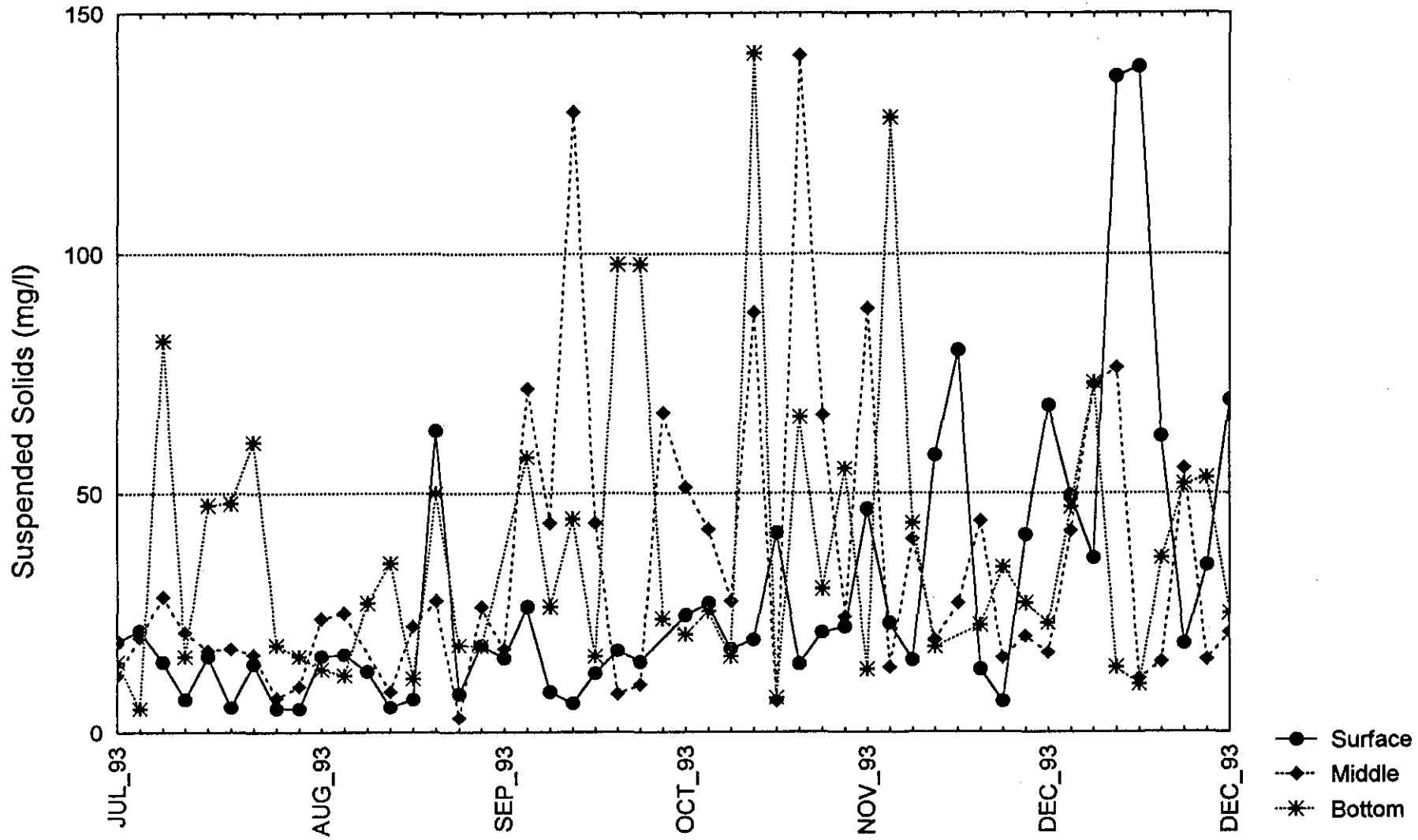


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.5

Variation in Suspended Solids at MB12 during July to December, 1993



TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

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土木工程署 Civil Engineering Department	Initial: YPS	Graph No.: 5.6

Potential Marine Water Quality Impact

5.32 SS is an indicator of dredging activities and this was reflected in the high SS levels measured near the site in 1993 indicating the extensive dredging activities in the area.

5.33 The high levels of suspended solids in the bottom layer might reflect high amount of settleable material.

5.34 Extensive dredging activities in the marine borrow areas between Tuen Mun and North Lantau Island have been taking place since November, 1992 and will continue throughout the To Kau Wan Construction period.

5.35 The closest marine borrow area to To Kau Wan (0.8 km) has been dredged since November, 1992 and is proposed for use until September, 1994 for the "North Lantau Expressway - Tai Ho Section (HY/91/07)" project. The fill volume of this marine borrow area has been estimated to be 24.00 Mm^3 which will be used for the Tai Ho section of North Lantau Expressway.

5.36 Marine water quality may improve after the commencement of the To Kau Wan Project when the nearby borrow area is shut down. However extensive reclamation work near the site will be undertaken in this period.

5.37 Visual observations from the hill behind the site determined an obvious dredging plume crossing the site area from the nearby dredging activities in Tsing Chai Wan under the of Toll Plaza contracts. It was also observed that the plume did not extend very far.

5.38 Figure 5.7 is a copy of an aerial photograph taken over Ma Wan. It clearly shows the fish culture zone at Ma Wan. A plume of suspended material can be seen extending from the north-east tip of Lantau down the Kap Shui Mun Channel.

Dissolved Oxygen

Data Analysis

5.39 Oxygen dissolved in seawater (DO) is an indicator of organic pollution. When organic pollution is high, the dissolved oxygen content can fall to a level where normal aquatic life cannot be supported. Therefore, low dissolved oxygen concentration is generally an indication of organic pollution. When SS are raised during dredging, DO levels are affected to varying degrees dependent upon the chemical nature of the sediment disturbed.

5.40 The level of oxygen dissolved in seawater also varies with changes in temperature, atmospheric pressure, the degree of water turbulence and mixing.

5.41 Water Quality Objective for North Western Marine Waters were given in detail in Chapter 1. They include the following:

"Depth averaged dissolved oxygen - in marine waters	not less than 4 mg/l for 90% of samples;
Dissolved Oxygen within 2 m of bottom - in marine waters	not less than 2 mg/l for 90% of samples;

5.42 The depth averaged DO levels in fish culture subzones in Western Buffer should not be less than 5 mg/l for 90% of samples.

5.43 The DO levels around the coast of North Lantau Island are generally acceptable due to the open marine waters and good flushing capacity, especially in the Kap Shui Mun channel.

5.44 The minimum and maximum depth-averaged DO saturation in Yam O section were 58.67% at station YOW24 in September, 1993 and 138.67% at station YOW21 in August, 1993 respectively. The DO concentrations in Kap Shui Mun channel were greater than 60% saturation as an average throughout the water column.

5.45 Monthly depth-averaged variation in dissolved oxygen (DO) indicated compliance with the EPD objectives (Table 5.2, Graph 5.7). The DO levels of the Yam O and Kap Shui Mun marine monitoring stations ranged between 4 mg/l and 8 mg/l. A steady trend of increasing DO levels was observed during September and December, 1993 at all stations.

5.46 Examination of DO data in Table 5.2 indicates well oxygenated conditions in the inshore waters with dissolved oxygen levels around 6 mg/l. Not unexpectedly there was little evidence of faecal contamination offshore at To Kau Wan.

5.47 The DO levels recorded at YOW31 were comparatively lower. The exceedance of the WQO (4 mg/l) was common during August and September at the control station, YOW31 (Graph 5.8). Surface and middle layers were observed to be lower than 4 mg/l in September on some sampling occasions. The lowest DO value (close to 3 mg/l) was in August.

5.48 Data obtained from the marine borrow area monitoring stations MB11 and MB12 (Graphs 5.9 and 5.10) showed well-oxygenated conditions. The DO levels in these two stations ranged between 4 and 9 mg/l. Surprisingly, the marine borrow area monitoring stations showed better oxygenated condition than the control station, YOW31 (Graph 5.8).

5.49 The plots of individual stations show that DO at Yam O stations (YOW21-25 and YOW31) ranged between 3 and 11 mg/l During March to December, 1993 (Table 5.2, Graphs 5.16). During the same period, DO ranged between 4 and 9 mg/l at Kap Shui Mun stations (Table 5.2, Graphs 5.16),.

TO KAU WAN RECLAMATION EIA

AERIAL PHOTOGRAPH OF MA WAN
19th AUGUST, 1993 AT 10,000 FEET
SOURCE : SURVEY & MAPPING OFFICE,
HONG KONG GOVERNMENT (CN 4262)

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Civil Engineering Department

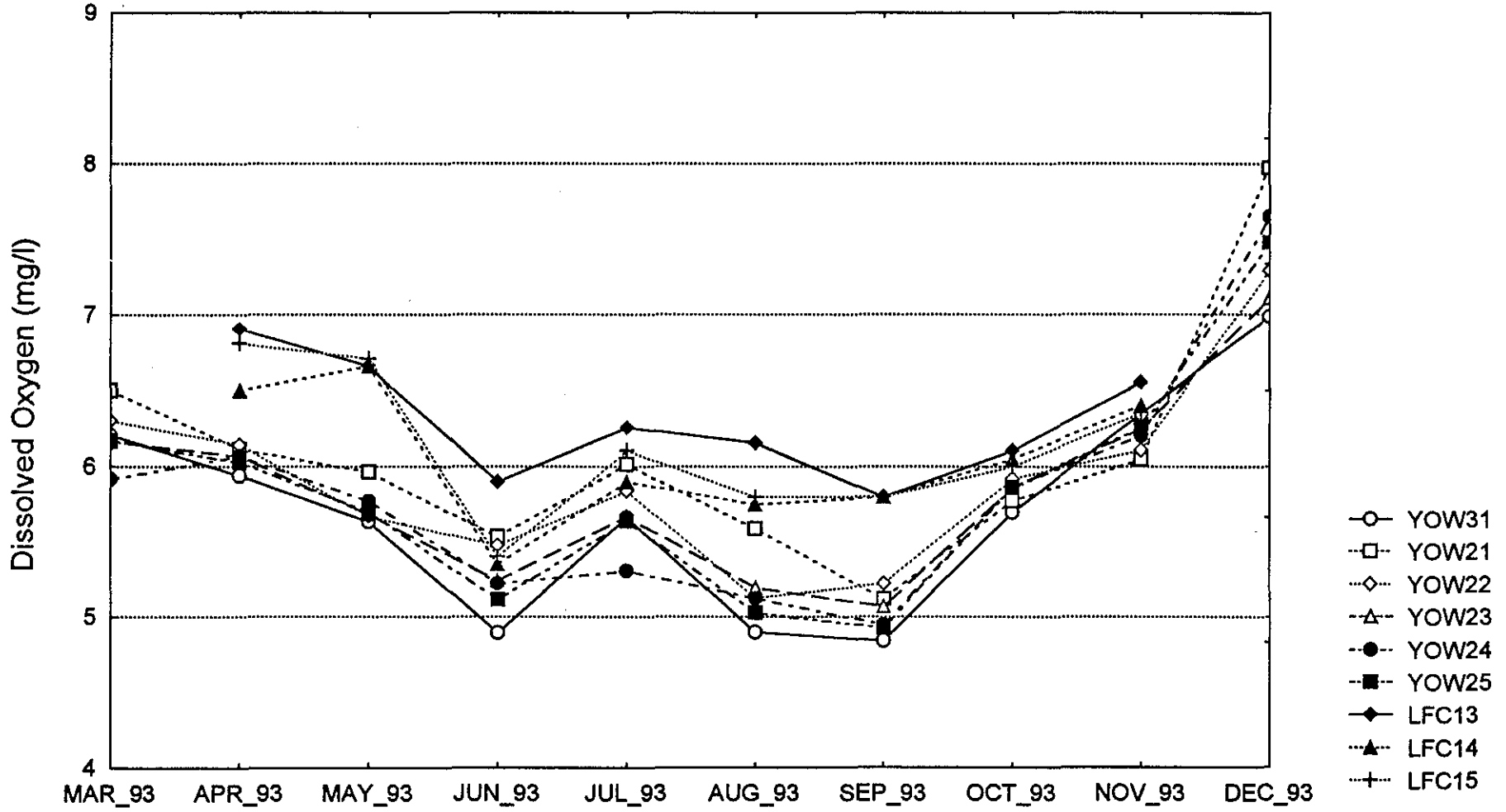
Date	Scale
Feb. 94	N.T.S.
Initial	Figure No.
SHT	5.7

Table 5.2 Dissolved Oxygen in Marine Water (YOW and LFC Data) over the period March to December, 1993

Monitoring Station	Dissolved Oxygen Concentration (mg/l)									
	Mar 93	Apr 93	May 93	Jun 93	Jul 93	Aug 93	Sep 93	Oct 93	Nov 93	Dec 93
YOW 21										
Range	5.8 - 7.2	5.5 - 7.0	4.5 - 6.9	4.8 - 6.8	5.3 - 6.5	4.1 - 9.5	4.2 - 5.8	5.0 - 6.5	4.7 - 7.4	6.4 - 9.8
Mean	6.5	6.1	6.0	5.5	6.0	5.6	5.1	5.8	6.0	8.0
YOW22										
Range	5.6 - 7.1	5.7 - 7.3	4.4 - 6.9	4.7 - 6.8	5.3 - 6.5	4.2 - 6.5	4.1 - 6.3	5.0 - 8.0	4.7 - 7.7	6.2 - 8.8
Mean	6.3	6.1	5.7	5.5	5.8	5.1	5.2	5.9	6.1	7.3
YOW23										
Range	5.6 - 7.8	5.7 - 7.1	4.5 - 6.8	4.6 - 5.6	5.2 - 6.1	4.4 - 6.0	4.0 - 6.3	4.8 - 7.8	4.6 - 7.9	6.0 - 9.0
Mean	6.2	6.1	5.7	5.2	5.7	5.2	5.1	5.9	6.2	7.1
YOW24										
Range	5.5 - 6.8	5.6 - 24.5	4.9 - 6.5	4.4 - 6.0	3.6 - 6.1	4.4 - 6.0	3.9 - 5.7	4.6 - 8.2	4.6 - 7.7	6.1 - 10.0
Mean	5.9	6.1	5.8	5.2	5.3	5.1	4.9	5.9	6.2	7.6
YOW25										
Range	5.6 - 7.3	5.6 - 7.0	4.8 - 6.4	4.4 - 5.9	5.3 - 5.8	4.3 - 5.7	3.9 - 5.4	4.6 - 8.1	4.6 - 7.9	5.6 - 9.3
Mean	6.2	6.0	5.7	5.1	5.6	5.0	4.9	5.9	6.3	7.5
YOW31										
Range	5.6 - 7.3	5.5 - 7.1	4.5 - 6.5	4.2 - 5.6	5.2 - 6.0	4.0 - 5.6	3.5 - 5.3	4.5 - 6.6	4.5 - 7.9	5.5 - 8.8
Mean	6.2	5.9	5.6	4.9	5.7	4.9	4.8	5.7	6.3	7.7
LFC13										N.D.
Range	N.D.	5.2 - 9.4	5.8 - 7.7	4.1 - 7.4	4.6 - 8.0	4.8 - 7.9	5.2 - 6.5	5.0 - 7.1	5.9 - 7.3	
Mean		6.9	6.7	5.9	6.3	6.2	5.8	6.1	6.6	
LFC14										
Range	N.D.	0.0 - 9.3	5.7 - 7.8	4.3 - 6.6	4.2 - 7.5	4.7 - 6.9	5.1 - 6.6	5.4 - 6.9	5.7 - 7.0	N.D.
Mean		6.5	6.7	5.4	5.9	5.8	5.8	6.1	6.4	
LFC15										N.D.
Range	N.D.	5.4 - 9.2	5.8 - 7.7	4.3 - 6.6	4.3 - 7.4	4.9 - 6.8	5.1 - 6.3	5.4 - 7.0	5.6 - 7.1	
Mean		6.8	6.7	5.4	6.1	5.8	5.8	6.0	6.4	

Note:
1. N.D. = no data
2. YOW31 is the YOW control station
3. Figures presented are depth-averaged data
4. Surface: 1 m below water surface
   Middle : mid-depth of water column
   Bottom : 1 m above seabed

Monthly Depth-averaged Variation in Dissolved Oxygen during April to November, 1993



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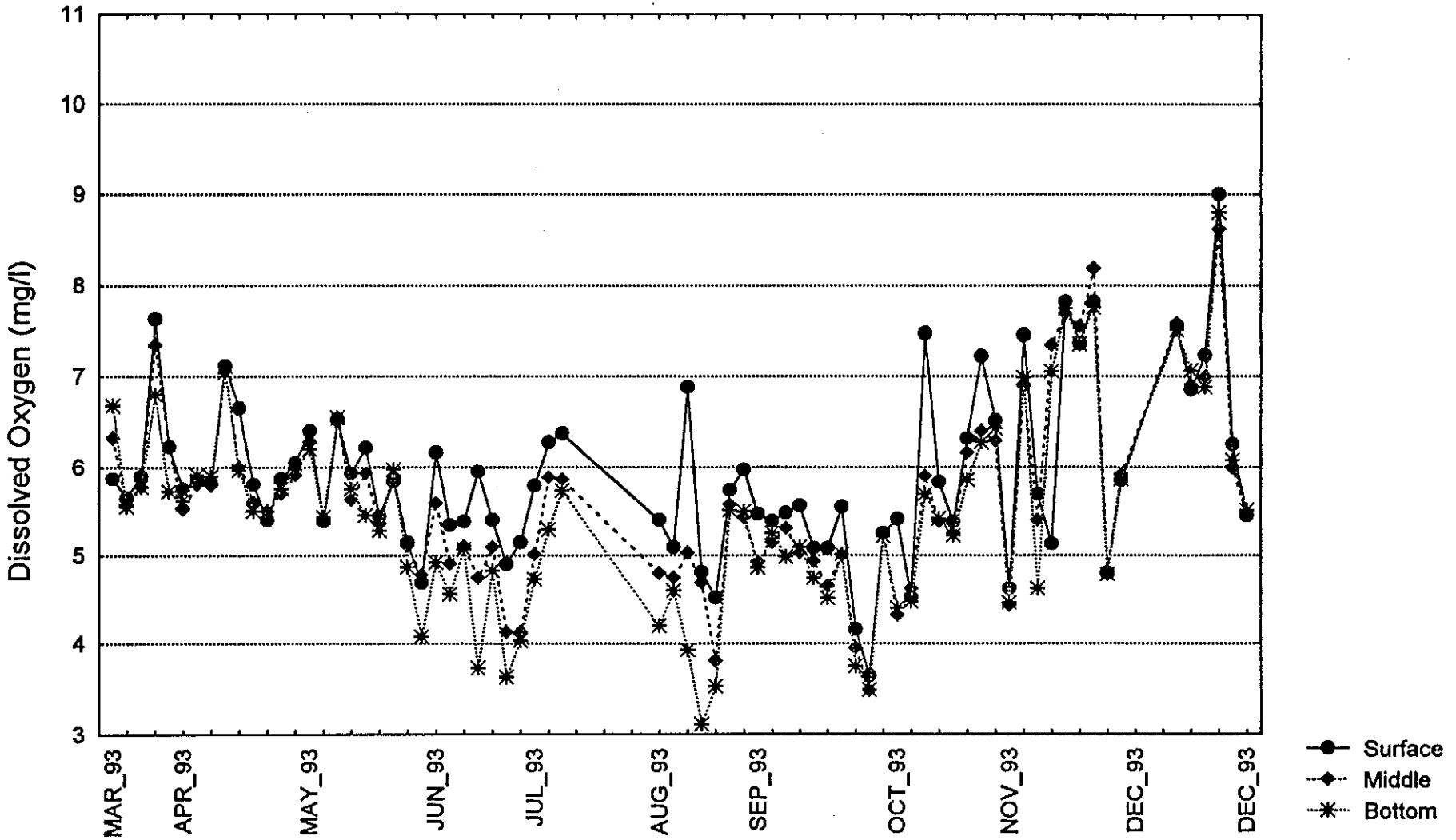
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.7

Variation in Dissolved Oxygen at YOW31 during March to December, 1993



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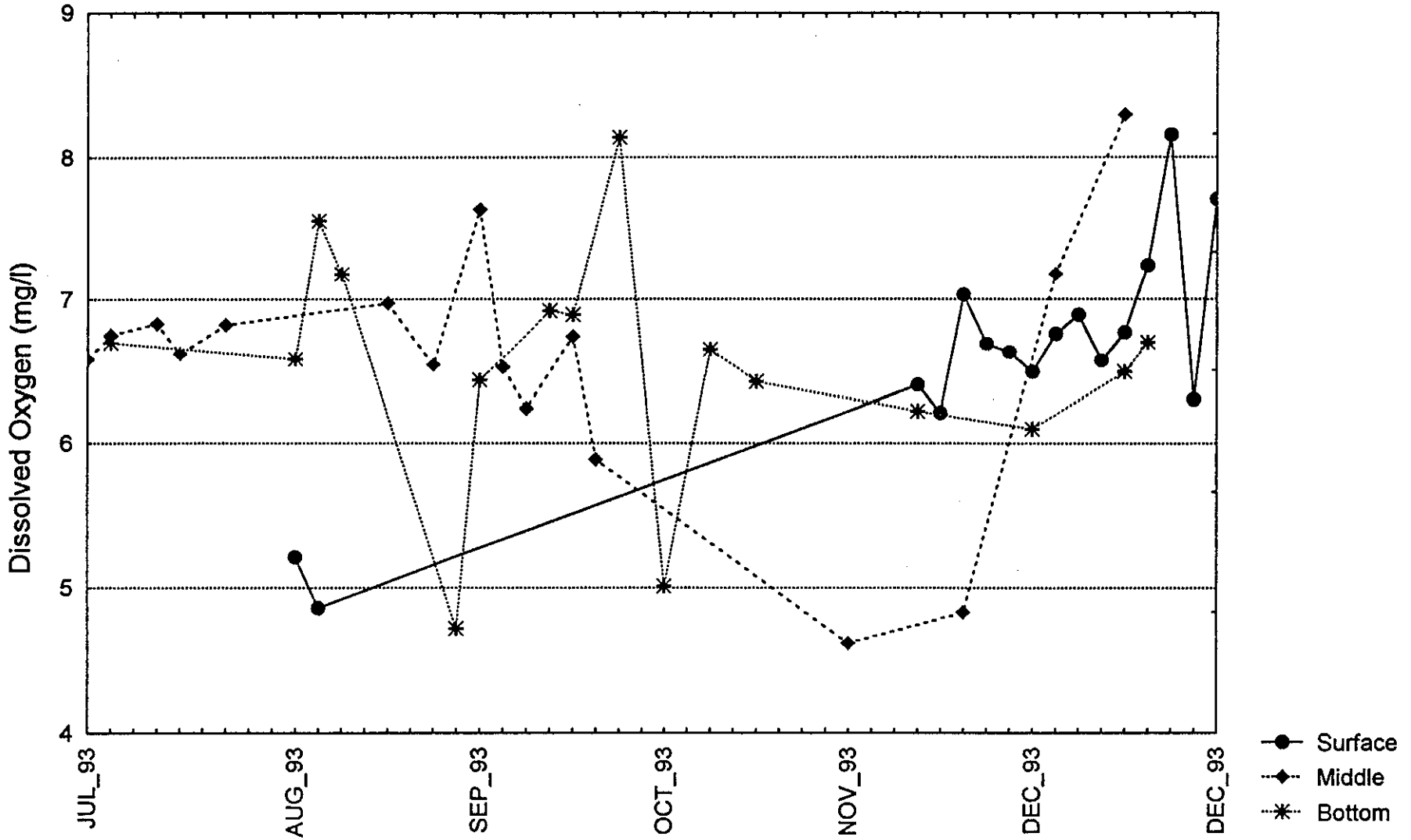
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.8

Variation in Dissolved Oxygen at MB11 during July to December, 1993



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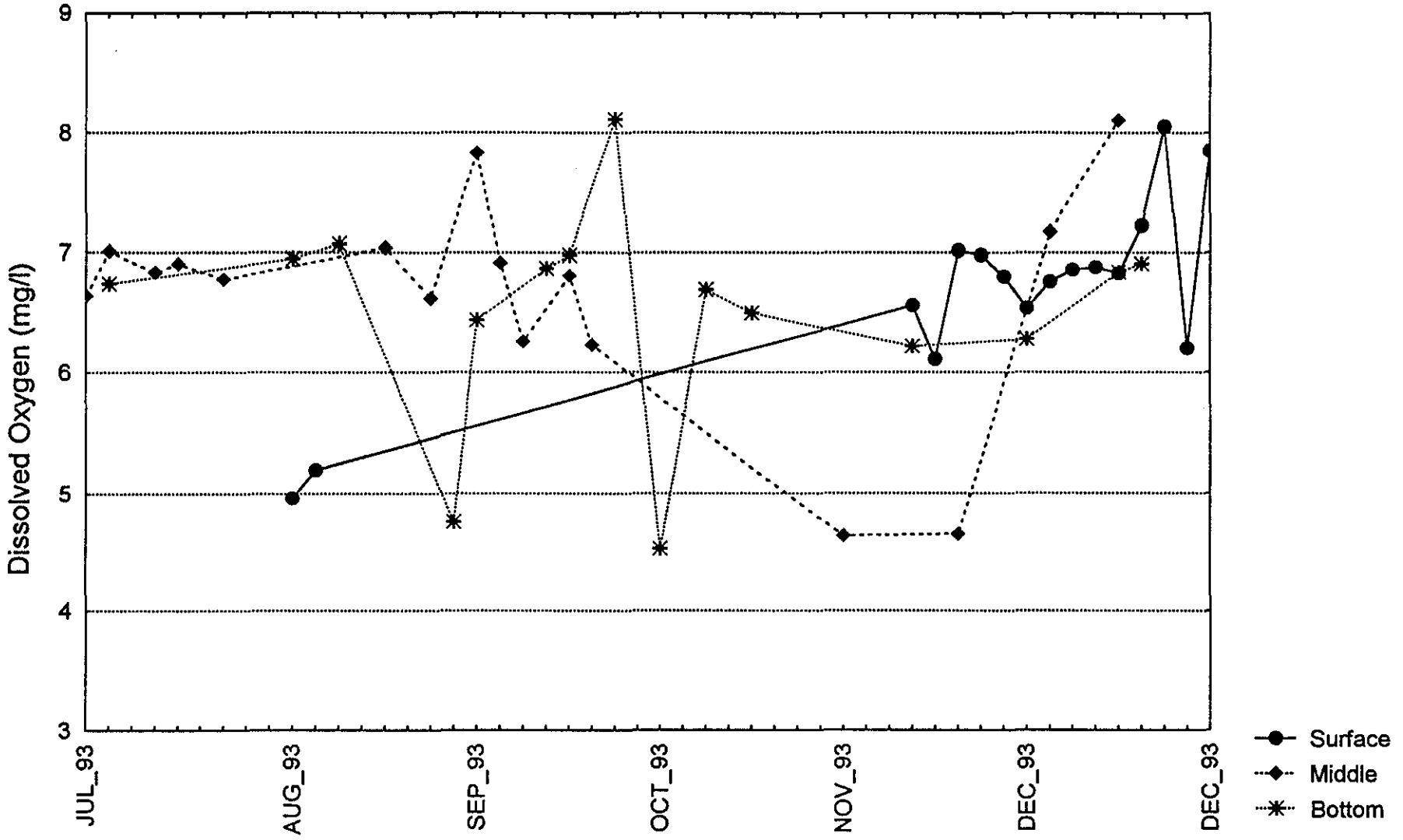
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.9

Variation in Dissolved Oxygen at MB12 during July to December, 1993



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BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.10

5.50 Only at the YOW monitoring stations were DO levels in the middle layer occasionally lower than the WQO value of 4 mg/l (DO at YOW21 and YOW31 in August and YOW23, 24, 25 and 31 in September). Since the WQO limit for bottom waters is 2 mg/l, no exceedance of WQO was observed at any monitoring stations.

5.51 The difference in DO levels at the surface and bottom is due to the exposure of surface waters to a source of oxygen. In all layers, there was a seasonal trend with lower DO during the summer time (May to September). DO levels below 4 mg/l were observed only in the summer time.

5.52 The DO decline at the monitoring stations were mirrored by declines at the control station (YOW31), although the declines were localised and short-lived.

5.53 Despite the level of dredging and reclamation that could effect the baseline station data analysed, DO levels remained very reasonable. This would suggest that the sediments stirred up by these activities do not have either a high chemical or biological demand. The sediments are relatively clean due to a comparative lack of pollution from industrial activity or sewerage disposal in this area of Hong Kong.

5.54 Both the SS and DO levels are higher at the LFC stations than at the YOW stations presumably due to greater turbulence and flushing.

5.55 Comparing the monthly variation trends of SS and DO, they show parallel trends close to the Ma Wan fish zone.

5.56 Low DO levels are in part due to the inverse relationship between oxygen solubility and temperature. This in part explains the low DO levels registered in June and September and the high DO levels in the winter season.

Potential Marine Water Quality Impact

5.57 The data gathered would suggest that the Ma Wan fish culture zone DO levels will not be affected by the dredging and reclamation works at To Kau Wan.

5.58 Any effect on DO levels should be local and very short-term.

Turbidity

Data Analysis

5.59 Monthly depth-averaged variation of turbidity at the Yam O and Kap Shui Mun monitoring stations is presented in Table 5.3 and Graph 5.11. Turbidity values of all monitoring stations ranged between 5 and 50 NTU with two anomalous values greater than 60 NTU in March at stations YOW21 and 23.

5.60 The turbidity values increase in parallel with SS levels from July to December, 1993. The high turbidity and SS levels would be due to the ongoing works close to the monitoring stations.

5.61 Comparing the turbidity level at the Yam O control station, YOW31 (Graph 5.12) with the marine borrow area monitoring stations, MB11 and 12 (Graphs 5.13 and 5.14), the latter stations showed greater variation.

5.62 The plots of individual stations are given in Graphs 5.31 to 5.38. The turbidity at the YOW monitoring stations showed that the turbidity levels during March to December, 1993 were less than or around 100 NTU, except a few anomalous values which were about 400 NTU.

5.63 Turbidity levels of the Yam O stations during September to December were worse than during the months between March and August.

5.64 The turbidity levels of the Kap Shui Mun marine monitoring stations (LFC13-15) during March to December were generally below 80 NTU, except in August and September. The peak values in these three stations ranged between 100 and 180 NTU. The turbidity level in the surface layer was around 120 NTU in September, 1993. The increase in turbidity level from September on was also observed in the Kap Shui Mun stations. This situation was confirmed in the monthly depth-averaged variation in turbidity. The turbidity levels of LFC14 and 15 were much higher than the general variation.

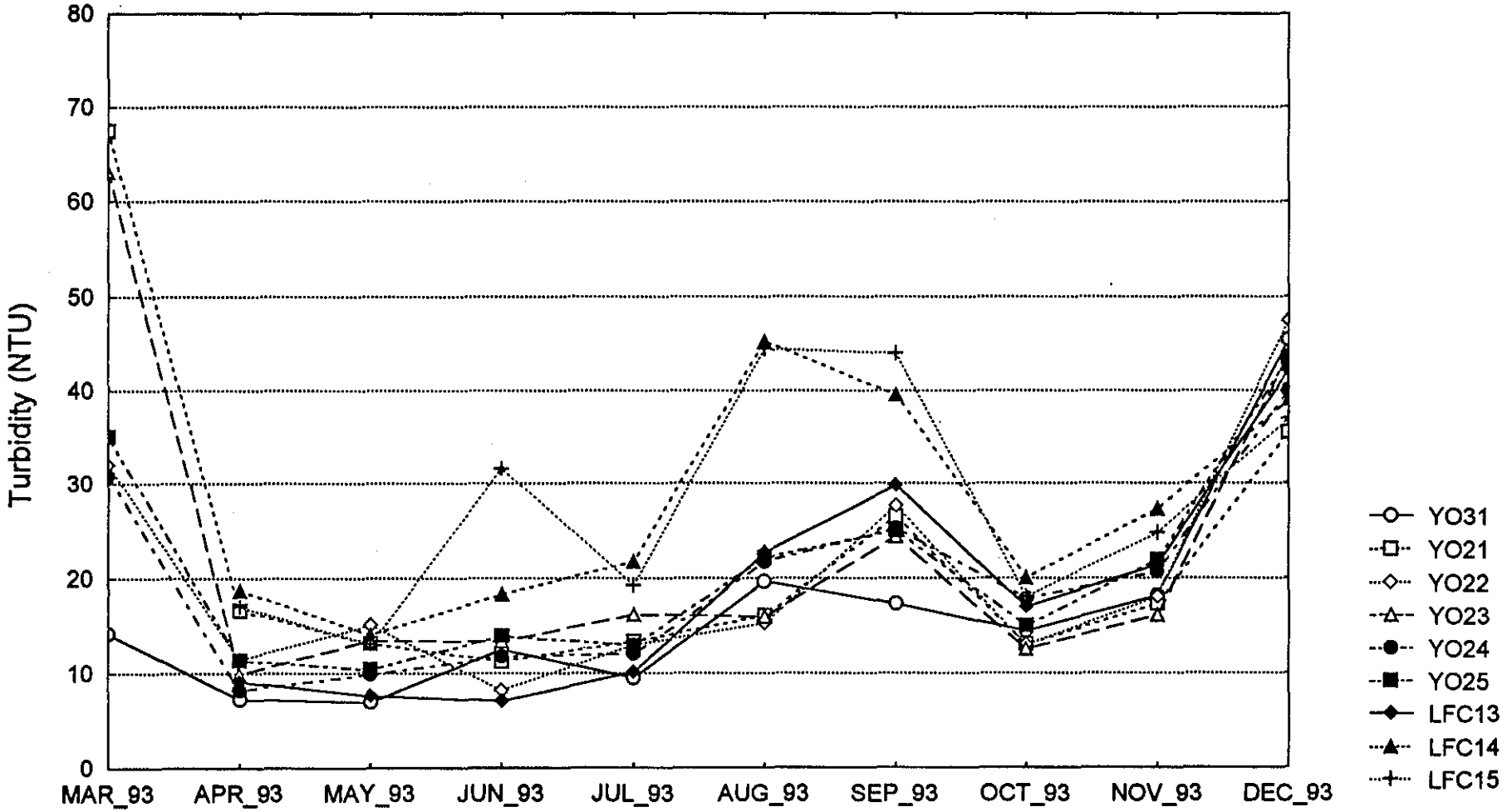
5.65 Variation in surface level turbidity during March to December, 1993 also showed an obvious increase pattern from August to December. The turbidity peak was in December, 80 NTU.

Table 5.3 Turbidity in Marine Water (YOW and LFC Data) over the period March to December, 1993

Monitoring Station	Turbidity Concentratoin (NTU)									
	Mar 93	Apr 93	May 93	Jun 93	Jul 93	Aug 93	Sep 93	Oct 93	Nov 93	Dec 93
YOW 21										
Range	10 - 212	4 - 39	5 - 31	6 - 16	6 - 34	6 - 23	11 - 66	7 - 19	8 - 43	9 - 65
Mean	67	17	13	11	13	16	26	13	17	35
YOW22										
Range	11 - 68	6 - 19	5 - 26	3 - 11	5 - 24	5 - 25	9 - 61	6 - 18	10 - 39	14 - 115
Mean	32	11	15	8	13	15	28	13	18	47
YOW23										
Range	8 - 165	5 - 18	5 - 32	5 - 27	6 - 42	5 - 28	8 - 57	5 - 24	10 - 31	13 - 138
Mean	63	10	13	13	16	16	24	13	16	44
YOW24										
Range	9 - 58	3 - 16	5 - 26	3 - 22	6 - 28	5 - 35	11 - 69	8 - 46	11 - 40	14 - 72
Mean	31	8	10	12	12	22	25	18	21	40
YOW25										
Range	8 - 77	4 - 35	6 - 21	2 - 31	8 - 29	7 - 35	12 - 63	5 - 33	9 - 48	14 - 87
Mean	35	11	10	14	13	22	25	15	22	43
YOW31										
Range	7 - 24	3 - 12	3 - 16	1 - 26	6 - 15	6 - 43	11 - 30	5 - 30	7 - 41	16 - 78
Mean	14	7	7	13	9	20	17	14	18	45
LFC13										
Range	N.D.	2 - 32	2 - 20	1 - 28	4 - 37	4 - 136	5 - 115	5 - 60	4 - 93	10 - 81
Mean		9	8	7	10	23	30	17	21	42
LFC14										
Range	N.D.	2 - 95	3 - 40	2 - 49	5 - 89	6 - 193	9 - 162	6 - 58	4 - 93	9 - 27
Mean		19	14	18	22	45	40	20	27	39
LFC15										
Range	N.D.	3 - 55	3 - 35	3 - 33	5 - 56	6 - 168	8 - 151	7 - 43	5 - 89	8 - 82
Mean		17	13	32	19	44	44	18	25	37

Note:
1. N.D. = no data
2. YOW31 is the YOW control station
3. Figures presented are depth-averaged data
4. Surface: 1 m below water surface
   Middle : mid-depth of water column
   Bottom : 1 m above seabed

Monthly Depth-averaged Variation in Turbidity during April to December, 1993



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BACKGROUND MARINE WATER QUALITY

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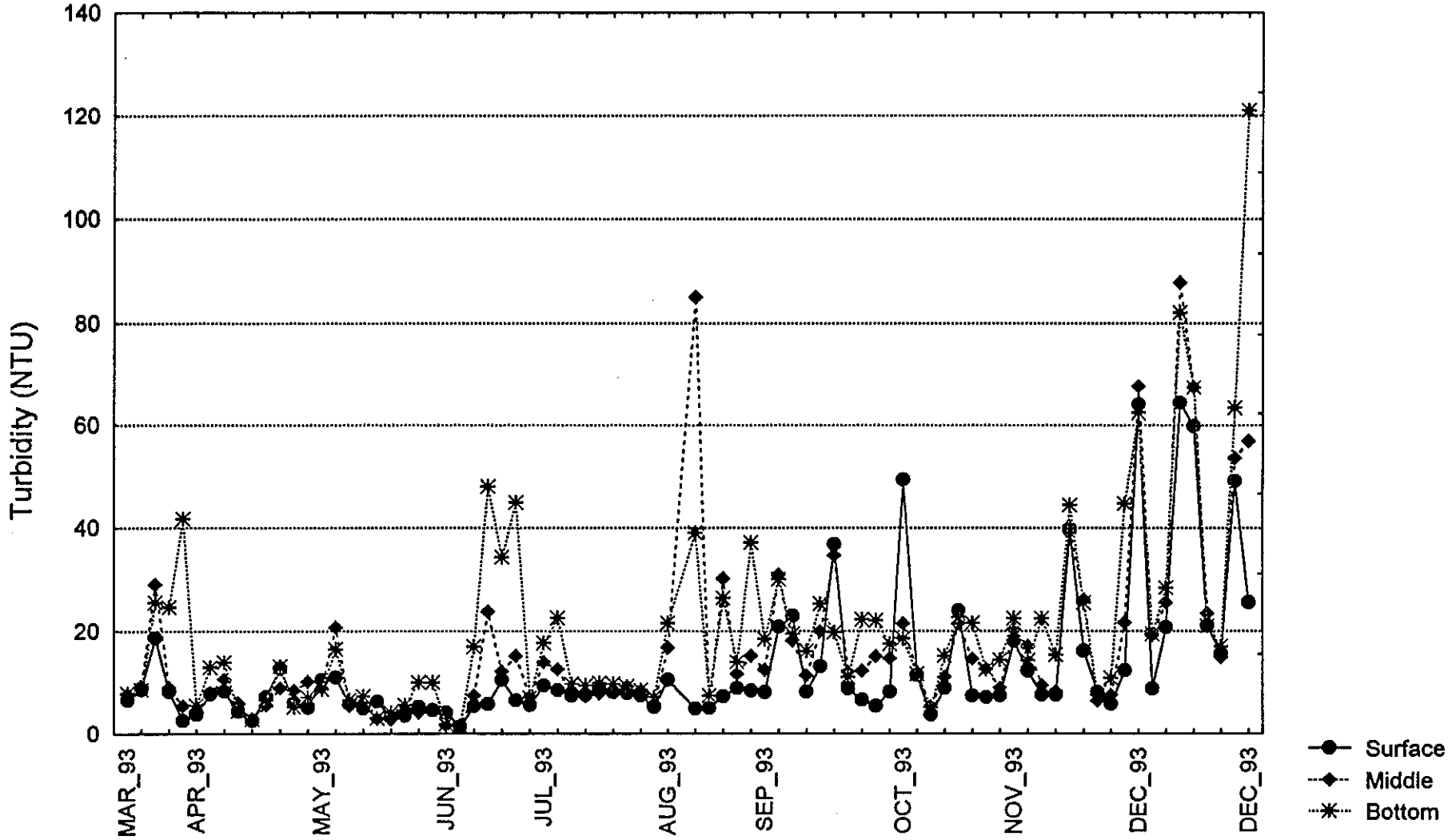
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.11

Variation in Turbidity at YOW31 during March to December, 1993



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BACKGROUND MARINE WATER QUALITY

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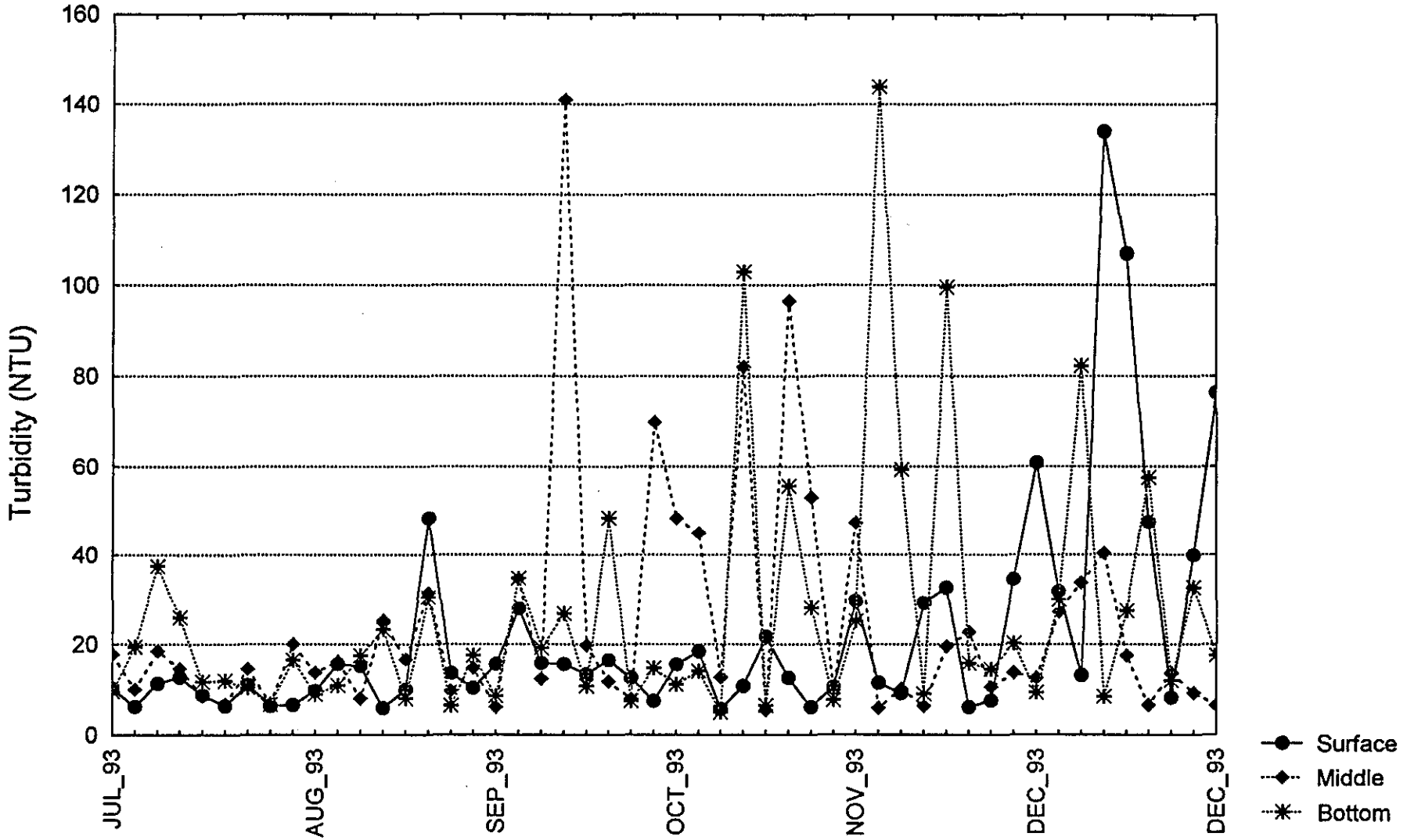
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.12

Variation in Turbidity at MB11 during July to December, 1993



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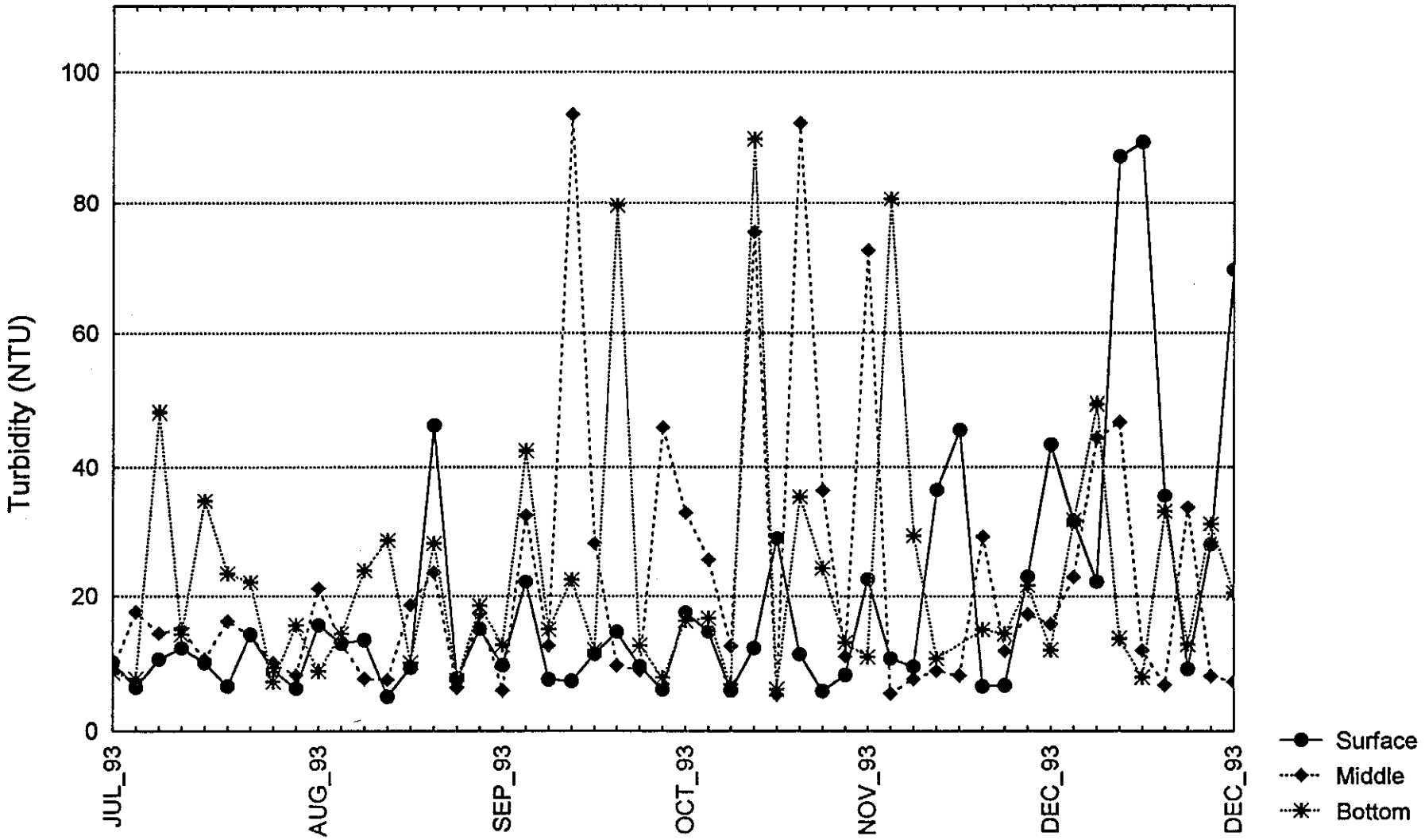
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.13

Variation in Turbidity at MB12 during July to December, 1993



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BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.14

Potential Marine Water Quality Impact

5.66 Turbidity in water can be caused by the presence of suspended matter or dissolved matter. Similar variation patterns were observed in the suspended solids and turbidity plots. The turbidity peaks nearly always paralleled the SS peaks. As the SS peaks, high turbidity values lasted only for a short period of time and were localized.

5.67 By comparing the monthly variation of turbidity and the surface SS level variation, same rise and fall patterns were seen suggesting they are influenced by the same factors.

5.68 It is expected that turbidity and SS levels will mirror one another during the To Kau Wan project construction period. The turbidity effect is expected to be very localised and short term. Background values may be comparatively high.

Water Quality Assessment of the Project

5.69 The scale of the project compared to others in the vicinity affecting water quality is small. The construction phase will raise SS levels and turbidity principally due to the dredging activity. These increases will be high in the immediate vicinity of the works. Since nearshore current velocities are very low, resuspended sediments would be likely to settle close to the dredging area.

5.70 Taking into account the design layout and the natural geography of the area, the bay is very sheltered. Sediments are not likely to travel very far from the works area. Any sediment which reaches the tip of North Lantau would be swept rapidly down the Kap Shui Mun channel for the majority of the day.

5.71 Reclamation will occur behind the seawall. By beginning at the shore first, mud waves will be minimised as much as possible. This should minimise any impact of the reclamation process on the marine water column.

5.72 The increases in SS and turbidity will be limited in time. The construction schedule limits water quality impact to about 6 months with the dredging impact limited to a few months at most. These increases may be difficult to detect outside of the immediate vicinity of the project. The background levels are likely to vary considerably due to the various PADS projects.

5.73 Oxygen levels are likely to be even less affected. It is hard to picture any scenario where the project has a negative impact on the mariculture zone at Ma Wan.

5.74 Despite the relatively small effect of the To Kau Wan project in the context of those around it, water quality impacts of the project need careful environmental controls. Mitigation measures will be required to minimise any impacts of dredging and effluent disposal on the receiving water quality during the construction period. Suitable measures to mitigate water quality impacts from dredging and other marine activities are suggested in this report in Chapter 8.

5.75 Monitoring of the adjacent water quality during construction is also recommended to ensure compliance with the Water Quality Objectives and Standards applicable to this Project. The detail of environmental monitoring and audit can be found in Chapters 8 of this report.

Storm Water

5.76 The proposed reclamation will affect the drainage from the hillsides to the south and east of the site. However, apart from in the south-east corner of the development all the sub-catchments which intersect the site boundary are small. Other features which will affect the design of the stormwater drainage include:-

- the local drainage around the Yiu Lian Shipyard which will have to be intercepted and conveyed across the proposed reclamation; and

- the works for the North Lantau Expressway which have cut-off the original drainage paths from the upper parts of the catchments draining towards the southern boundary of the proposed reclamation. Two culverts will however be constructed under the Expressway which channel the flow from the hillsides above the Expressway and the Expressway itself to the streams below (as indicated in Figure 5.8).

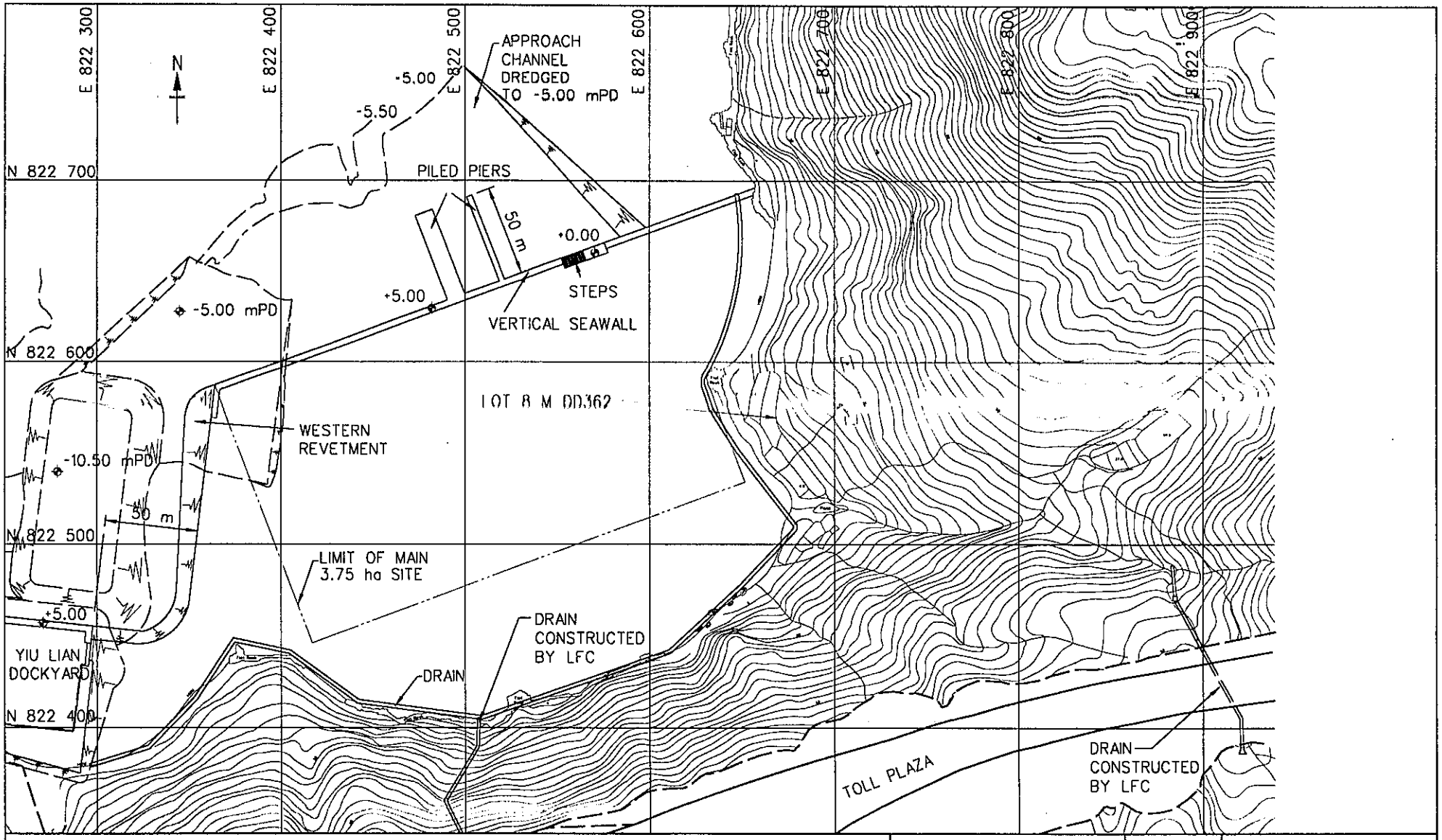
5.77 The runoff from the hillsides to the south and east of the proposed reclamation will be intercepted by an open channel which will be constructed at the interface between the reclamation and the existing ground. One outfall will be provided and the drainage system will be adequately supplied with silt traps.

5.78 The storm-water drainage system will be designed to cope with:

- a 50-year rainstorm with a mean high high tide water level at the outlet; and

- a 5-year rainstorm with a 50-year storm surge level at the outlet.

5.79 There are a number of natural streams in the study area but only two streams run year round. The larger culvert from the Toll Plaza Project (CH 21265) feeds into the larger of these two streams. The design capacity of the main Toll Plaza culverts directed towards To Kau Wan are given below.



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SITE LAYOUT PLAN

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB. 94	Scale 1 : 3000
土木工程署 Civil Engineering Department	Initial YPS	Figure No. 5.8

Table 5.4 Design Capacities for the Two Culverts Directed to To Kau Wan by the Toll Plaza Works

	Discharge (cu.m./sec)	Outlet
Culvert (Ch.20856)	5.2	near Yiu Luen Dockyard
Culvert (Ch.21265)	7.9	directed to a stream

5.80 Summarising the EIAs undertaken for the Toll Plaza Project[4] Mott MacDonald Hong Kong Limited wrote:

On-site activities will include handling construction materials, stockpiling, plant storage and construction of site offices. Sources of pollution will include domestic sewage, site drainage, erosion and runoff waters potentially contaminated with sediments, oils, greases and lubricants from vehicle maintenance. Appropriately designed drainage facilities must be provided to collect any grit, oil and grease prior to discharge of surface waters. Sewage treatment facilities of adequate size to accommodate the maximum number of workers on-site must be provided and properly maintained. ..... Any discharges from the site will be controlled under the Technical Memorandum on Standard for Effluents Discharged into Sewerage Systems, Inland and Coastal Waters. Discharges are thus not likely to have any significant impact on water quality.

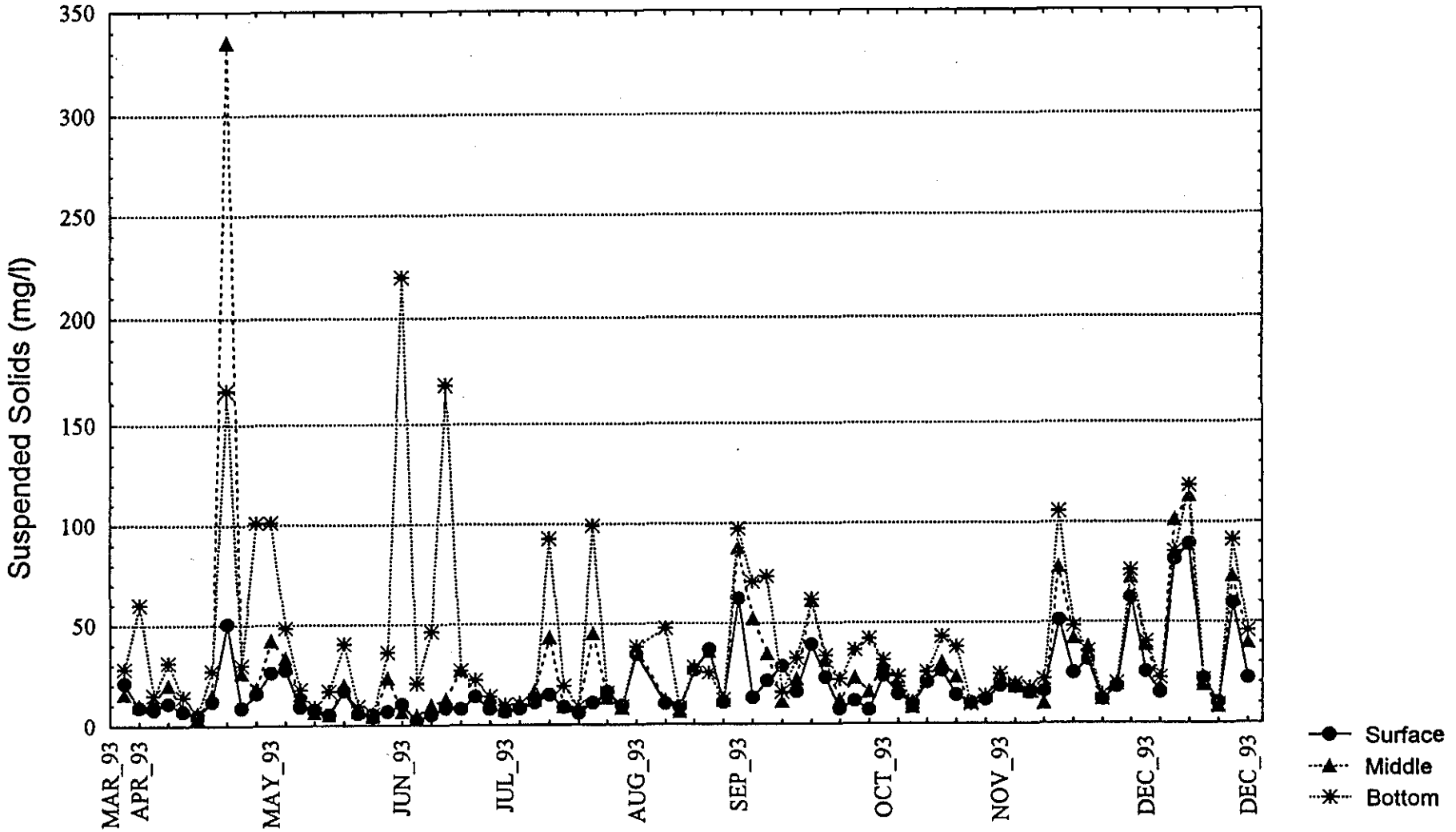
Drainage from the East Lantau Tunnels contract also needs treatment before it is discharged into the main stream.

5.81 Environmental Controls and Mitigation Measures relating to water quality impacts are given in Chapter 8. A few points particularly relevant to surface water and the possible contamination due to generated waste on the site polluting surface water run-off are re-iterated below.

5.82 Waste water due to construction activities will include runoff from silt and dust suppression activities, runoff from soil/spoil and fuel and lubricating oil spillage. Any muddy or silty water should be collected and appropriate silt-traps/settling tanks used before the water is discharged.

5.83 The Contractor should prevent fuel and lubricating oil leakage from plant and storage sites contaminating the construction site. The Contractor should prepare a spill action plan and keep suitable clean-up materials on site. Layers of sawdust, sand or equivalent material should be laid underneath and around any construction plant and equipment that may possibly leak oil. The polluted clean-up materials should be replaced with some clean materials on a regular basis. Any polluted materials should be disposed of in an acceptable and regular manner. Plant and storage sites for fuel and lubricating oil should be formed on bunded and impervious ground. Adequate numbers of oil/petrol interceptors should be provided.

Variation in Suspended Solids at YOW21 during April to December, 1993



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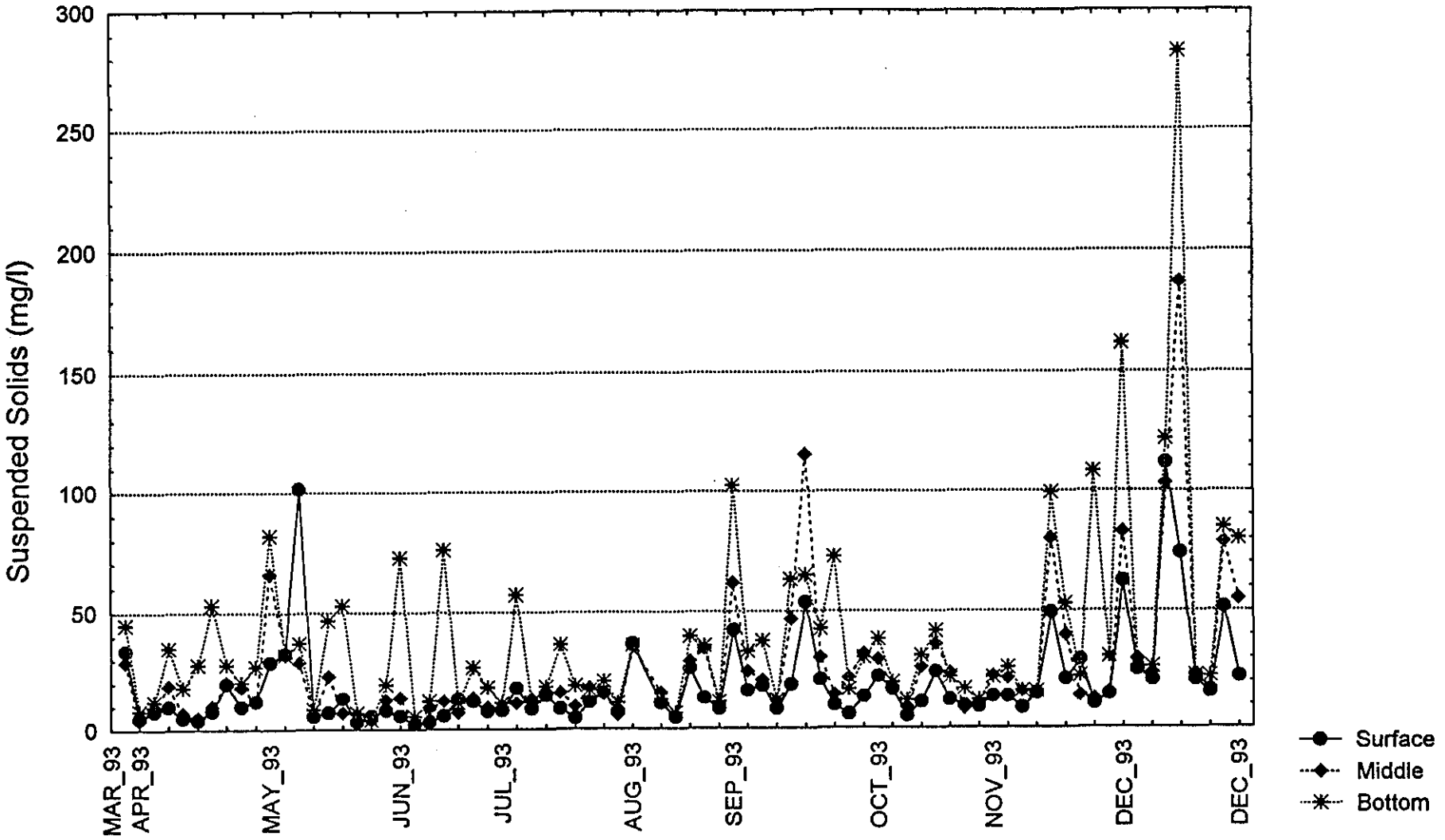
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.15

Variation in Suspended Solids at YOW22 during April to December, 1993



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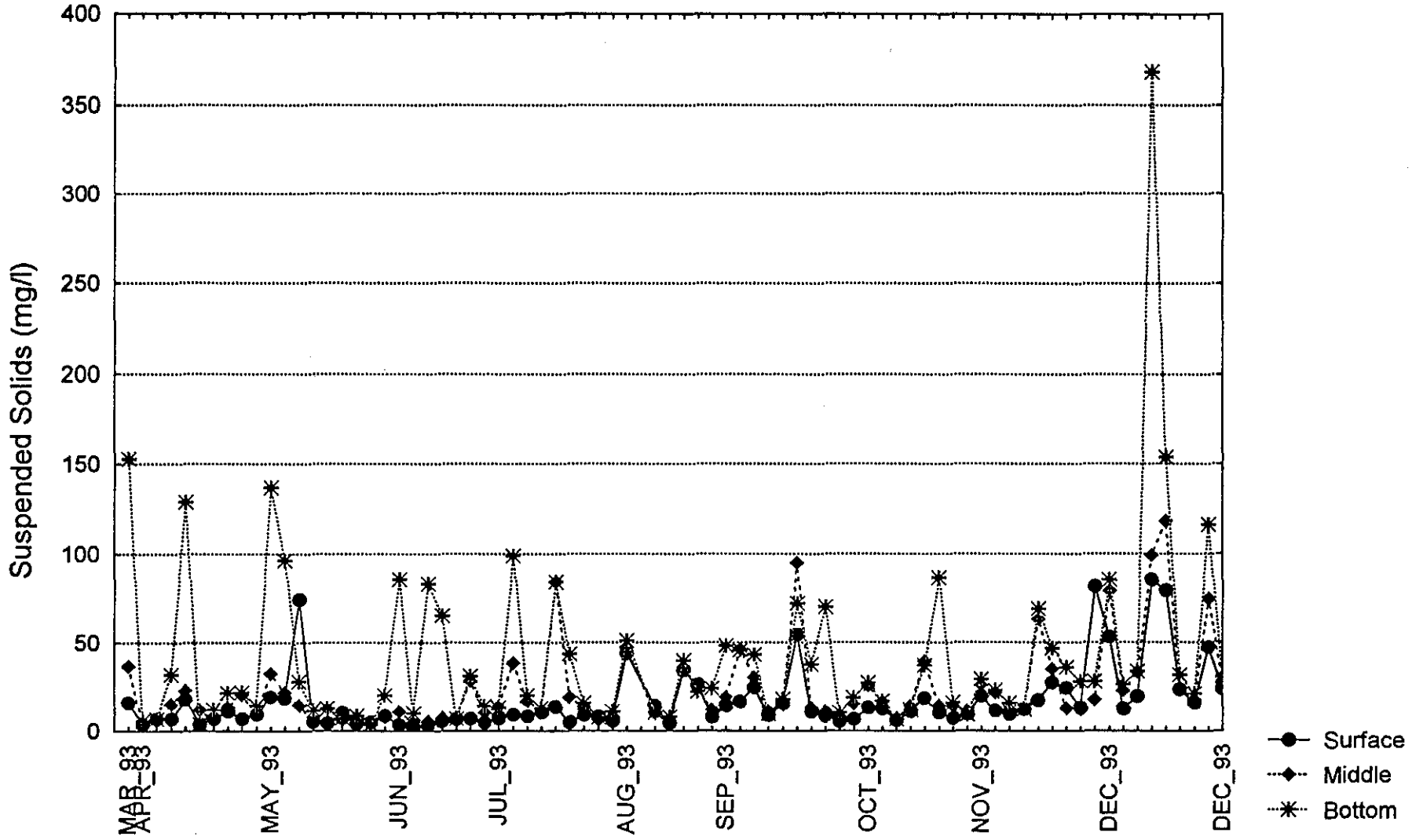
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.16

Variation in Suspended Solids at YOW23 during March to December, 1993



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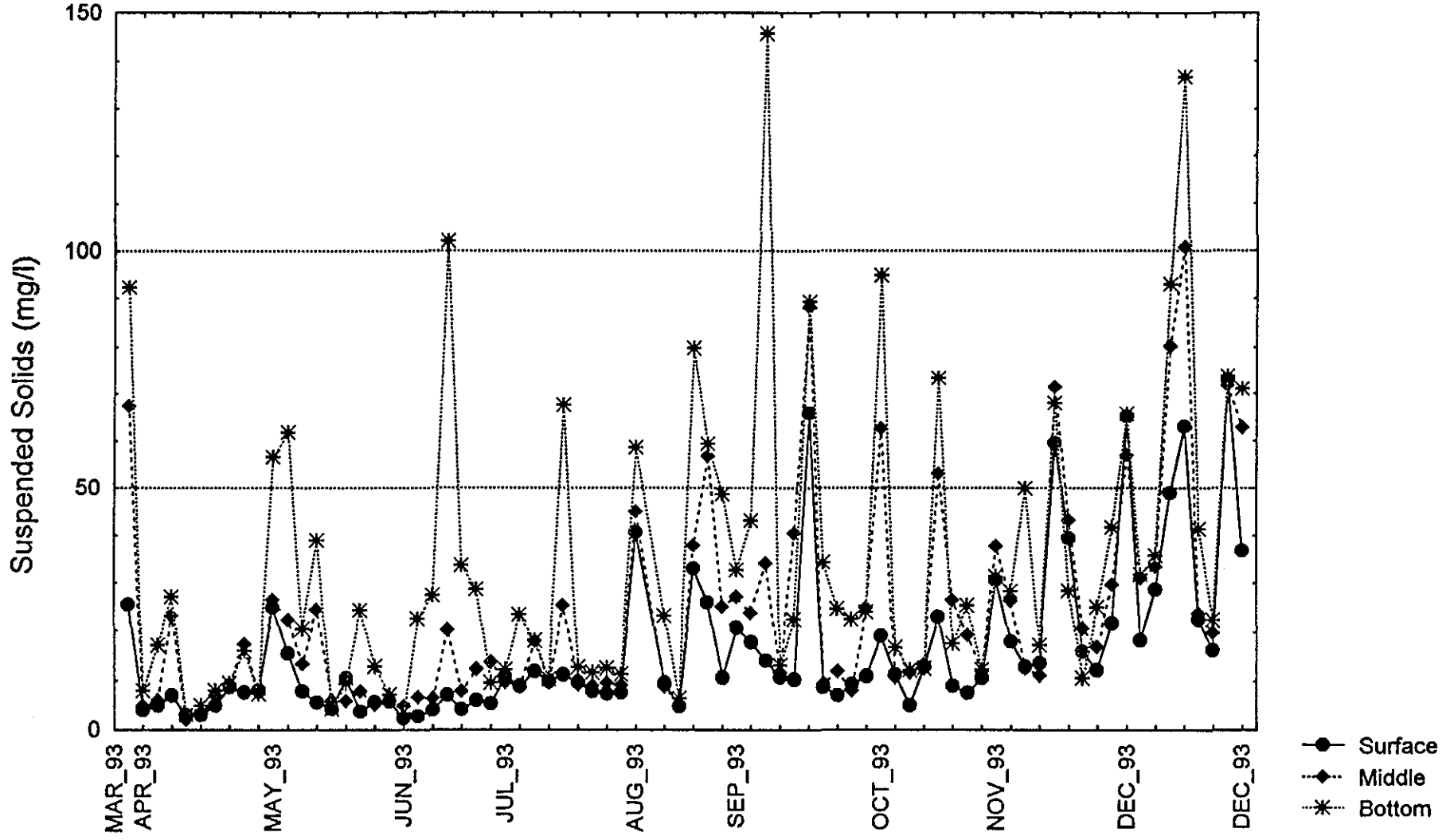
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.17

Variation in Suspended Solids at YOW24 during April to December, 1993



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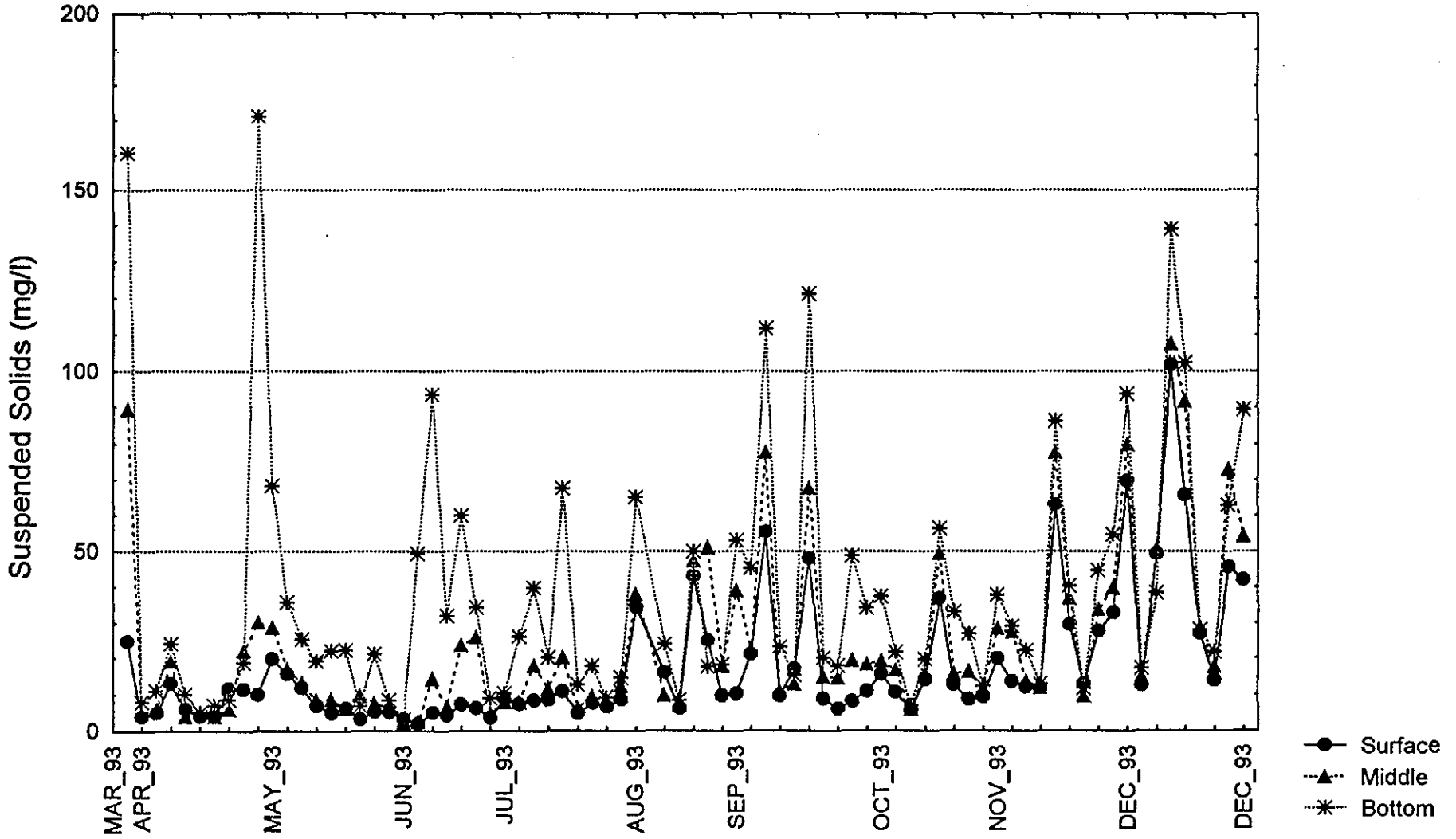
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.18

Variation in Suspended Solids at YOW25 during April to December, 1993



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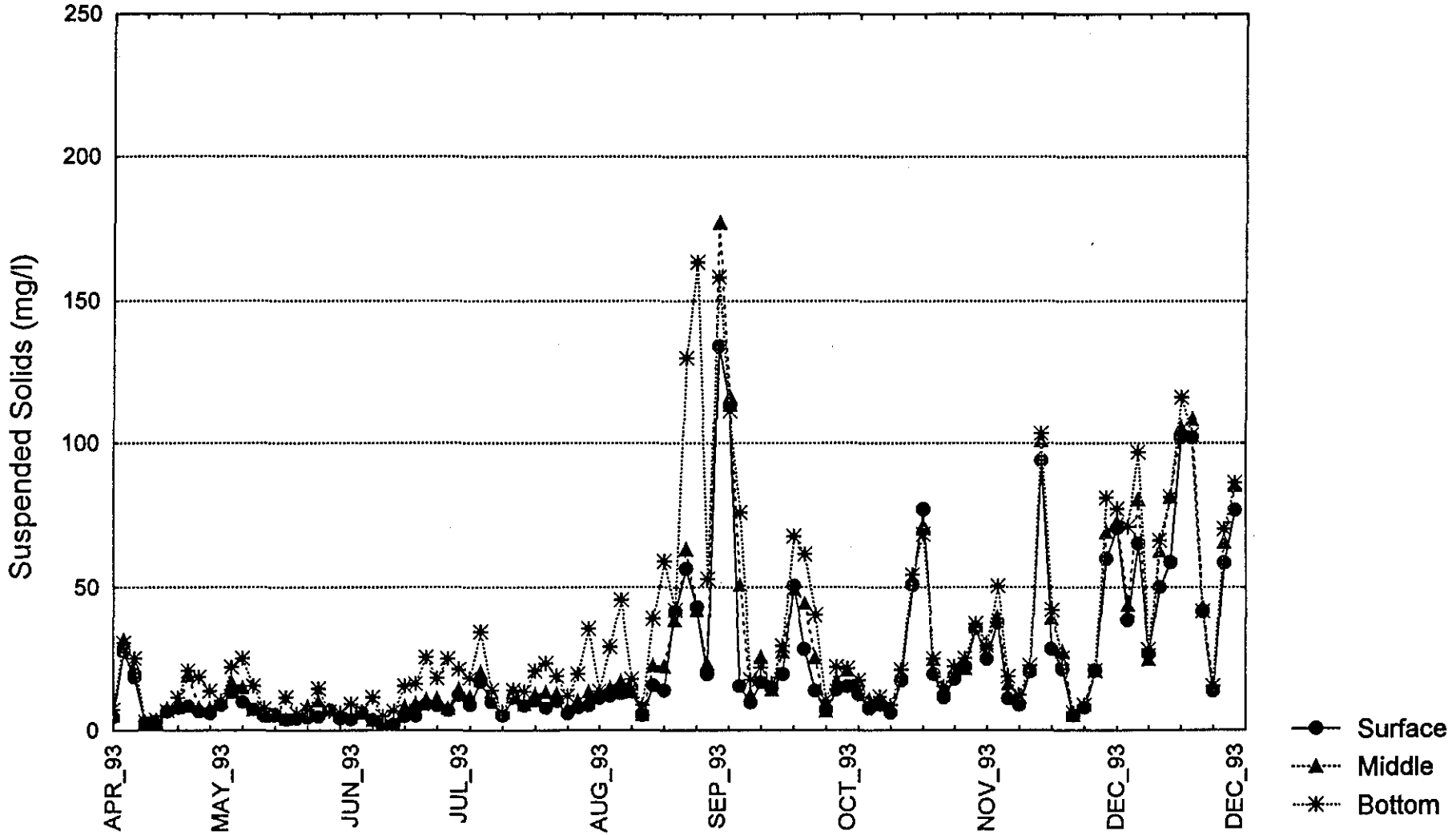
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.19

Variation in Suspended Solids at LFC13 during April to December, 1993



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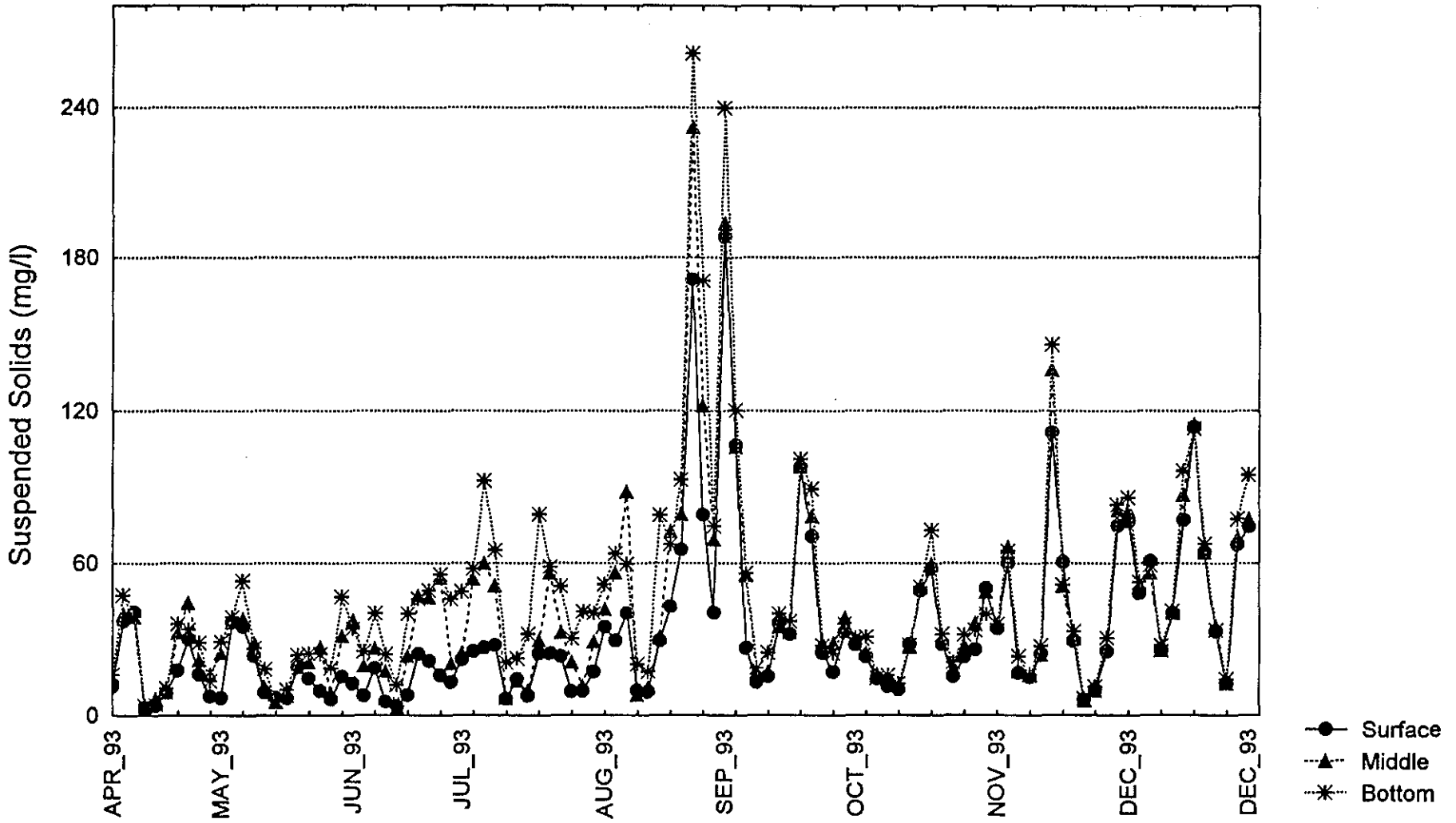
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.20

Variation in Suspended Solids at LFC14 during April to December, 1993

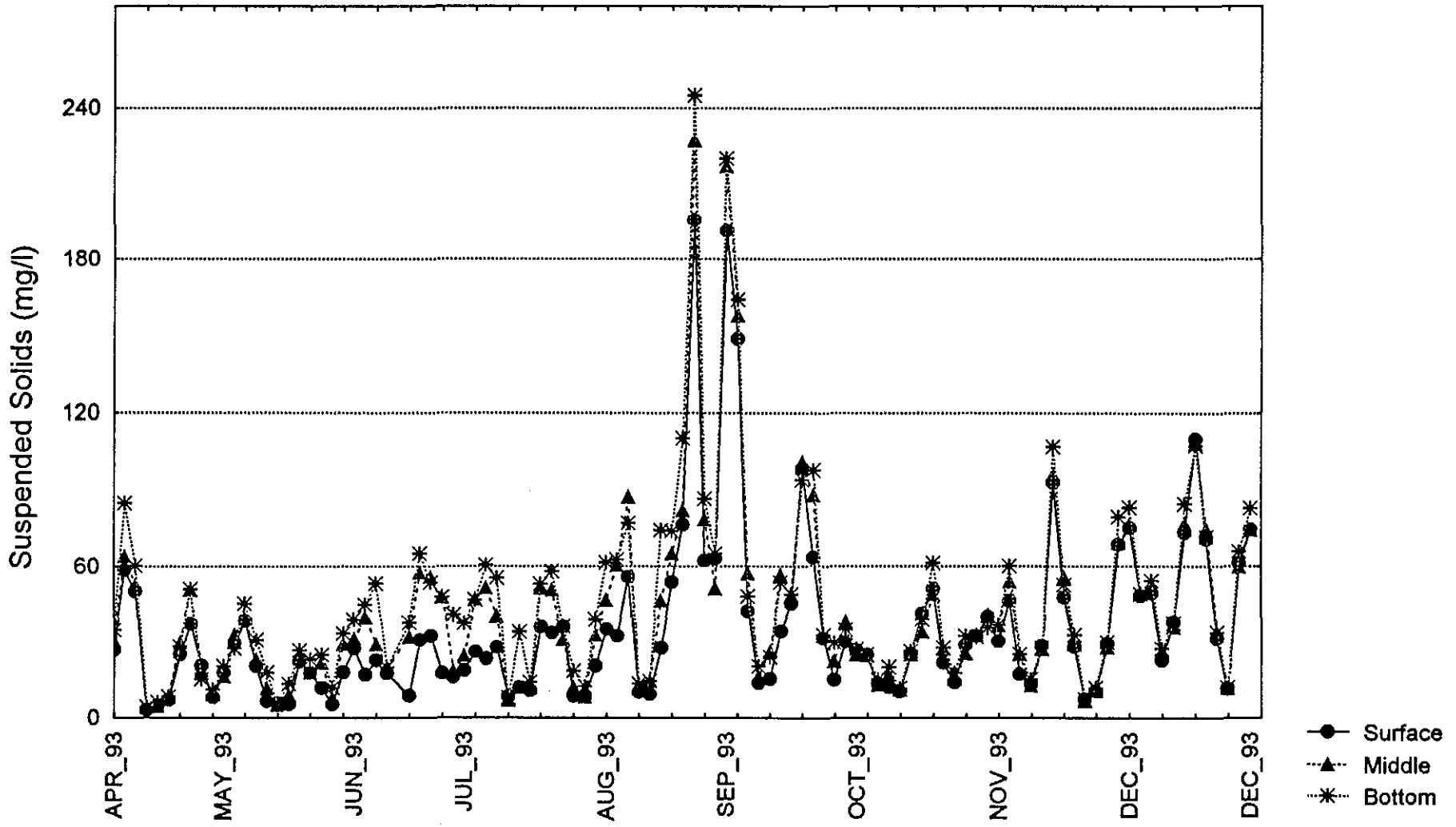


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.21

Variation in Suspended Solids at LFC15 during April to December, 1993

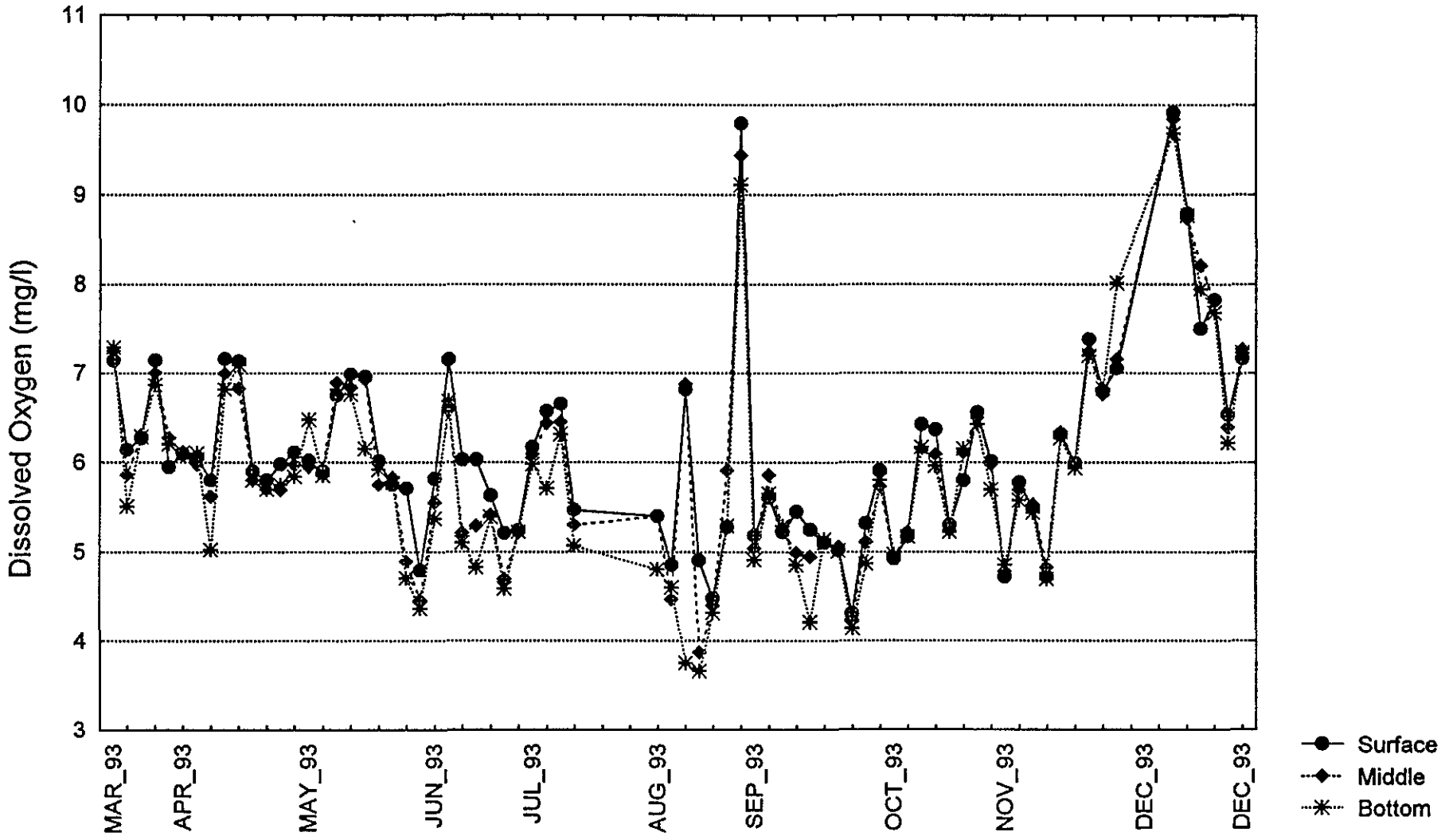


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.22

Variation in Dissolved Oxygen at YOW21 during March to December, 1993

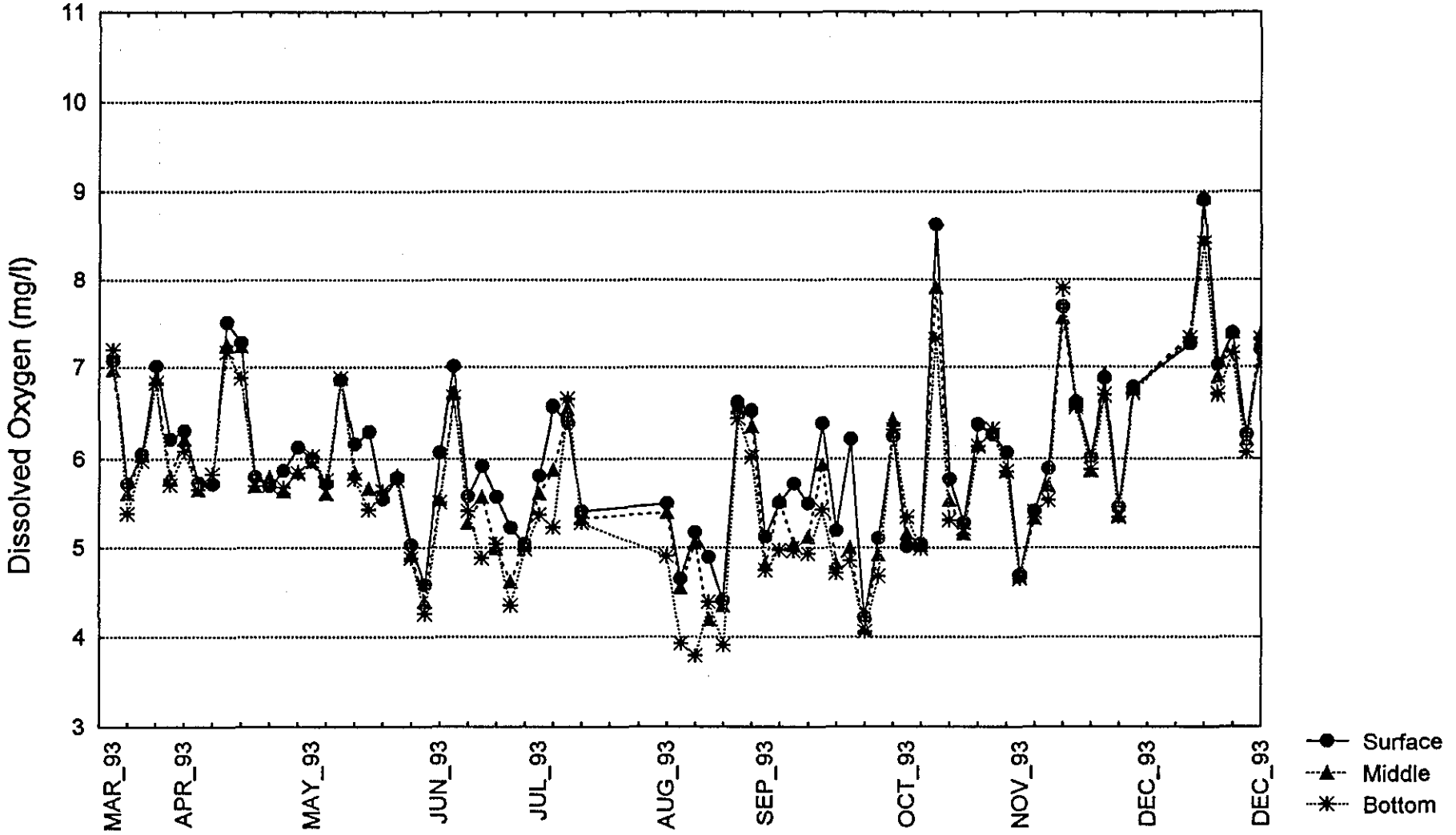


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.23

Variation of Dissolved Oxygen at YOW22 during March to December, 1993

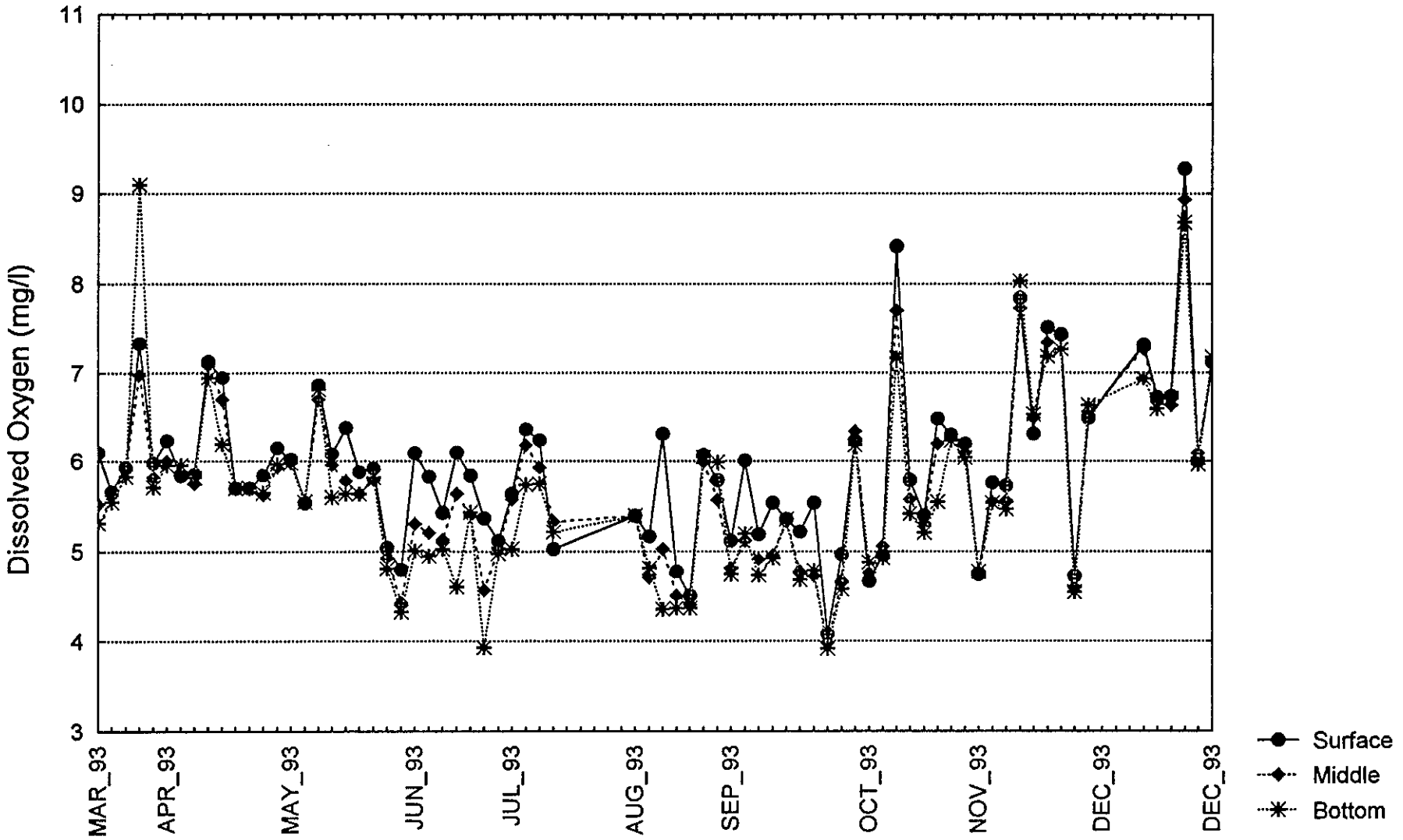


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.24

Variation in Dissolved Oxygen at YOW23 during March to December, 1993

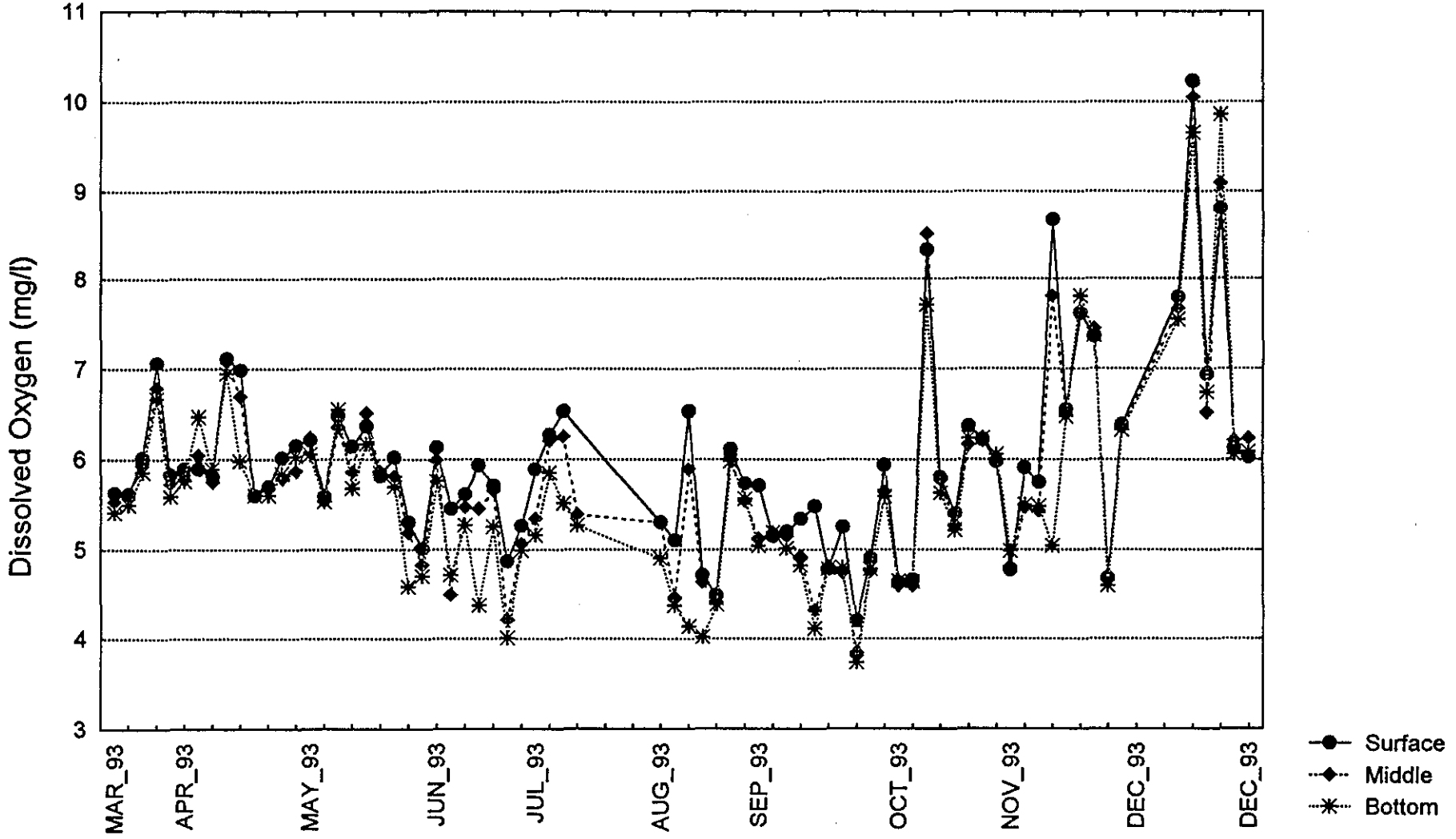


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.25

Variation in Dissolved Oxygen at YOW24 during March to December, 1993

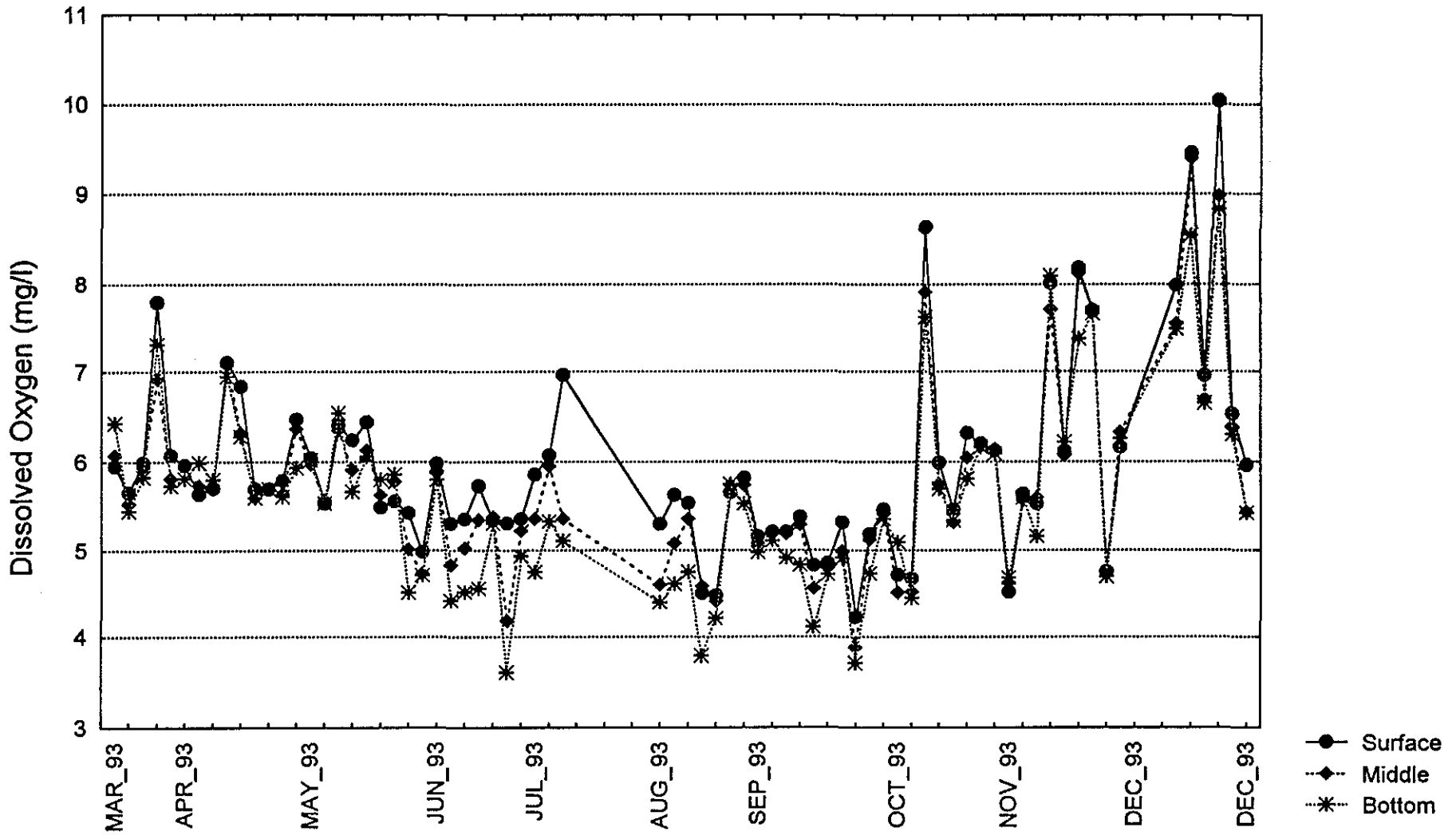


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.26

Variation in Dissolved Oxygen at YOW25 during March to December, 1993

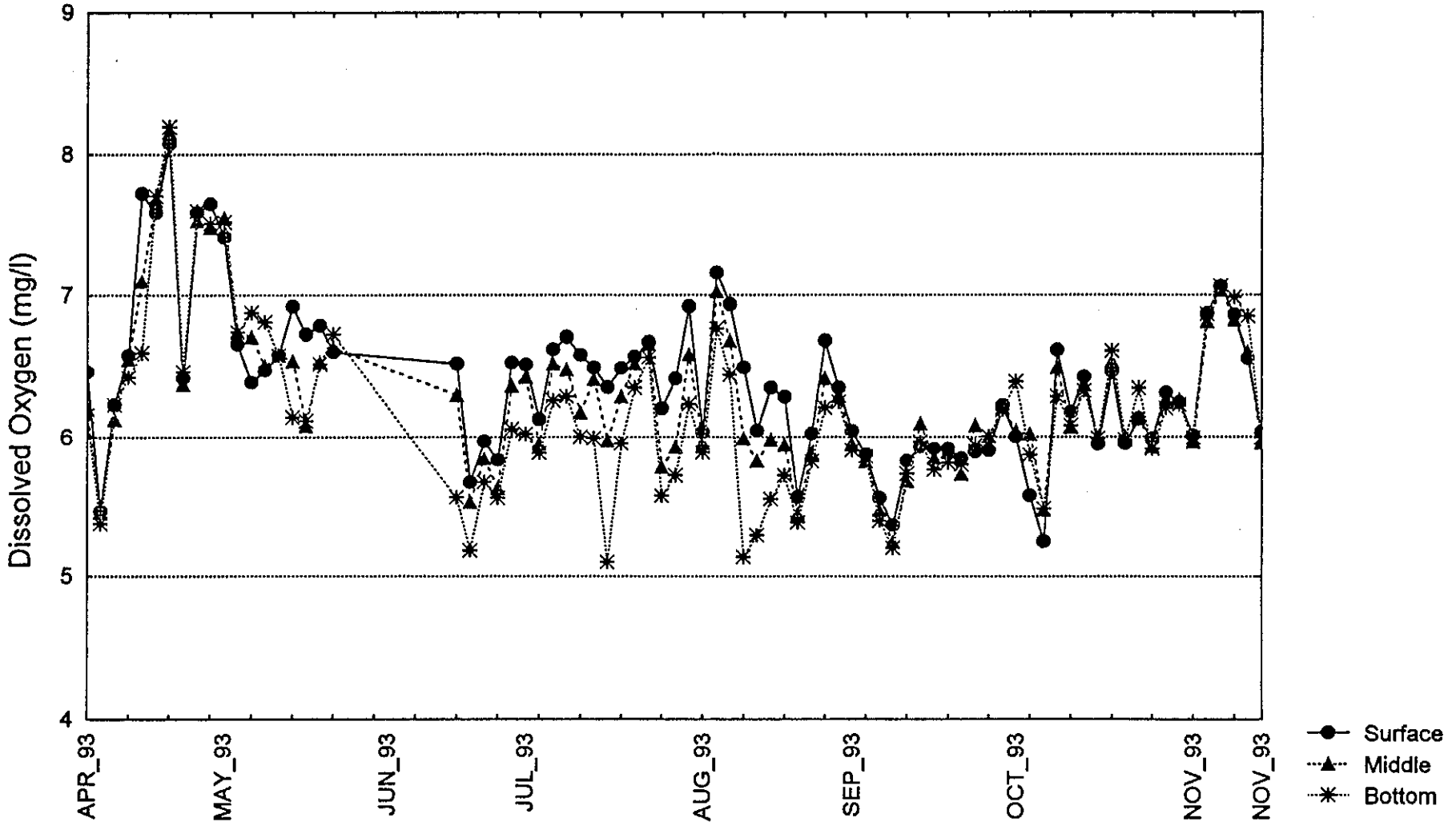


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.27

Variation in Dissolved Oxygen at LFC13 during April to November, 1993

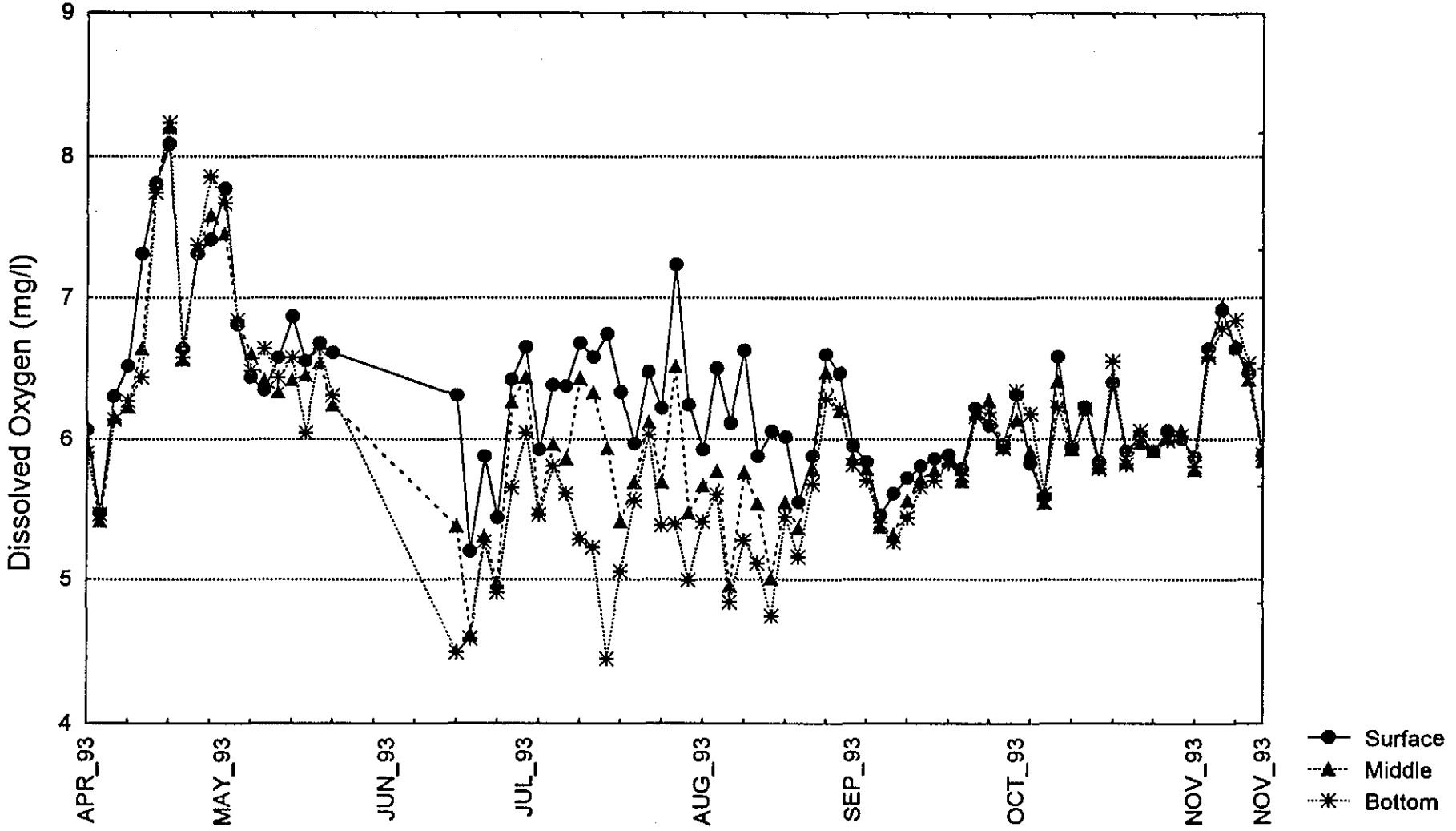


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.28

Variation in Dissolved Oxygen at LFC14 during April to November, 1993

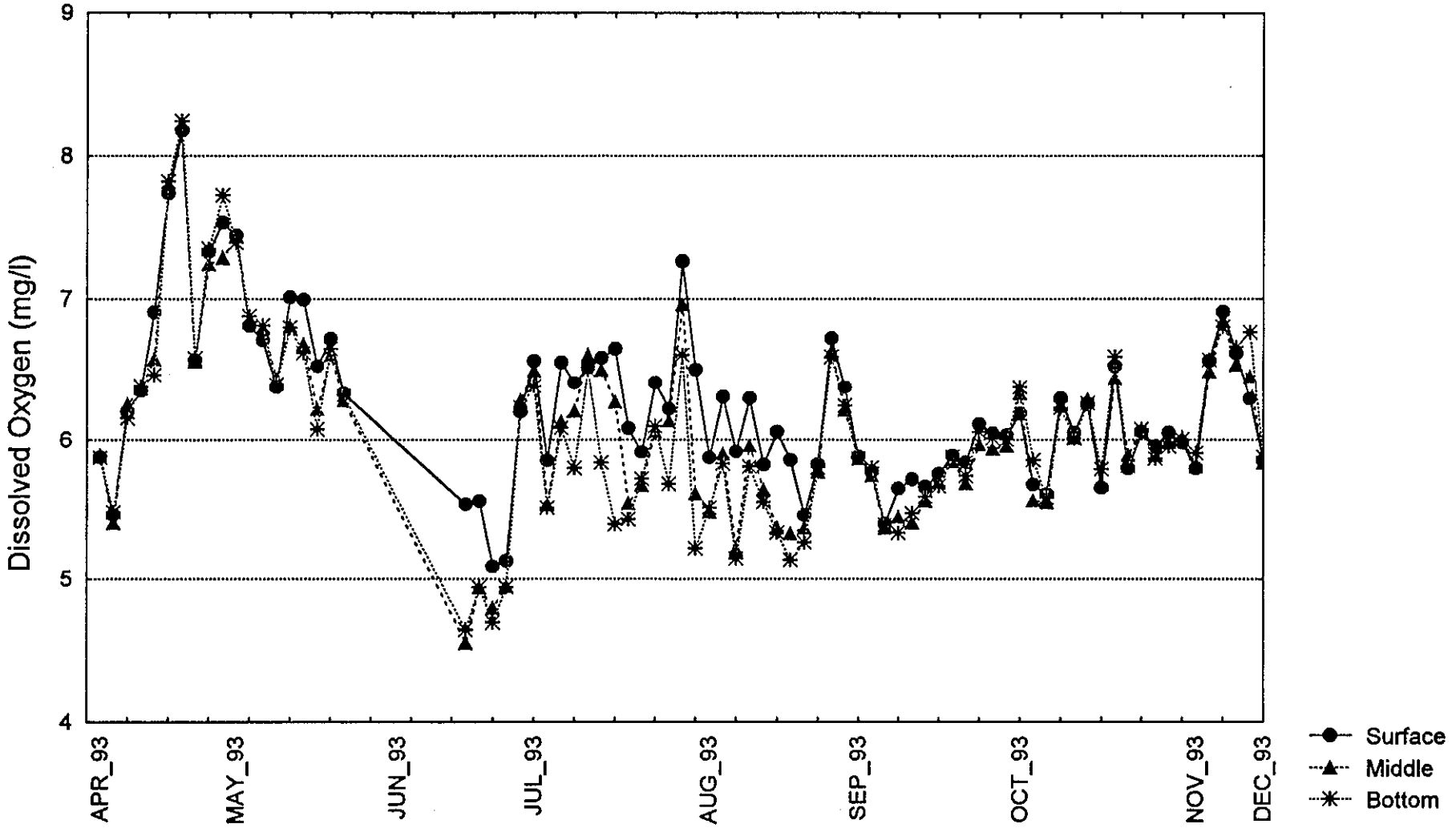


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.29

Variation in Dissolved Oxygen at LFC15 during April to November, 1993

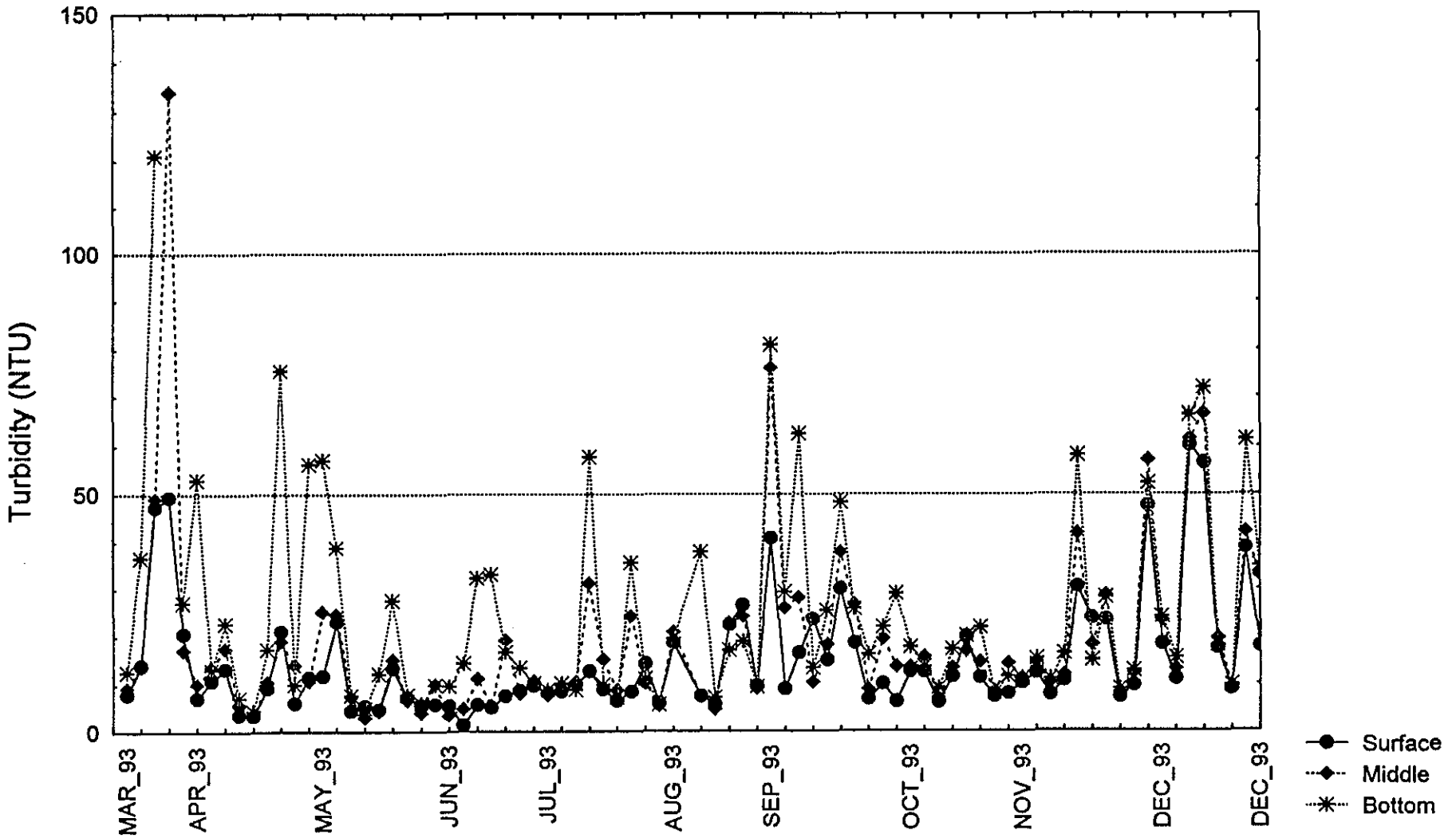


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.30

Variation in Turbidity at YOW21 during March to December, 1993

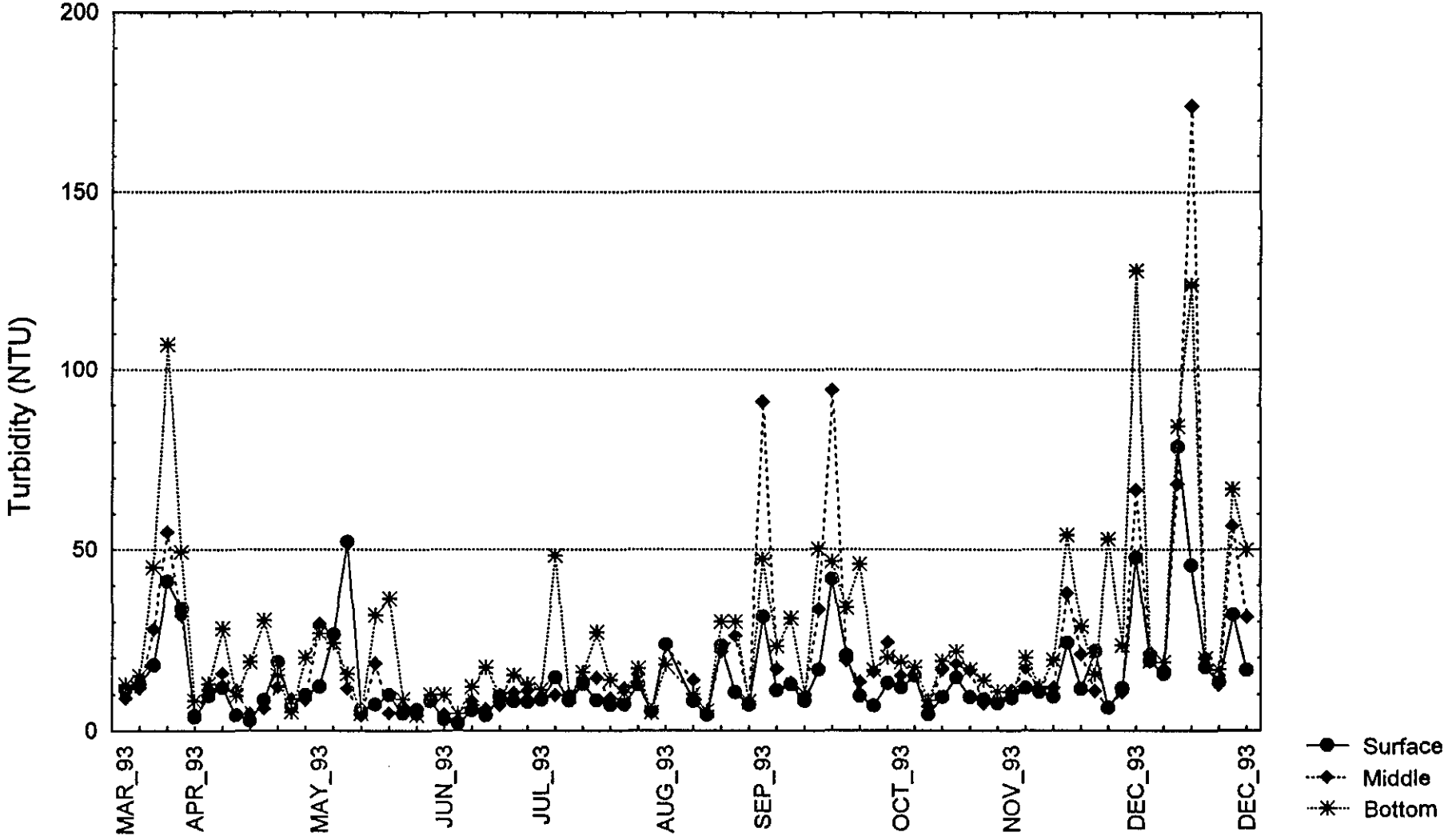


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.31

Variation of Turbidity at YOW22 during March to December, 1993



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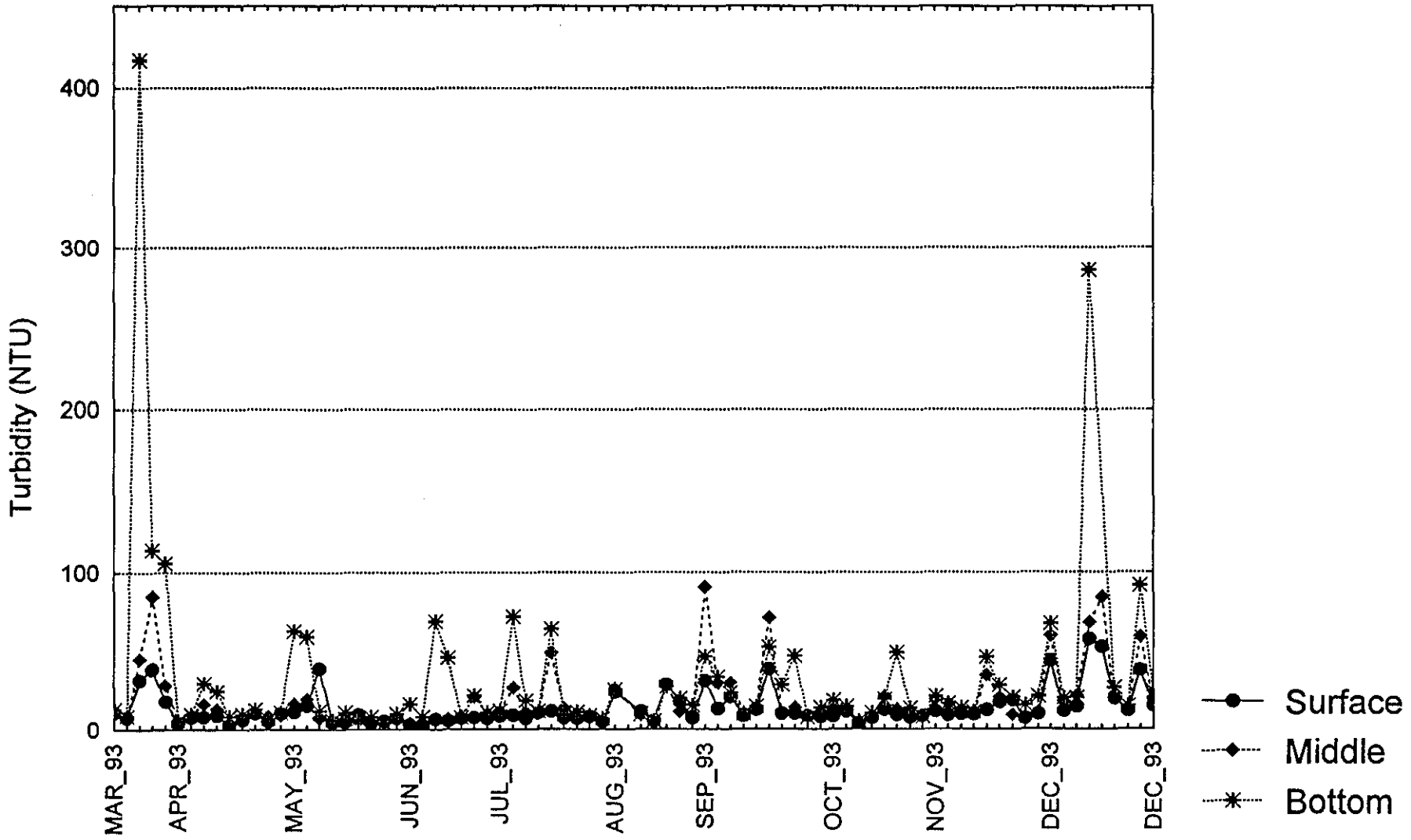
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.32

Variation in Turbidity at YOW23 during March to December, 1993

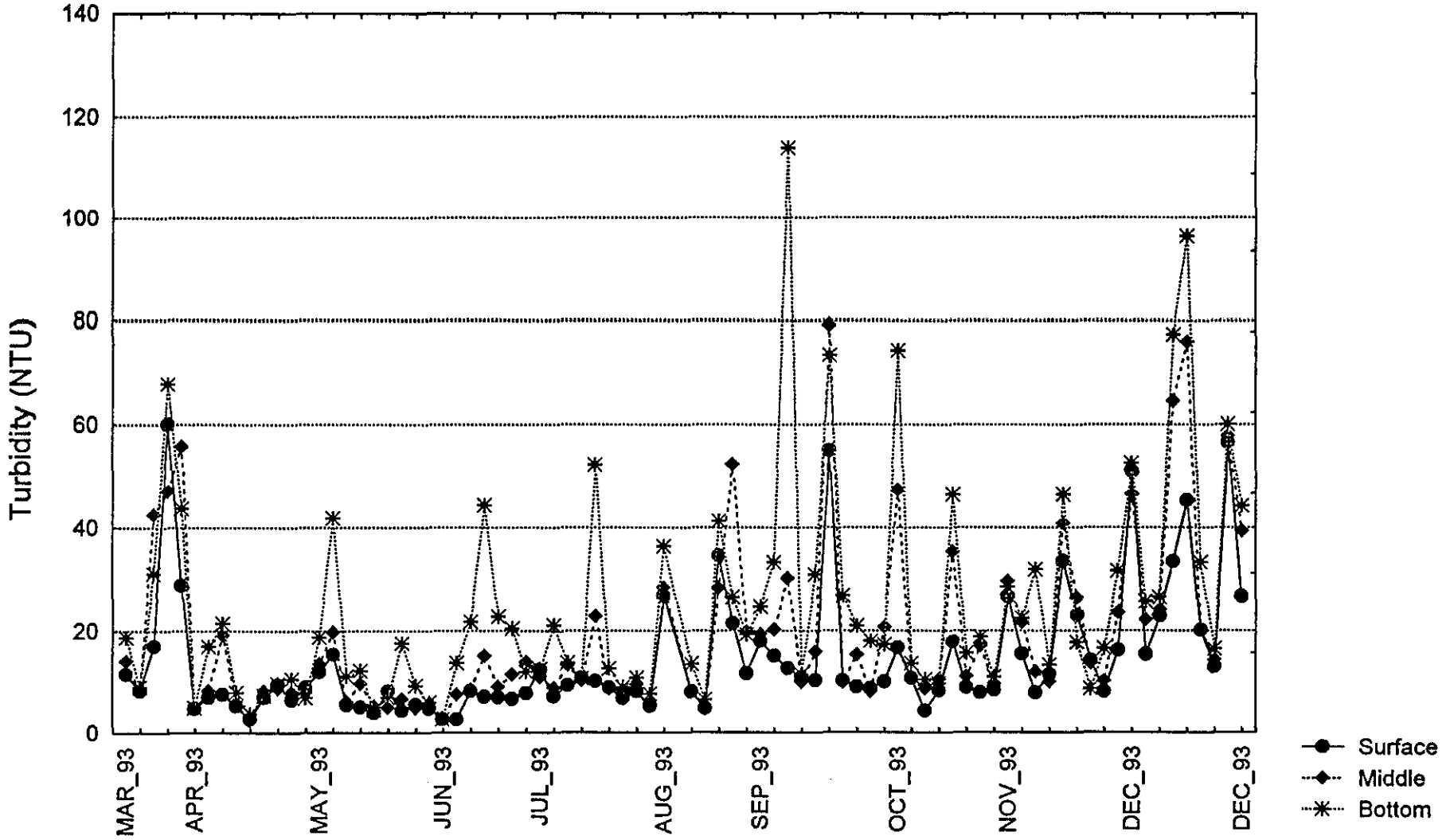


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.33

Variation in Turbidity at YOW24 during March to December, 1993

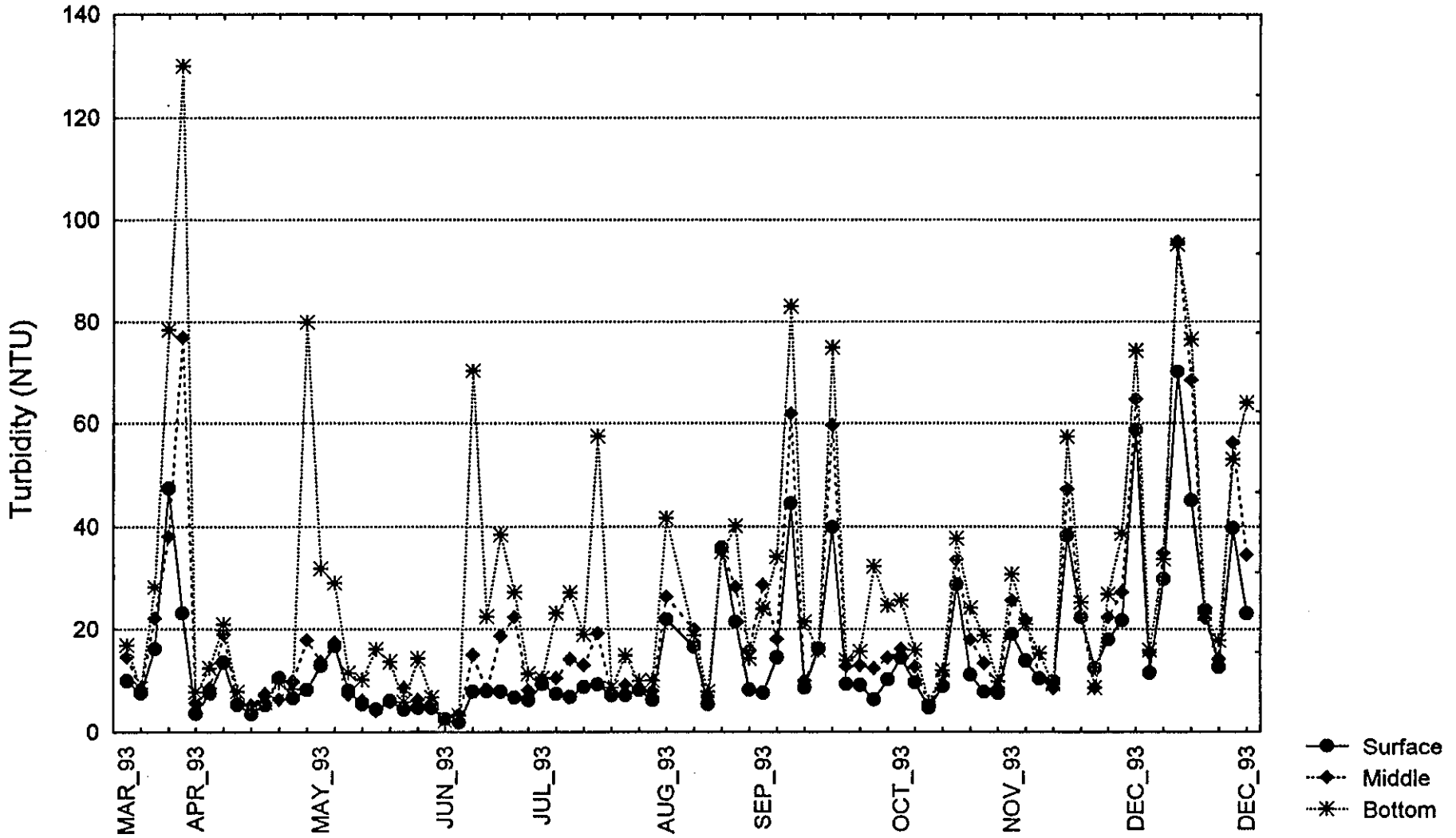


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.34

Variation in Turbidity at YOW25 during March to December, 1993

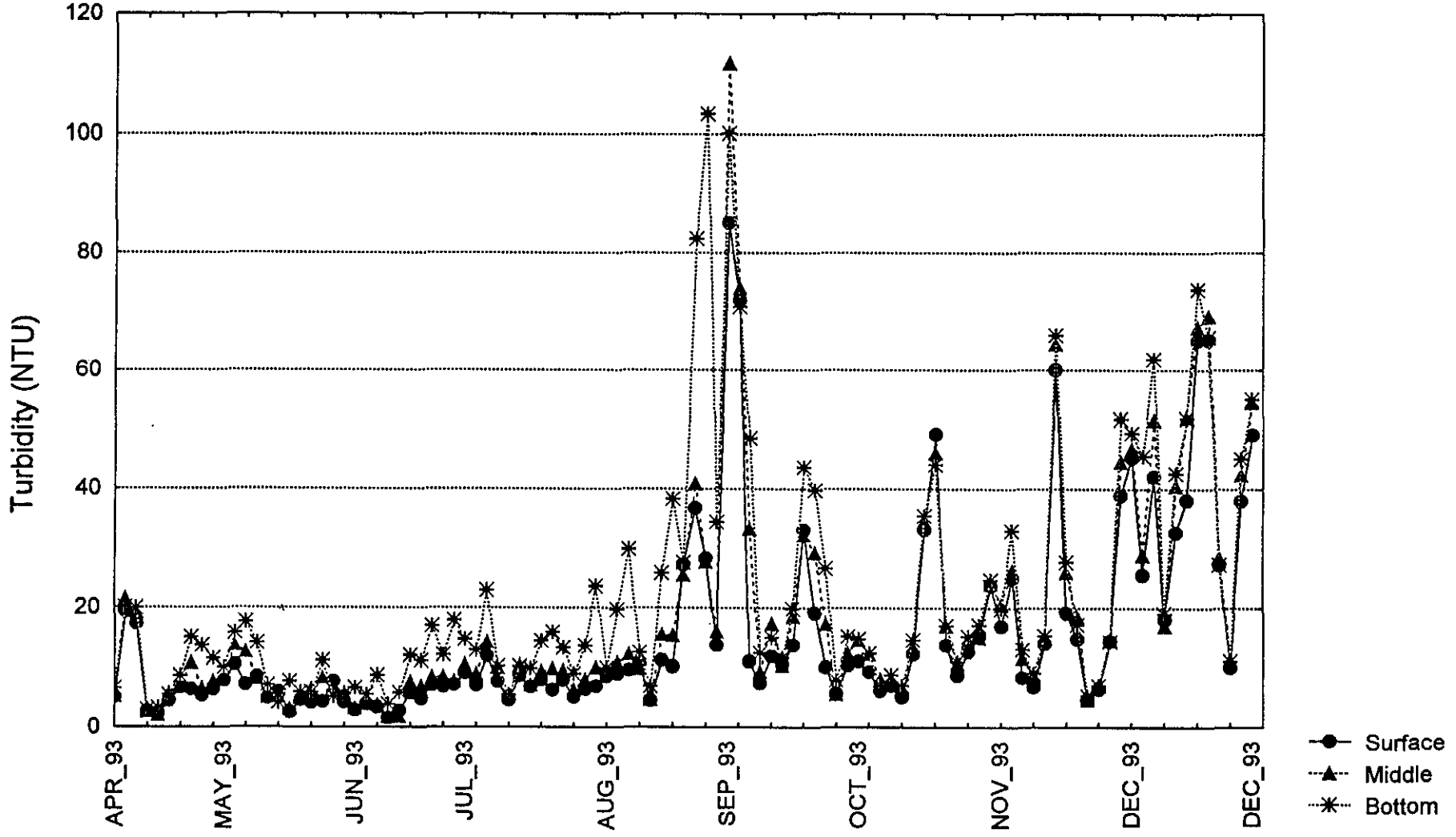


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.35

Variation in Turbidity at LFC13 during April to December, 1993



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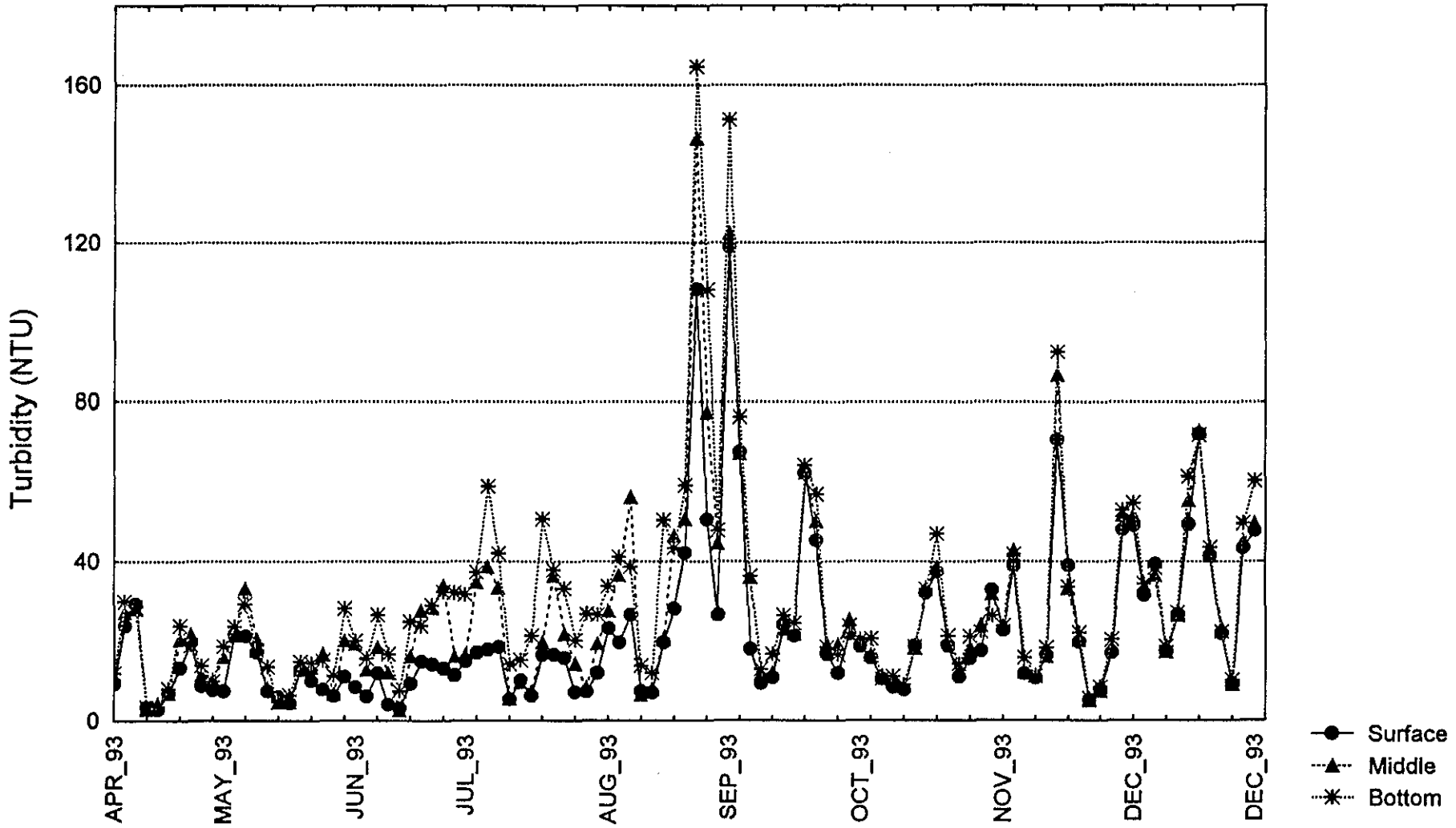
BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.36

Variation in Turbidity at LFC14 during April to December, 1993

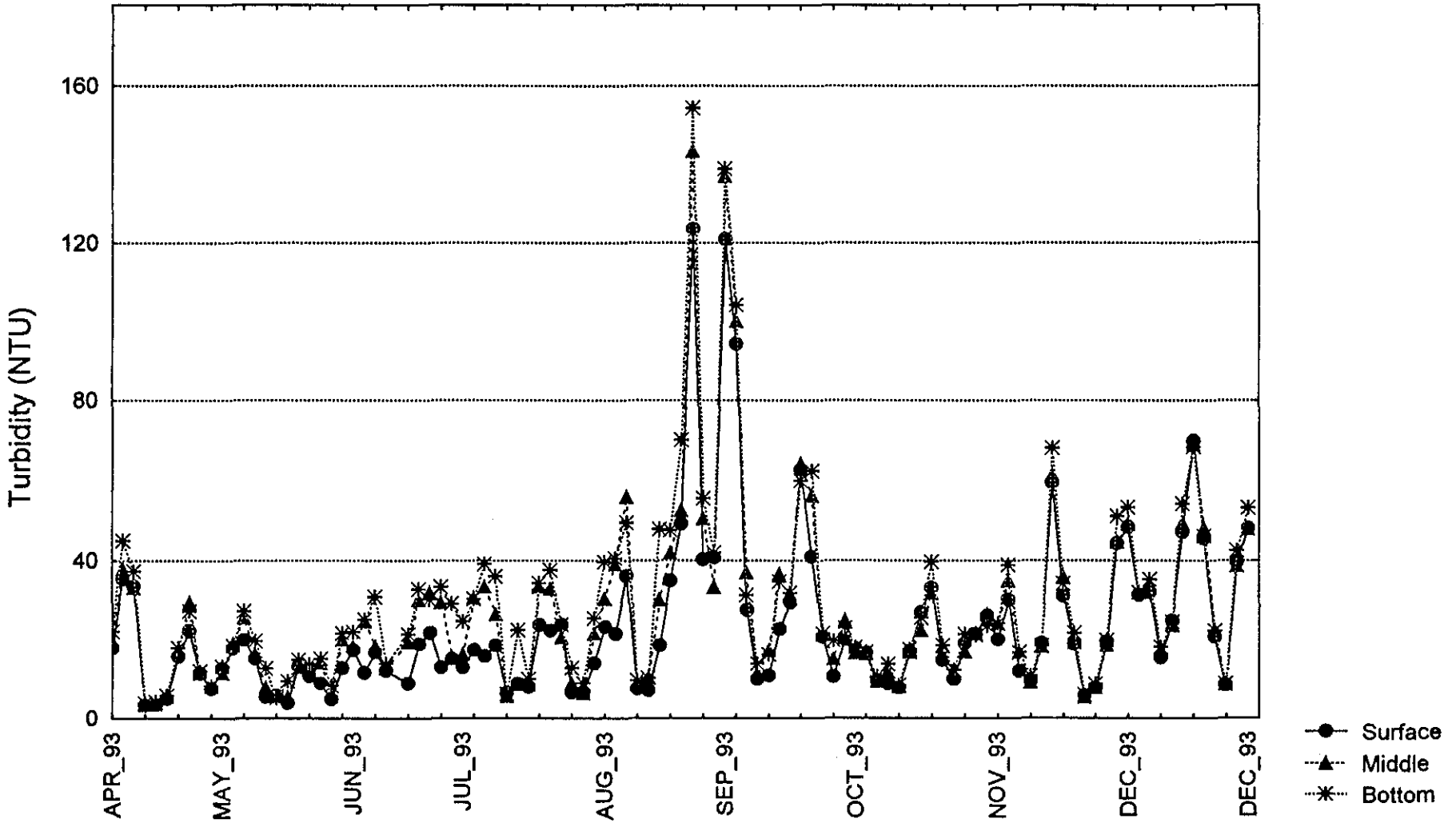


TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.37

Variation in Turbidity at LFC15 during April to December, 1993



TO KAU WAN RECLAMATION EIA

BACKGROUND MARINE WATER QUALITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB.94	Scale
土木工程署 Civil Engineering Department	Initial YPS	Graph No. 5.38

6. WASTE DISPOSAL

Scope

6.1 Assessment of the generation and disposal of the following materials has been undertaken:

- marine mud;
- storm water;
- construction waste;
- cleared vegetation;
- domestic-type sewerage; and
- domestic-type solid wastes.

Marine Mud

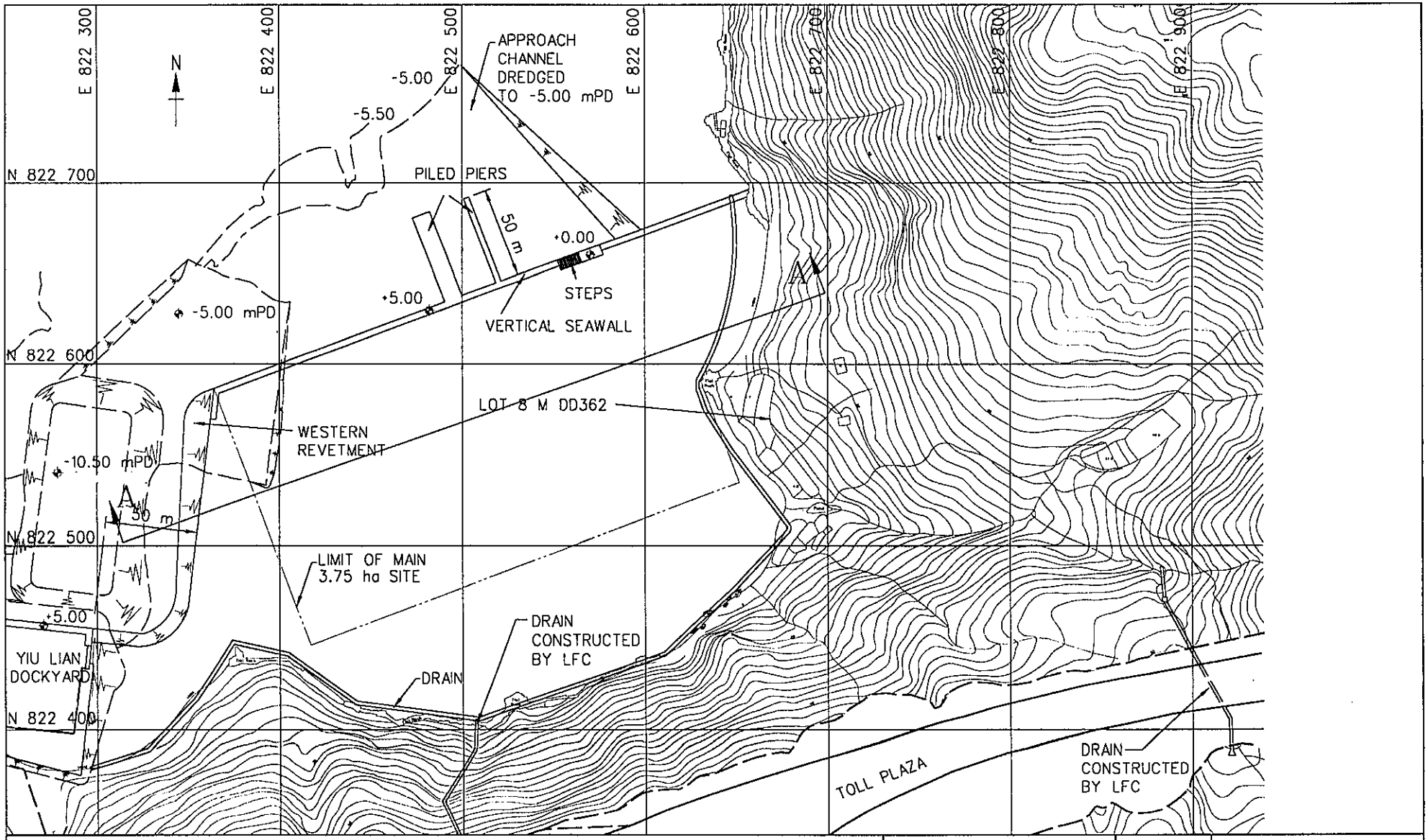
6.2 The proposed works were described in some detail in Chapter 2. A summary is provided below.

6.3 The proposed reclamation covers a marine area of about 80,000 m^2 with a surface area of about 63,000 m^2. The layout plan is shown in Figure 6.1. Marine mud will be left in place under the reclamation. The nominal final design level is to be +5.00 mPD. A vertical seawall is to be constructed along the northern edge of the site to retain the reclamation fill. The western edge will be retained by a revetment.

6.4 Dredging will only be required for the seawalls and the navigation channel. A number of options have been considered during the preliminary design stage. The options still under examination, described in Chapter 2, all pertain to the construction of the vertical sea-wall. A number of these options for the vertical sea-wall design do not require dredging under the wall but due to factors previously described have low probabilities of implementation.

6.5 The conceptual design[1] was based upon the assumption that marine mud would only be 2 metres deep. Site investigation studies undertaken during the preliminary design phase have shown the mud to be 0 to 13 metres deep, a much more complex situation.

6.6 The seabed is underlain by a layer of very soft to soft, dark grey, slightly organic marine mud overlying various sand deposits. Figure 6.2 shows the longitudinal section of A-A in Figure 6.1. The geotexture of the layer of marine mud is mainly marine clay which is not suitable for filling purposes and any dredged mud would need to be disposed at assigned borrow pits.



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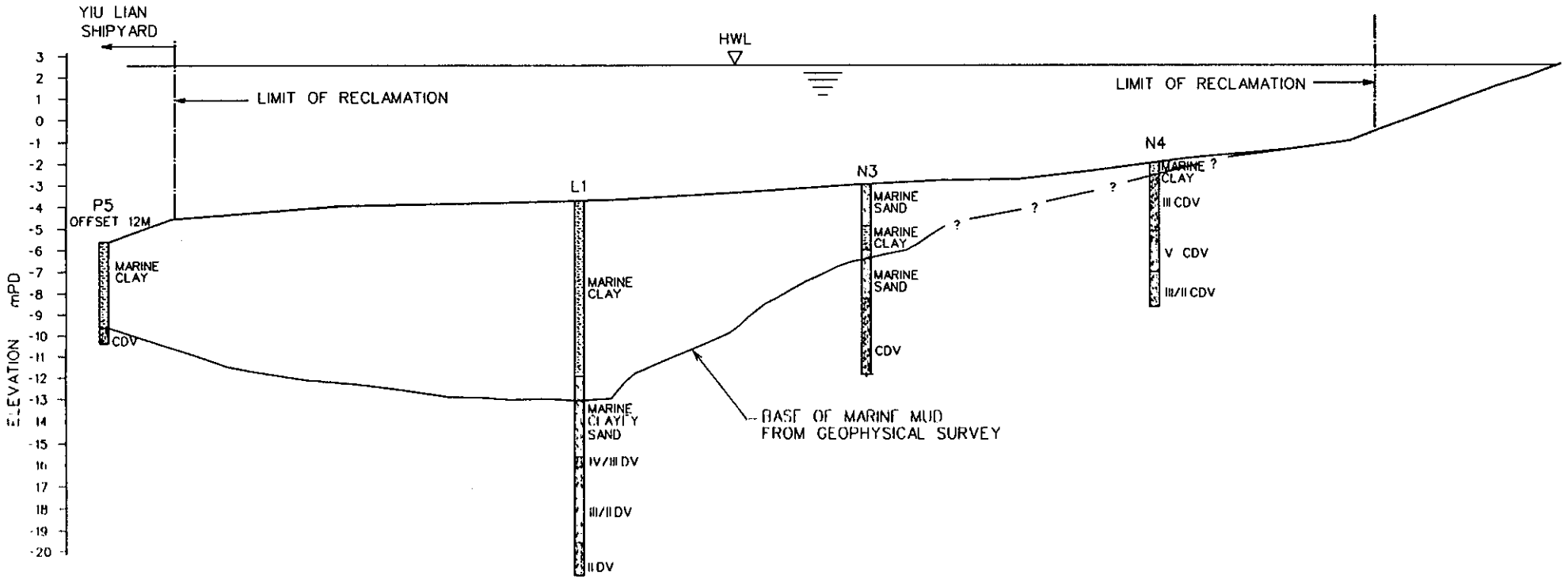
SITE LAYOUT PLAN

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB. 94	Scale 1 : 3000
土木工程署 Civil Engineering Department	Initial YPS	Figure No. 6.1



NOTES :

1. SEE FIGURE 6.1 FOR LOCATION OF SECTION
2. BASED UPON PRELIMINARY LOGS ONLY

TO KAU WAN RECLAMATION EIA

SECTION A-A
TYPICAL GEOLOGICAL SECTION
THROUGH THE SITE

MMM CONSULTANTS LIMITED 賓尼工程顧問有限公司 賓尼	Date 2/94	Scale HORIZ 1 : 1000 VERT 1 : 200
土木工程署 Civil Engineering Department	Initial EA	Figure No. 6.2

6.7 An estimated volume of about 215,000 m^3 of marine mud would be removed if a conventional vertical seawall is built, the most likely option at this time:

- 50,000 m^3 for the Western Revetment;
- 150,000 m^3 for the foundation of the vertical seawall and slipway; and
- 15,000 m^3 for the approach channel.

6.8 A disposal licence will be obtained from EPD and the Fill Management Committee (FMC) before disposal of the marine mud takes place.

6.9 The following Government technical circulars were published in Hong Kong in 1992 under the Dumping at Sea Act 1974 (Overseas Territories) Order 1975:

- Works Branch Technical Circular No. 6/92. *Fill Management.* Ref: WB(W) 209/32/96 (91);
- Works Branch Technical Circular No. 22/92. *Marine Disposal of Dredged Mud.* Ref: WB(W) 209/32/96 (92) Pt. II; and
- Environmental Protection Department Technical Circular No. (TC) NO1-1-92. *Classification of Dredged Sediments for Marine Disposal.* Ref: EP 100/C10/16.

6.10 These technical circulars define the role of the Fill Management Committee; provide outlines of the procedures to be followed in all works, both public and private, which involve the marine disposal of dredged mud; and provide a classification of sediments according to their level of contamination by toxic metals.

6.11 The classes are defined as follows:

- Class A Uncontaminated material, for which no special dredging, transport or disposal methods are required beyond those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Objectives, or for protection of sensitive receptors near the dredging or disposal areas.
- Class B Moderately contaminated material, which requires special care during dredging and transport, and which must be disposed of in a manner which minimises the loss of pollutants either into solution or by resuspension.

- Class C Seriously contaminated material, which must be dredged and transported with great care, which cannot be dumped in the gazetted marine disposal grounds and which must be effectively isolated from the environment upon final disposal.

6.12 The classification criteria for contamination levels are shown in Table 6.1. It should be noted that it is necessary for the concentration of only one metallic element to be exceeded for sediments to be identified as falling within a particular class.

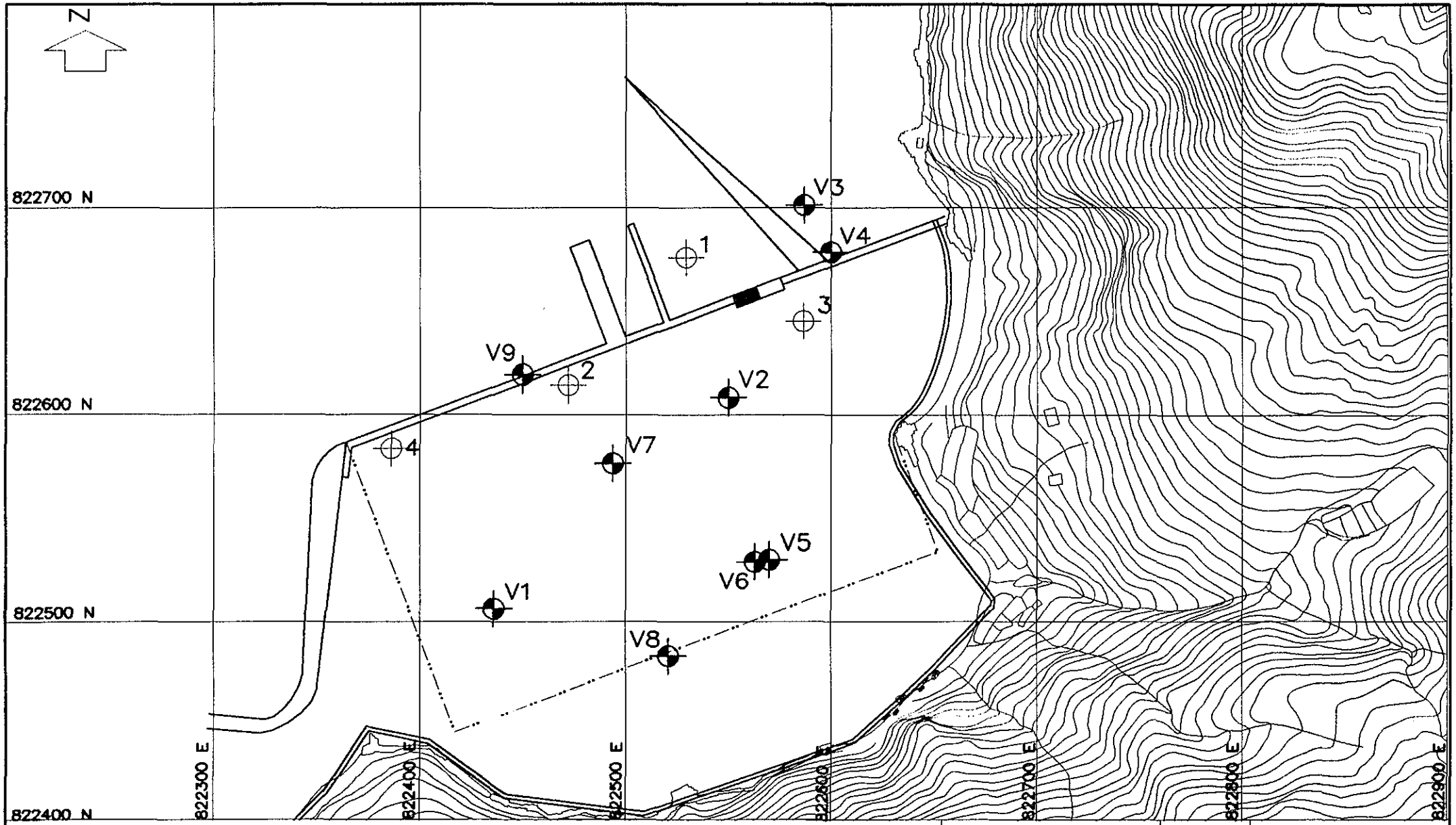
Table 6.1 Classification of Sediments by Metal Content (mg/kg dry weight)

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

6.13 Nine marine sediment samples were taken from the surface sediments of the site for the determination of heavy metal content. As is the normal practice, Total Chromium (Cr), Copper (Cu) and Nickel (Ni) content were analysed by direct acid digestion followed by Atomic Absorption Analysis and Total Mercury (Hg) was analysed by Cold Vapour Generation.

6.14 The location of sampling sites is shown on Figure 6.3. The results of the testing undertaken by a laboratory, HOKLAS accredited for a range of construction material tests[12], is shown below in Table 6.2.

All heavy metals levels except that of Mercury (Hg) lie within Class A classification. Three samples V1, V4 and V9 had measured Hg levels of 0.78, 5.08 and 0.82 mg/kg of dry sample.



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SEDIMENT SAMPLING LOCATIONS

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 2500
土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 6.3

Table 6.2 Analytical Results of Sediment Testing (mg/kg of dry sample)

	Cr	Cu	Pb	Zn	Cd	Ni	Hg
V1	47.0	34.9	48.4	119.7	< 0.11	21.1	0.78
V2	23.6	21.4	29.0	66.7	< 0.11	10.5	0.38
V3	30.2	33.5	30.2	73.6	< 0.11	11.8	0.37
V4	48.4	20.1	21.7	44.7	< 0.11	5.4	5.08
V5	19.5	18.2	21.2	53.1	< 0.11	8.0	0.61
V6	12.7	10.0	11.7	31.5	< 0.11	4.5	0.16
V7	20.7	49.7	37.1	114.2	< 0.11	20.8	0.44
V8	16.3	10.2	18.2	39.1	< 0.11	6.7	0.38
V9	36.5	14.6	29.6	79.1	< 0.11	17.2	0.82

6.15 The laboratory retested four of the samples for Hg. The remainder of the sample, V4, was divided in half and both halves retested. The laboratory manager noticed that sample V4 was composed principally of shell, about 70%. The results of the retesting is given below.

Table 6.3 Retesting Results for Mercury Content[13]

Sample No.	Original test results (mg/kg)	Retesting results	% Change	Average values
V1	0.78	0.49	-37%	0.64
V2	0.58			0.58
V3	0.37			0.37
V4	5.08	1.74 and 1.40	-64% and -72%	2.74
V5	0.61			0.61
V6	0.16			0.16
V7	0.44	0.32	-27%	0.38
V8	0.36			0.36
V9	0.82	0.84	+2%	0.83

6.16 Geotechnical investigation since undertaken near V4 showed a 0.5 m layer of brownish white, slightly sandy material with intact shells and shell fragments underlain by 3 m of soft, brownish grey to greenish grey, very sandy silty clay with some shell fragments.

6.17 The laboratory noted shell in a number of other samples although not in the same proportions. Animals such as bivalves biomagnify and time integrate heavy metals in their environment within their soft tissues by many orders of magnitude. Heavy metals bioaccumulate in their shells. A Hg level of 15 mg/kg in a bivalve shell is not unusual.

6.18 It is likely that the sample V4 was principally shells and is not indicative of the quality of the marine mud to be dredged from the site.

6.19 Further tests have been undertaken near V4 and V9 and these results are given below in Table 6.4.

Table 6.4 Second Set of Sediment Testing

Sample ID	Metal Content (Total mg/kg Dry Weight)						
	Cu	Cd	Cr	Pb	Ni	Zn	Hg
(1)	15.4	1.7	16.1	58.0	14.5	39.3	0.6
(2)	17.9	1.8	16.3	56.9	14.3	41.3	0.2
(3)	13.9	1.8	15.0	56.4	13.9	37.1	0.2
(4)	15.9	1.8	16.2	59.2	14.7	39.7	<0.1

6.20 These tests were undertaken by another laboratory accredited by HOKLAS for some environmental testing. Hg was at Class A levels. Cd levels in all samples were Class C.

6.21 Sediments tested in the bay to the west of the Yiu Lian Dockyard for the Toll Plaza reclamation works were classified as Class A.

6.22 Mitigation measures suggested in the Chapter 8 on Water Quality have been proposed to protect the water column and the surrounding marine environment from the effects of dredging and will be adequate to ensure that no significant impact will results from the dredging operations outside of the mixing zone. The EM&A programme provides action plans designed to ensure compliance with WQO outside of the immediate dredging area.

Storm Water

6.23 This section can be found in Chapter 5.

Construction and Other Wastes

6.24 Assessment and mitigation proposals for construction and other wastes are included in Chapter 8.

7. ECOLOGICAL IMPACT

Introduction

So as to assess the ecological impact of the project on the surrounding area and limit this impact as much as possible the following steps have been undertaken:

- The area of reclamation has been optimised.
- Considerable effort has been expended during the preliminary design phase to the amount of dredging needed. If the depth of marine muds had been only the 2 metres or so as predicted in the conceptual study[1], very limited dredging would have been required.
- Revetments have been designed so as to be suitable as habitats for marine organisms. The unavoidable loss of some rocky foreshore will be mitigated by the Western Revetment. This has been designed to provide niches for organisms of the rocky foreshore and will be particularly suitable for colonization by gastropods. Rocks will be randomly placed to form the revetment with a slope of 1 or 2.5.
- By optimising the reclamation area and the amount of dredging necessary, the loss of sea-floor has also been minimised.
- Mitigation measures recommended in earlier chapters particularly those affecting water quality will minimise any impacts on marine life.
- Faunal and vegetation surveys were carried out on 19th and 27th January 1994 respectively in the vicinity of the proposed reclamation site for the shipyard at To Kau Wan. The results of these surveys are discussed separately below.

The surveys were undertaken with the following aims:

- to identify ecologically significant habitats;
- to determine the baseline conditions;
- to recognise any significant potential disturbance to significant habitats or species;
- to assess the degree of ecological impact resulting from the implementation of the project; and
- to aid in the formulation of additional mitigation measures to minimise this ecological if necessary.

Faunal Survey

Methods

7.1 Birds in a variety of habitats including woodland, scrubland, grassland, sandy beach and rocky shore were observed and counted on site using binoculars.

7.2 Aquatic animals in streams were collected by kick sample method which involved using a net sampler (with 0.5 mm mesh size) facing up-stream and vigorously disturbing an area of substrate.

7.3 A 28 m transect line was run from the exposed upper sandy beach (intertidal) to submerged shallow water (subtidal, 0.3 m depth). Sediments (5 cm in depth) were collected from seven 0.5 m^2 quadrates along the transect and live animals were sorted, numerated and identified.

7.4 A 10 m transect line was run at a rocky shore on the eastside of the surveyed coastal area. Animals were counted and identified within five quadrats.

Results and comments

7.5 Birds: At least nine species of birds (Table 7.1) were observed within the site. More birds than the numbers revealed by this short observation are expected to occur within the area. However, the site is unlikely to be attractive to birds, because the habitats were strongly disturbed by impacts such as noise, visual intrusion, wastes and dust from a number of current human activities. Such activities identified includes ships around the dockyard on the west side of the site, land reclamations along the south-west coastal area and the construction of the Toll Plaza. Habitat for shore birds will be lost due to the proposed project.

7.6 Stream fauna: Only two streams at the site contained water and discharge was very small (< 0.001 m^3/sec., estimated by Newbury's method[15]). Faunal composition was poor in terms of number of species (Table 7.2). Only six species (excluding Chironomids) were present in qualitative samples. No fish were seen in streams during the stream survey.

Table 7.1 Birds recorded at To Kau Wan on 19th January 1994

Common name	Latin name	Number
Woodland birds:		
Magpie	*Pica pica*	3
Black-eared kite	*Milvus migrans*	1
Black-faced laughing thrush	*Garrulax perspicillatus*	5
Crested bulbul	*Pycnonotus jocosus*	2
Warbler (hear sound)	(species undertermined)	2-4
Shore birds:		
Little egret	*Egretta garzetta*	1
Common sandpiper	*Actitis hypoleucos*	2
White wagtail	*Motacilla alba*	1
White-brested kingfisher	*Halcyon smyrnensis*	1
Total number		19

Table 7.2 Stream animals collected from To Kau Wan on 19th January 1994

Common name	Latin name	Abundance
Shrimp	*Neocaridina serata*	++
Mayfly	*Cinygmina* sp.	+
Caddisfly	*Hydropsyche* sp.	+
Water skater	*Gerris* sp.	++
Backswimmers	*Notonecta* sp.	++
Tropical backswimmers	*Anisops* sp.	++
Chironomids	(species undetermined)	++

Note: +, present; ++, common

Table 7.3 Macrobenthic species and density on sandy beach and shallow water at To Kau Wan. Samples were collected from seven quadrats along a transect line on 19th January 1994

Common name	Latin name	quadrate*						
		1	2	3	4	5	6	7
Hermit crab	(species undetermined)						1	
Amphipods	*Orchestia* spp.					14	17	51
Isopods	(species undetermined)					5	21	29
Gastropods	*Monodonta australis*							1
Micro-gastropods	(species undetermined)					1	1	
Flatworm	(species undetermined)						1	
Polychaete	*Marphysa* sp.						1	1
Total no. of indiv.		0	0	0	0	20	42	82
Density (No. of indiv./m²)		0	0	0	0	40	84	164

*: Quadrate 1-4 were located on exposed sandy shore (intertidal), while quadrate 5-7 were in shallow water.

Table 7.4 Macrobenthic species and density on rocky shore at To Kau Wan. Samples were collected from five quadrats along a transect line on 19th January 1994

Common name	Latin name	quadrate*				
		1	2	3	4	5
Gastropods	*Nodilittorina pyramidalis*		36	230	29	
Gastropods	*Nodilittorina millegrana*		5	31	18	
Gastropids	*Littorina* sp.			15	198	
Gastropods	*Drupa musiva*					3
Limpets	*Patelloida saccharina*					35
Limpets	*Cellana eucosmia*					1
Isopods	*Ligia exotica*	16				
Stalked barnacle	*Pollicipes mitella*					13
Cricket	*Gryllidae*	1				
Cockroach	c.f. *Opisthoplatia orienta*	1				
Total no. of indiv.		18	41	276	245	52
Density (No. of indiv./m²)		36	82	552	490	104

7.7 Sandy beach fauna: Macrobenthic species and density on sandy beach and shallow water sampled by quadrats are given in Table 7.3. No animals were obtained from the exposed upper sandy shore. At least seven species of benthos were recorded from the shallow water quadrats where small amphipods and isopods were common. Animal densities varied between 40 to 164 indiv./m^2. A search around the beach including shallow water found no fish or other visible animals (>1 cm). Poor faunal composition may be due to degradation of the water quality in the bay and intensive navigation and land formation nearby.

7.8 Rocky shore fauna: In total, ten species were recorded within five quadrats on the rocky shore (Table 7.4). Gastropods, belonging to genus *Nodilittorina* and *Littorina*, were the dominant species on the rocky shore as on many other similar habitats in Hong Kong[16]. The animal density on the rocky shore was up to 552 indiv./m^2.

Conclusions

7.9 Species richness is poor in streams, sandy and rocky shores. Replacement of rocky shore habitats will be provided by the Western Revetment.

7.10 The bay is polluted with floating rubbish and disturbed by ships and other cumulative effects from land reclamations in adjacent coastal areas.

7.11 A benthic grab survey in this heavily disturbed bay was not undertaken as it is unlikely to enhance the current level of relevant information. The substratum, at least in shallow water of the bay, is made up of cobbles where the grab sampler cannot operate. Literature review information about the marine ecology of the area is given at the end of this chapter.

7.12 A more detailed survey of the vegetation was recommended and carried out as the principal ecological impacts are likely to be the loss of the vegetation itself and as habitat for birds. Habitat for shore birds will be reduced due to the proposed project. This survey is described below.

Vegetation Survey

Habitats of To Kau Wan

7.13 The slopes at the southern side of To Kau Wan are very steep (> 45° on average) and are more gentle at the eastern side. On these slopes the dominant vegetation formations are "fernland with grasses and low shrubs" especially on the upper slopes. There are some patches of woodland on the low-land by the coast at the western end and southeastern part of the bay. Discrete patches of woodland are also found in the ravines. Above the high water mark there are some seashore plants on the sandy beach or established on thin soils above the rocks. The different plant communities are discussed separately.

Seashore Plants and Mangroves

7.14 The reclamation would directly affect all the vegetation between the shoreline and places up to +5.5 mPD. The plants along the coast would therefore be affected most. This band is very narrow, due to the steepness of the hillside.

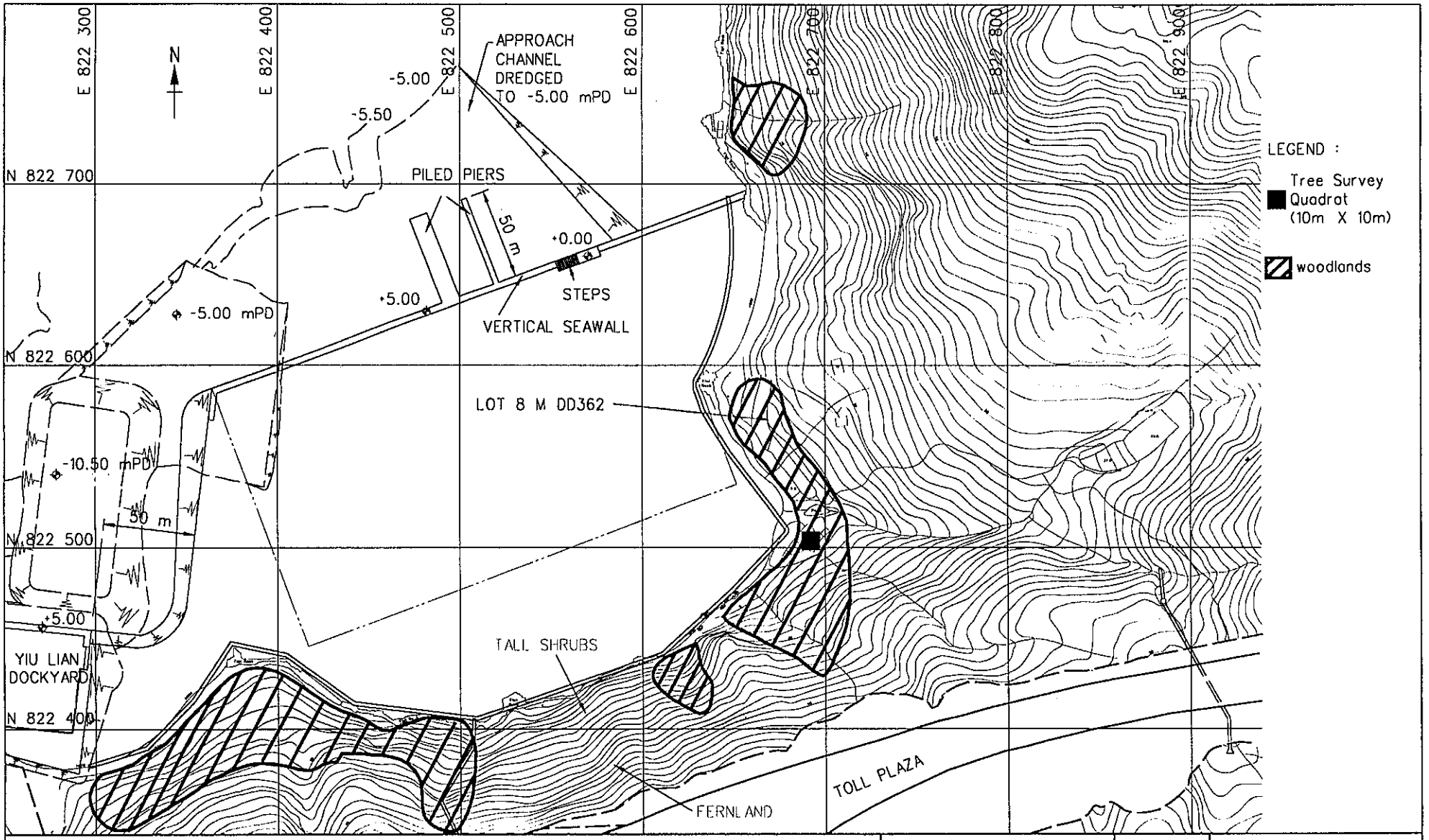
7.15 Two individuals of the mangrove plant *Aegiceras corniculatum* were found on the rocks above the high water mark in the eastern side of the bay. These *Aegiceras* are very small and less than 80 cm in height. There is no other mangrove species (**true** mangrove species, see[17]) and no mangrove community in the study site. This is presumably due to the lack of large streams or rivers in this area which are needed to supply adequate sediments, organic material and fresh water for the establishment and growth of mangrove plants.

7.16 Other seashore plants that occur in the study area include *Hibiscus tiliaceus*, *Thespesia populnea*, *Pandanus tectoris*, *Sceavola sericea*, *Clerodendrum inerme*, *Ipomoea brasiliensis*, *Gynura divaricata*, *Melanthera bicolor* and *Sporobulus virginicus*. All these plants are common in other similar habitats over the whole Territory.

Coastal Woodlands

7.17 Patches of wooded areas are commonly found along the coast. Those in the study area are shown in Figure 7.1. The most uniform patch of woodland is at the back of the beach in the eastern side of the bay. The trees grow on a seemingly abandoned cultivation field. A quantitative survey of trees in a 10 m x 10 m quadrat was undertaken in this woodland. Inside the quadrat all trees with diameter at breast height (dbh, 1.3 m above ground level) greater than 2 cm were measured and the result is summarised in Table 7.5[18]. There are 23 individuals of 10 tree species in the quadrat. The dominant species are *Microcos paniculata*, *Mallotus paniculatus*, *Liquidamber formosana* and *Sterculia lanceolata*. The height of the top canopy species is 12 m and the canopy coverage is 85%. Judging from the pattern of regular spacing between individuals and the uniformity in size, the *Liquidamber formosana* trees in this quadrat and in the vicinity are very likely planted. The woodland is now at its young-mature phase. Only one quadrat was done in the whole study site due to the small extent of the woodlands and the steep topography.

7.18 The physiognomy of the woodland patch at the western end of the bay is similar to the previously described woodland on Lantau although the species composition is slightly different. The dominant species in this woodland include *Schefflera octophylla*, *Microcos paniculata*, *Cerbera manghas*, and *Ficus microcarpa*.



TO KAU WAN RECLAMATION EIA

VEGETATION

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB. 94	Scale 1 : 3000
土木工程署 Civil Engineering Department	Initial YPS	Figure No. 7.1

Table 7.5 Results of Tree Survey in the Quadrat (10 m x 10 m) in To Kau Wan, North Lantau

	Plant Species	N	Height (m)	dbh (cm)	Dominance	Relative Abundance	Relative Dominance	Importance Value
*	Microcos paniculata	4	8-12	4.5-19.7	1498.7	17.39	40.58	57.97
	Mallotus paniculatus	4	5-12	6.1-22.6	813.8	17.39	22.03	39.42
	Liquidambar formosana	4	5-12	13.4-19.1	778.4	17.39	21.07	38.47
*	Sterculia lanceolata	5	3-10	2.9-13.4	421.8	21.74	11.42	33.16
*	Bridelia tomentosa	1	5	4.8-7.3	77.9	4.35	2.11	6.46
	Daphniphyllum calycinum	1	5	6.4	31.8	4.35	0.86	5.21
	Phyllanthus emblica	1	6	6.1	28.7	4.35	0.78	5.12
	Rhussuccedanea	1	4	4.5	15.6	4.35	0.42	4.77
	Cratoxylum ligustrinum	1	6	4.1	13.4	4.35	0.36	4.71
	Pithecellobbium lucidum	1	7	4.1	13.4	4.35	0.36	4.71
Total	10 species	23			3693.5			

Remarks:

* = multi-trunk

Dominance = total trunk area at breast height

Dominance, Relative Abundance, Relative Dominance and Importance Value follow Muller-Dombois and Ellenberg (1974).

Fernland with Grasses and Shrubs

7.19 Beyond the coastal woodland there are fernlands with grasses and shrubs on the upper slopes. The vegetation is maintained by fire and evidence shows that the fernland was burnt in the last fire season (October 1992 to April 1993). The dominant species in the fernland are the rhizomatous fern *Dicranopteris linearis*, shrubs such as *Rhodomyrtus tomentosa*, *Litsea rotundifolia* var. *oblongifolia* and *Melastoma* spp., and grasses such as *Miscanthus sinensis* and *Arundinella nepalensis*.

7.20 A list of plants recorded in the study are with relative abundance on site and other information is given in Table 7.6.

Protected or Rare Species

7.21 The major aim of biological conservation is to preserve or enhance species diversity in the ecosystem. Therefore the coastal woodlands are of high conservation value because of their rich bio-diversities. Moreover many of the trees and shrubs in the woodland provide habitat and food (fruit, nectar and leaf) to birds, butterflies and wasps (see Table 7.6).

7.22 One plant species found in the study site is protected under the Forests and Countryside Ordinance (Cap. 96) Forestry (Amendment) Regulations 1993. The species is *Pavetta hongkongensis*. It is a small tree about 4 m high located at the coastal fringe of the woodland at the western end of the bay. This tree will be buried by the proposed reclamation. *Pavetta hongkongensis* is **not** currently a rare nor endangered species and is frequently found in woodlands in many places in the Territory. It is presumably protected to prevent commercial harvesting[19] since the dense, large inflorescence of white flowers makes it a good ornamental plant. The loss of this tree is not of concern.

7.23 All orchid species are also protected under the same ordinance. Some grassland orchids such as *Arundina chinensis* and *Spathoglottis pubescens* may occur in the study are but they are virtually undetectable at present since they are not in flower. However, these grassland orchids are widespread in similar habitats in Hong Kong.

7.24 None of the plant species recorded in this study are rare in Hong Kong or in the South China region.

Table 7.6 Plant species occurring in To Kau Wan, North Lantau

Remarks:

BL = Foodplant for Butterfly Larvae
Ntr = Nectar source for Butterflies and Wasps
Frt = Fruit for birds, etc.

Relative Abundance:

A = Abundant
C = Common
F = Frequent
O = Occasional
R = Rare

	Plant Species	Family / (fern group)	On-site relative abundance	Native/Exotic	Remarks
Trees	Acronychia pedunculata	Rutaceae	O	Native	BL
	Aleurites moluccana	Euphorbiaceae	R	Exotic	
	Antidesma ghaesembilla	Euphorbiaceae	O	Native	
	Aporusa dioica (A. chinensis)	Euphorbiaceae	O	Native	Frt
	Aralia chinensis	Araliaceae	F	Native	
	Bambusa sp.	Poaceae	O	Native	
	Bridelia tomentosa	Euphorbiaceae	O	Native	BL Frt
	Celtis sinensis	Ulmaceae	R	Native	BL Frt
	Cerbera manghas	Apocynaceae	C	Native	
	Cratoxylum ligustrinum	Hypericaceae	C	Native	BL Ntr
	Daphniphyllum calycinum	Daphniphyllaceae	F	Native	
	Delonix regia	Caesalpiniaceae	R	Exotic	
	Euphoria longan	Sapindaceae	O	Exotic	
	Ficus hispida	Moraceae	F	Native	
	Ficus microcarpa	Moraceae	F	Native	BL Frt
	Glochidion dasyphyllum	Euphorbiaceae	R	Native	
	Glochidion hongkongense	Euphorbiaceae	O	Native	
	Glochidion macrophyllum	Euphorbiaceae	O	Native	
	Hibiscus tiliaceus	Malvaceae	C	Native	BL

Table 7.6 **Plant species occurring in To Kau Wan, North Lantau** (cont'd)

	Plant Species	Family / (fern group)	On-site relative abundance	Native/Exotic	Remarks		
	Liquidambar formosana	Hamamelidaceae	A	Native			
	Litsea glutinosa	Lauraceae	F	Native	BL		
	Mallotus paniculatus	Euphorbiaceae	A	Native			
	Microcos paniculata	Tiliaceae	A	Native	BL	Ntr	
	Musa sp.	Musaceae	R	Exotic	BL		
	Paliurus ramosissimus	Rhamnaceae	R	Native	BL		
	Pandanus tectorius	Pandanaceae	O	Native			
	Pavetta hongkongensis	Rubiaceae	R	Native, Protected			
	Phoenix hanceana	Arecaceae	O	Native	BL		
	Phyllanthus emblica	Euphorbiaceae	O	Native			
	Pinus massoniana	Pinaceae	O	Native			
	Pithecellobium lucidum	Mimosaceae	F	Native			
	Pongamia pinnata	Papilionaceae	O	Native			
	Psidium guajava	Myrtaceae	O	Exotic			Frt
	Rhus hypoleuca	Anacardiaceae	O	Native	BL		
	Rhus succedanea	Anacardiaceae	A	Native			
	Sapium discolor	Euphorbiaceae	O	Native			
	Sapium sebiferum	Euphorbiaceae	F	Native			Frt
	Schefflera octophylla	Araliaceae	A	Native	BL	Ntr	Frt
	Soolopia chinensis	Flacourtiaceae	O	Native	BL		
	Sideroxylon wightianum	Sapotaceae	R	Native			
	Sterculia lanceolata	Sterculiaceae	A	Native	BL		
	Symplocos sp.	Symplocaceae	O	Native			
	Thespesia populnea	Malvaceae	F	Native			
	Trema orientalis	Ulmaceae	O	Native	BL		Frt
	Zanthoxylum avicennae	Rutaceae	O	Native	BL	Ntr	
Shrubs	Adhaloda vasica	Acanthaceae	R	Exotic			
	Aegiceras corniculatum	Aegiceritaceae	R	Native			
	Ardisia crenata	Myrsinaceae	F	Native			

Table 7.6 **Plant species occurring in To Kau Wan, North Lantau** (cont'd)

	Plant Species	Family / (fern group)	On-site relative abundance	Native/Exotic	Remarks		
	Atalantia buxifolia	Rutaceae	A	Native	BL	Ntr	
	Baeckea frutescens	Myrtaceae	O	Native			
	Breynia fruticosa	Euphorbiaceae	O	Native	BL		
	Clerodendrum inerme	Verbenaceae	O	Native			
	Desmos oochinchinensis	Annonaceae	F	Native	BL		
	Diospyros vaccinioides	Ebenaceae	O	Native			
	Eurya chinensis	Theaceae	O	Native			
	Ficus hirta	Moraceae	F	Native			
	Glochidion eriocarpum	Euphorbiaceae	O	Native	BL		
	Helicteres angustifolia	Sterculiaceae	O	Native			
	Ilex asprella	Aquifoliaceae	O	Native			Frt
	Ilex pubescens	Aquifoliaceae	O	Native			Frt
	Inula cappa	Asteraceae	O	Native			
	Lantana camara	Verbenaceae	C	Exotic		Ntr	
	Litsea rotundifolia var. oblongifolia	Lauraceae	C	Native	BL	Ntr	
	Melastoma candidum	Melastomataceae	F	Native			Frt
	Melastoma sanguineum	Melastomataceae	O	Native			
	Psychotria rubra	Rubiaceae	A	Native		Ntr	Frt
	Rhaphiolepis indica	Rosaceae	F	Native		Ntr	Frt
	Rhodomyrtus tomentosa	Myrtaceae	F	Native			Frt
	Scaevola sericea	Goodeniaceae	F	Native			
	Uvaria microcarpa	Annonaceae	O	Native	BL		
	Vitex rotundifolia	Verbenaceae	R	Native			
	Wikstroemia indica	Thymelaeaceae	O	Native			
Climbers	Alyxia sinensis	Apocynaceae	R	Native			
	Asparagus oochinchinensis	Liliaceae	F	Native			
	Canavalia lineata	Papilionaceae	R	Native	BL		
	Cansjera rheedii	Opiliaceae	R	Native			
	Cassytha filiformis	Lauraceae	O	Native			

Table 7.6 **Plant species occurring in To Kau Wan, North Lantau** (cont'd)

	Plant Species	Family / (fern group)	On-site relative abundance	Native/Exotic	Remarks		
	Celastrus hindsii	Celastraceae	R	Native			
	Celastrus orbicufatus	Celastraceae	R	Native			
	Cocculus trilobus	Menispermaceae	O	Native			
	Embelia laeta	Myrsinaceae	F	Native	BL		Frt
	Embelia ribes	Myrsinaceae	O	Native			Frt
	Gymnema alterniflorus	Asclepiadaceae	R	Native			
	Hedyotis hedyotidea	Rubiaceae	O	Native			
	Ipomoea brasiliensis	Convolvulaceae	O	Native			
	Ipomoea cairica	Convolvulaceae	F	Exotic			
	Ipomoea sp.	Convolvulaceae	R				
	Melodinus suaveolens	Apocynaceae	R	Native			
	Mikania micrantha	Asteraceae	F	Exotic		Ntr	
	Millettia nitida	Papilionaceae	O	Native	BL		
	Mussaenda pubescens	Rubiaceae	O	Native	BL	Ntr	
	Paederia scandens	Rubiaceae	O	Native		Ntr	
	Passiflora foetida	Passifloraceae	R	Native			
	Psychotria serpens	Rubiaceae	O	Native			
	Pueraria phaseoloides	Papilionaceae	O	Native	BL		
	Rubus reflexus	Rosaceae	O	Native	BL		
	Smilax china	Smilacaceae	C	Native	BL		Frt
	Smilax glabra	Smilacaceae	O	Native			
	Smilax lanceaefolia	Smilacaceae	R	Native	BL		
	Tetracera aslatica	Dilleniaceae	F	Native			
	Zanthoxylum cuspidatum	Rutaceae	F	Native	BL		
	Zanthoxylum nitidum	Rutaceae	A	Native	BL		
Herbs	Ageratum conyzoides	Asteraceae	O	Native		Ntr	
	Commelina communis	Commelinaceae	R	Native			
	Dianella ensifolia	Liliaceae	O	Native			
	Emilia sonchifolia	Asteraceae	R	Native			

Table 7.6 **Plant species occurring in To Kau Wan, North Lantau** (cont'd)

	Plant Species	Family / (fern group)	On-site relative abundance	Native/Exotic	Remarks
	Gynura divaricata	Asteraceae	F	Native	Ntr
	Liriope spicata	Liliaceae	F	Native	
	Melanthera bicolor	Asteraceae	F	Native	Ntr
Grasses & Sedges	Apluda mutica	Poaceae	F	Native	BL
	Arundinaria sinica	Poaceae	C	Native	
	Arundinella nepalensis	Poaceae	F	Native	
	Cyperus cyperoides	Cyperaceae	R	Native	
	Digitaria sanguinalis	Poaceae	R	Native	
	Fimbristylis sp.	Cyperaceae	R		
	Ischaemum aristatum	Poaceae	F	Native	
	Miscanthus sinensis	Poaceae	A	Native	BL
	Neyraudia reynaudiana	Poaceae	F	Native	
	Pennisetum sp.	Poaceae	R		
	Sporobolus virginicus	Poaceae	O	Native	
Ferns	Adiantum flabellulatum	Adiantum Group	O	Native	
	Blechnum orientale	Blechnum Group	F	Native	
	Dicranopteris linearis	Gleicheniaceae	A	Native	
	Lycopodium sp.	Lycopodiaceae	R	Native	
	Lygodium japonicum	Schizaeceae	F	Native	
	Lygodium microphyllum	Schizaeaceae	O	Native	
	Pteris semipinnata	Pteris Group	O	Native	
	Sphenomeris chinensis	Lindsaea Group	R	Native	

Potential Impact and Recommended Mitigation Measures

7.25 The coastal woodland at the western end of the bay has been badly disturbed already due to the construction works nearby. There are power lines and telephone lines newly connected running right above the coast at +5 to +10 mPD. Many trees and shrubs were felled for these power lines.

7.26 The reclamation work would destroy all the plants between the shoreline and places up to +5.5 mPD. Individual plants in the vicinity would also be affected by the dust created by the engineering works. Therefore the engineering works should be well planned and carried out very carefully to minimise the area being affected (see Sections 8.72 to 8.75).

7.27 Evidence of past hill fires is observed in the area. More fires could be brought about by construction works when engineering work is in operation if care not taken. Hill fires are the major ecological factor to arrest natural succession of plant communities in Hong Kong. It must be prevented or suppressed effectively to allow ecological succession to occur, which would bring a more stable ecological community with rich bio-diversity. Therefore the construction workers should be reminded of the harmful effects of hill fires to natural environment. It is a requirement that the contractor does not burn any waste at the site.

Review of the Marine Ecology Literature in the North Lantau Area

7.28 The construction of the To Kau Wan site will lead to the permanent loss of about 6 ha of sea-floor and a very small proportion of the coastline to be lost along north Lantau due to PADS projects. Not taking into account the coastline and the seabed lost at Chek Lap Kok, the To Kau Wan project will be responsible for 2% of the total loss of coastline and 1% of the total loss of seafloor at north Lantau.

7.29 This section summarizes the current level of knowledge about the north Lantau zone.

7.30 A review of Morton (1990), Morton (1992) and BCL's unpublished review of the literature revealed two studies undertaken in North Lantau in recent years which are relevant to this project. These studies are :

- Greiner-Maunsell (December 1991) : New Airport Master Plan EIA.
- Richards, J. and R.S.S. Wu (1985) : Inshore fish community structure in subtropical estuary. Asian Marine Biology 2 : 57-68.

7.31 Other marine benthic studies conducted by Shin (1977), Shin & Thompson (1982) and Wu & Richards (1981) involved sampling in North Lantau, but they did not include sampling stations which were relevant to this study. CES and BCL (EPD, 1993) also collected benthic biota data from East Sha Chau, but the data are less relevant because sampling sites are more than ten kilometres away from the current study site.

New Airport Master Plan EIA

7.32 The infauna of North Lantau was surveyed by grab sampling at 16 stations (3 replicates/station) in November 1990. This survey revealed a diverse infauna with at least 135 taxa including new species to science (i.e. pycnogonid Neopallene sp. and gastropod Pseudoliotia sp.) (Table 7.7). The high infaunal diversity may have resulted from the heterogenous sediment types along north Lantau. The new species recorded probably reflects the paucity of existing taxonomic knowledge in the region rather than indicating any special features of the sublittoral marine habitats.

7.33 The species list of the trawl samples collected in 1990 was also lengthy with considerable faunal diversity dominated by molluscs and crustaceans. At least 100 species of macroinvertebrates and 26 species of fish were recorded (Table 7.8).

7.34 Dolphins especially the Chinese White Dolphin (Sousa chinensis), were recorded frequently in North Lantau.

Richards and Wu

7.35 Richards and Wu (1985) conducted a monthly study of the inshore fish community in the area of north Lantau Island from December 1978 to December 1979 by using conventional trawls. One of the three trawling sites (Station 1) was near To Kau Wan, thus the fish data collected at this site provided valuable information. A total of 26 species of fish was recorded at Station 1 (Table 7.9). This is more species than was recorded at the other two stations located closer to Chek Lap Kok. The dominant species at Station are given in Table 7.10 by both numerical abundance and Biological Index of Dominance (BID). Leiognathus brevirostris was the most abundant fish followed by Apogon quadrifasciatus (46.3% and 7.6% of the total fish collected).

7.36 The current study site is near the mariculture site at Ma Wan and within one of Hong Kong's demersal fishery resources areas (Richards, 1980, 1984; unpublished paper).

Conclusion

7.37 The review shows :

- that the benthic communities at North Lantau are diverse with some rare species;
- that marine fish in the area are diverse. Unfortunately not enough is known about fish nursery areas in Hong Kong. Certain species may breed on the sandy seafloor north of Lantau and along the western end of the North Lantau coast. To Kau Wan has a very small sandy beach which does not extend far into the water. Small rocks predominate in the shallower areas with marine mud coating the deeper areas which will be disturbed or covered by the reclamation; and
- potential loss of nursery grounds or fishing area are considered small and possibly negligible.

8. EM&A MANUAL

Purpose of the Manual

8.1 This manual is a stand-alone document, while still forming a part of the EIA. It will subsequently be incorporated into the construction contract documents. The manual covers the mandatory requirements for the construction works under this assignment for:

- environmental monitoring;
- environmental auditing; and
- environmental mitigation measures.

8.2 It does not limit the Contractor's responsibility for taking any other measures necessary to comply with Hong Kong Law. (The definition of "Contractor" is that given in the General Conditions of Contract for Civil Engineering Works).

8.3 Two main areas have been identified by the EIA as necessitating environmental monitoring and auditing (EM&A):

- marine water quality; and
- dust pollution.

8.4 Due to the absence of noise sensitive receivers nearby and the reasonable levels of noise likely to be generated during construction of the works, mandatory noise monitoring requirements have not been included. Protection of the construction workers from excessive noise is covered under the *Checklist and Instructions for the Factories and Industrial Undertakings (Noise at Work) Regulation (Cap. 59 sub. leg. T)*

Description of the Project

8.5 The Project has been described in Chapter 1 of the EIA.

In the construction contract documents, the description of the project will be given in the Specification.

Monitoring and Auditing Objectives

Definition of Environmental Monitoring and Auditing

8.6 Monitoring can be most concisely defined as the systematic collection of data through a series of repetitive measurements. In this project this involves the measurement of environmental parameters during project construction and the identification of any changes in these parameters which may be attributed to the project so that proactive mitigation measures can be adopted to avoid the occurrence of adverse environmental impacts.

8.7 Baseline or control monitoring refers to the measurement of environmental parameters during a representative period for the purpose of determining the nature and range of "ambient", or natural, conditions in order to determine whether it is necessary to review or determine the standards with which construction monitoring results are to be compared.

8.8 The environmental audit system is intended to check methodically that the activities of the project are complying with previously defined environmental requirements and that the necessary measures have been identified to remedy any unacceptable or unforeseen environmental impacts. Environmental auditing is a check to reassure management and regulatory agencies that the facilities are being operated in an environmentally acceptable manner. It also enables a post analysis to be carried out to examine the accuracy of the original environmental impact assessment EIA.

Objectives of the Environmental Monitoring and Auditing Programme

8.9 The Environmental Monitoring & Auditing Programme shall include a schedule of monitoring & auditing of air and marine water quality in the locality of the To Kau Wan Reclamation site in order:

- To provide a baseline database of "ambient" conditions.
- To monitor and interpret conditions with respect to acceptance criteria during construction in order to provide an early indication that any of the environmental control measures or construction practices are failing to achieve the required standards.
- To provide data to determine the effectiveness of any mitigation or control measures implemented through changes in working practice undertaken if acceptance criteria are exceeded.
- To provide a database of conditions after construction for the assessment of the extended effects of construction and for the post project audit.

Scope of the Audit

8.10 The following points shall be considered, as appropriate, for each of the monitored environmental impacts, namely marine water quality and dust. The audit shall:

- check that the approved sampling procedures and analytical techniques are used to assess the quality of the collected data;
- consider tidal, wind and weather conditions where appropriate at the time of sampling;

- ascertain whether any extraneous activities, unrelated to the construction work on the site, may have influenced the data. Factors such as nearby construction works should be considered;
- ascertain what activities or operations take place at the site before or during the sampling period;
- compare the data with trigger, action and target (TAT) levels and identify any non-compliance as compared to data provided by baseline and control station monitoring;
- implement action plans where appropriate and communicate with all involved parties;
- review actions taken to deal with non-compliance;
- review the overall monitoring philosophy, in terms of sampling location, frequency, parameter measured, test method, acceptance criteria and control procedure. Revise if necessary;
- revise the scope and frequency of the auditing system to reflect changes in environmental impacts and construction procedures;
- carry out a post project analysis to compare the environmental impacts predicted in the EIA with actual impacts;
- issue regular reports on the monitoring & auditing programme; and
- review actions taken to deal with complaints from the general public and consider whether any fundamental changes are necessary. A clearly defined system shall be established to respond promptly to public complaints.

Water Quality Monitoring

8.11 A system of marine water quality monitoring and auditing of the construction of the To Kau Wan site shall be established to ensure that construction takes place with a minimum of adverse impact on marine waters and any associated environs.

8.12 The environmental monitoring & auditing programme of marine water quality shall:

- determine the essential environmental background and control data;
- collect all data necessary to monitor significant impacts;

- evaluate on the quality and significance of the data;
- compare the measured effects with acceptance criteria and any licences issued;
- identify any measures necessary to mitigate unacceptable effects;
- determine any extra monitoring necessary to assess the effectiveness of the mitigation measures;
- ensure that construction is undertaken in the most environmentally acceptable way and in such a manner as to cause as little nuisance as possible to the general public or any sensitive uses;
- assess compliance with the Environmental and Pollution Control Requirements; and
- issue reports on the above procedures on a regular monthly basis.

Water Quality Monitoring Equipment

8.13 The following in-situ measurements at the designated monitoring and control stations will be required:

- Dissolved Oxygen (in mg/l)
- Dissolved Oxygen (in % saturation)
- Turbidity (in NTU)
- Water Temperature (in °C)
- Water Depth (in m)

8.14 Water samples will be collected at the monitoring stations once a week and sent to a laboratory for determining the Suspended Solids content.

8.15 Laboratory analyses should be undertaken by accredited laboratories and results made available to the Engineer's Representative within 48 hours. Results of in-situ measurements should be made available within 24 hours.

8.16 Dissolved Oxygen and Water Temperature Measurement Equipment

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. It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 30 m in length. 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 degree Celsius.

8.17 Turbidity Meter

A portable turbidity-measuring instrument operating on a nephelometric principle. It shall contain a photoelectric sensor(s) and come with comprehensive operation manuals. The equipment shall be operable from a DC power source. It shall have a photoelectric sensor capable of measuring turbidity at least between 0-200 NTU and shall be a set of secondary turbidity standards for calibration in each range the equipment can measure (Hach 2100P Turbidimeter or similar approved).

8.18 Suspended Solids/Water Sampler

A water sampler, made of a transparent PVC or glass cylinder (capacity not less than 2 litres) which can be effectively sealed with cups at both ends. The sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (Kahlaico Water Sampler 135WB203 or similar approved). Water samples shall be kept in high density polythene bottles and packed in an ice container for transport to the laboratory as soon as possible. Upon arrival at the laboratory, the suspended solids shall be determined in accordance with the 2540D of Standard Methods for the Examination of Water and Wastewater (APHA, 18th edition, 1992). An accurate electronic balance with precision level not less than 0.1 mg (i.e. 0.0001 g) shall be used.

8.19 Water Depth Detector

A portable, battery-operated echo sounder shall be used to determined water depth at each designated monitoring station. This unit can either be hand-held or affixed to the bottom of the vessel if the same vessel is to be used throughout the monitoring programme. The detector shall have continuous graphic or digital display of water depth (Seafarer 701 or similar approved).

8.20 Positioning Device

A hand-held or boat-fixed type of digital Global Position System (GPS) or other equivalent position instrument of similar accuracy shall be provided and brought along during monitoring to ensure the monitoring vessel is at the correct position before taking measurements.

8.21 Thermometer

A laboratory standard certified mercury thermometer with an accuracy of at least 0.5 degree Celsius shall be provided for measuring the ambient (air) temperature.

8.22 All monitoring instruments shall be checked, calibrated and certified by an approved laboratory, preferably a HOKLAS accredited one, before use on the Works. The instruments shall be subsequently re-calibrated 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.

8.23 A set of backup equipment must be available to ensure that if any of the monitoring equipment is sent for repair or re-calibration, the monitoring programme can continue uninterrupted. Besides, sufficient stocks of spare parts and consumables for the equipment such as electrodes, membranes and cable shall be maintained.

8.24 A sufficient number of qualified technical staff who are capable of operating the monitoring equipment shall be available together with a suitable vessel and crew. The vessel shall be at least 6 m in length, self-powered, with a flat and stable working deck and a half-canopy.

Water Quality Monitoring Schedule

8.25 Water quality monitoring programmes can be divided into three stages: baseline, impact/compliance and post project. These three stages of monitoring shall be carried out in accordance with the following:-

8.26 Duration and Frequency

(i) Baseline Monitoring - A control station approach will be adopted. Baseline monitoring is not necessary.

(ii) Impact/Compliance Monitoring - 3 days per week (each day at mid-ebb and mid-flood) throughout the whole construction period that involves marine works.

(iii) Post Project Monitoring - 3 days per week (each day at mid-ebb and mid-flood) for 6 weeks after the completion of construction or cessation of all marine works.

The interval between each sampling period series (mid-ebb and mid-flood) will not be less than 36 hours.

8.27 General Rules for Monitoring

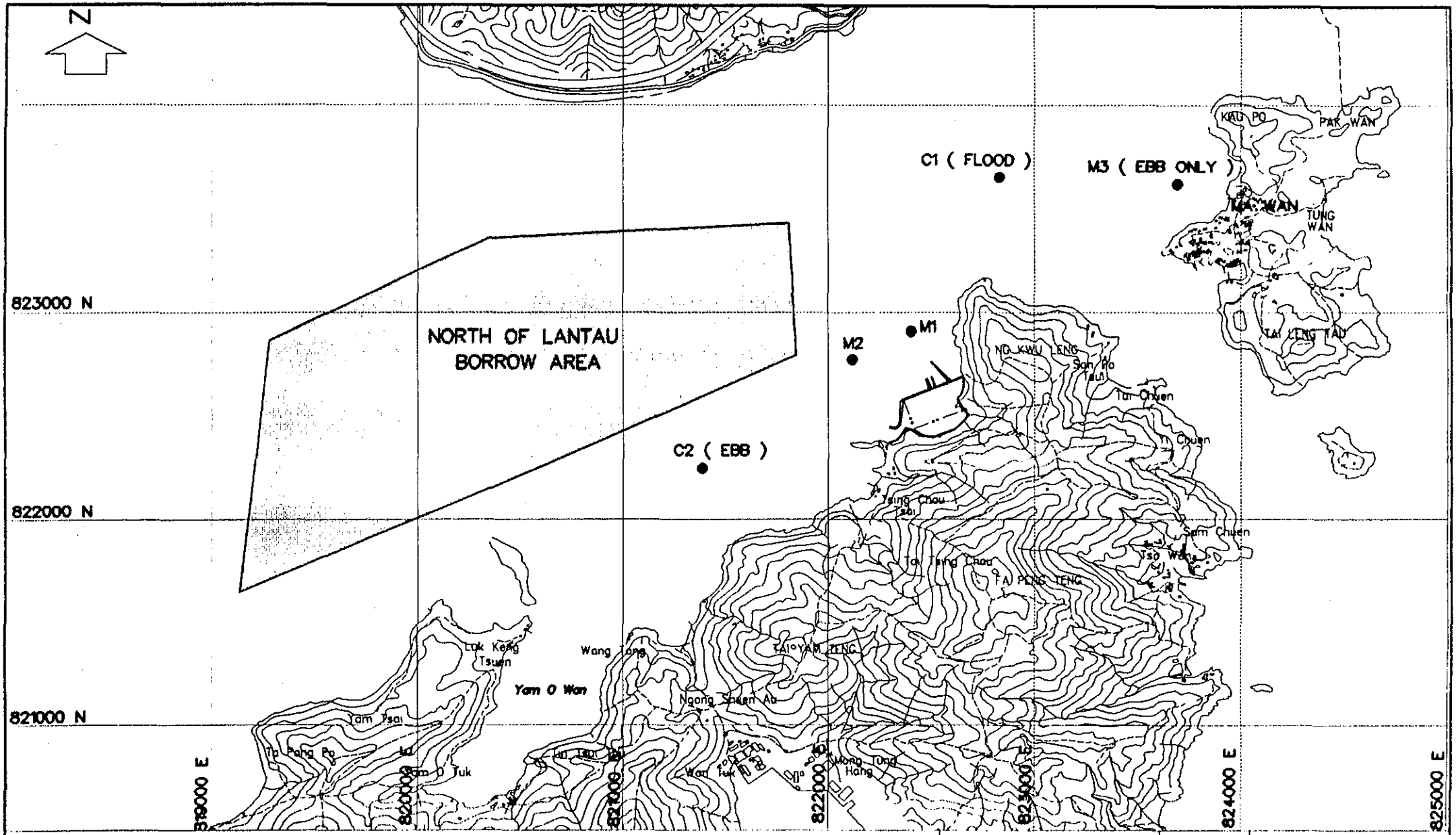
(i) Dissolved oxygen, turbidity and temperature measurements and sampling for suspended solids determinations shall be taken in-situ at 3 water depths, namely, 1 m below water surface, mid-water depth, and 1 m above sea bed; except that in water depth less than 6 m, the mid-depth measurement can be omitted.

(ii) All in-situ measurements of dissolved oxygen, turbidity and sampling for suspended solids determinations shall be done in duplicate. If the difference of the first and second reading of each set exceeds 25%, both readings shall be discarded and measurement shall be repeated.

(iii) Should the impact monitoring record levels of turbidity, suspended solids, or dissolved oxygen levels which are indicative of a deteriorating situation such that closer monitoring is reasonably indicated, then the Engineer will arrange to undertake more frequent monitoring at each Designated Monitoring Station until the results indicate an improvement to acceptable water quality.

Water Quality Monitoring and Control Sites

8.28 It is recommended that two control stations and two and a half monitoring station be established for marine water quality monitoring. M3 is only required at ebb tide and it is essential because of the presence of Ma Wan Marine Culture Zone. Their positions are shown on Figure 8.1A and given in Table 8.1.



TO KAU WAN RECLAMATION EIA

PROPOSED WATER QUALITY MONITORING STATIONS

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼	Date FEB 94	Scale 1 : 25000
土木工程署 Civil Engineering Department	Initial WYC	Drawing No FIGURE 8.1A

Table 8.1 Marine Water Quality Sampling Station Locations

Monitoring Stations	Northing	Easting	Latitude	Longitude
C1	823653	822831	22°21'12.67"	114°2'38.34"
C2	822254	821385	22°20'27.22"	114°1'47.89"
M1	822909	822402	22°20'48.49"	114°2'23.38"
M2	822773	822115	22°20'44.06"	114°2'13.37"
M3	823617	823690	22°21'11.53"	114°3'8.4"

Trigger, Action, Target (TAT) Levels

8.29 Depending on the direction of the current prior to sampling, the control stations will alternate. The "control" station is that station upstream of the site on any monitoring occasion.

Table 8.2A TAT Levels for Marine Water Quality EIA

	Trigger	Action	Target
DO (mg/l)	5.0	4.5	4.0
Turbidity	control + 15%	control + 20%	control + 30%
S.S.	control + 15%	control + 20%	control + 30%

Table 8.2B Special TAT Levels for Suspended Solids of Ma Wan Fish Culture Zone Monitoring Station

Trigger	Action	Target
50 mg/l less the error associated with suspended solid estimates from turbidity measurements calibrated at the monitoring station	50 mg/l	80 mg/l

Dust Monitoring

8.30 A system of dust monitoring and auditing of the construction of the To Kau Wan site shall be established to ensure that construction takes place with a minimum of adverse impact on nearby sensitive users.

8.31 The environmental monitoring and auditing of dust pollution should:

- determine the essential environmental background and control data;

- collect the data necessary to monitor significant impacts;
- evaluate and report on the quality and significance of the data
- compare the measured effects with the acceptance criteria;
- identify any measures necessary to mitigate unacceptable effects (action plans); and
- report the details of the above on a regular monthly basis.

Dust Monitoring Methodology

8.32 All measurements shall be carried out by suitably qualified and experienced staff.

8.33 Construction dust (TSP) monitoring shall be carried out using approved equipment, which shall be tested and calibrated at regular intervals in a manner and in a laboratory approved by EPD.

8.34 All dust monitoring equipment shall be properly maintained. If damage to equipment occurs, the equipment shall not be used until repaired. Sufficient equipment spare parts and any other necessary materials should be available to ensure that the schedule of air quality measurement is achieved at all specified times.

8.35 The dust (TSP) levels shall be measured by the "High Volume Method for Total Suspended Particulates" as described in Part 50 Appendix B of Title 40 of the Code of Federal Regulations of the USA.

8.36 Construction dust (TSP) monitoring shall consist of:-

- the collection of 24 hour samples using the High Volume Method at least once every 6 days; and
- the collection of one hour samples at least three times every 6 days.

Any variations to these proposals will be agreed with EPD.

8.37 Measurements shall be taken at times chosen to fairly represent normal construction activities.

8.38 Wind data shall be obtained from a suitable source such as the Royal Observatory.

8.39 Baseline monitoring shall be carried out to determine the ambient dust (TSP) levels when the site reaches 2.5 mPD (high water level). The baseline monitoring shall be carried out for a period of at least two weeks, with measurements to be taken everyday. The timing of the baseline monitoring will be proposed by the Environmental Monitoring Team and agreed with EPD.

8.40 The collection of 24 hour samples shall be undertaken at the boundary of the site facing the Yiu Lian Dockyards.

8.41 Information on the weather conditions at the time of measurement shall be recorded.

8.42 Due to the possibility of high background dust levels being generated as the result of nearby activities it is recommended that portable equipment be used to assist in determining the source of high dust levels. Control data should be collected whenever practicable during the construction period. Two monitoring stations are recommended for dust monitoring. Their positions are shown on Figure 8.1B and given below.

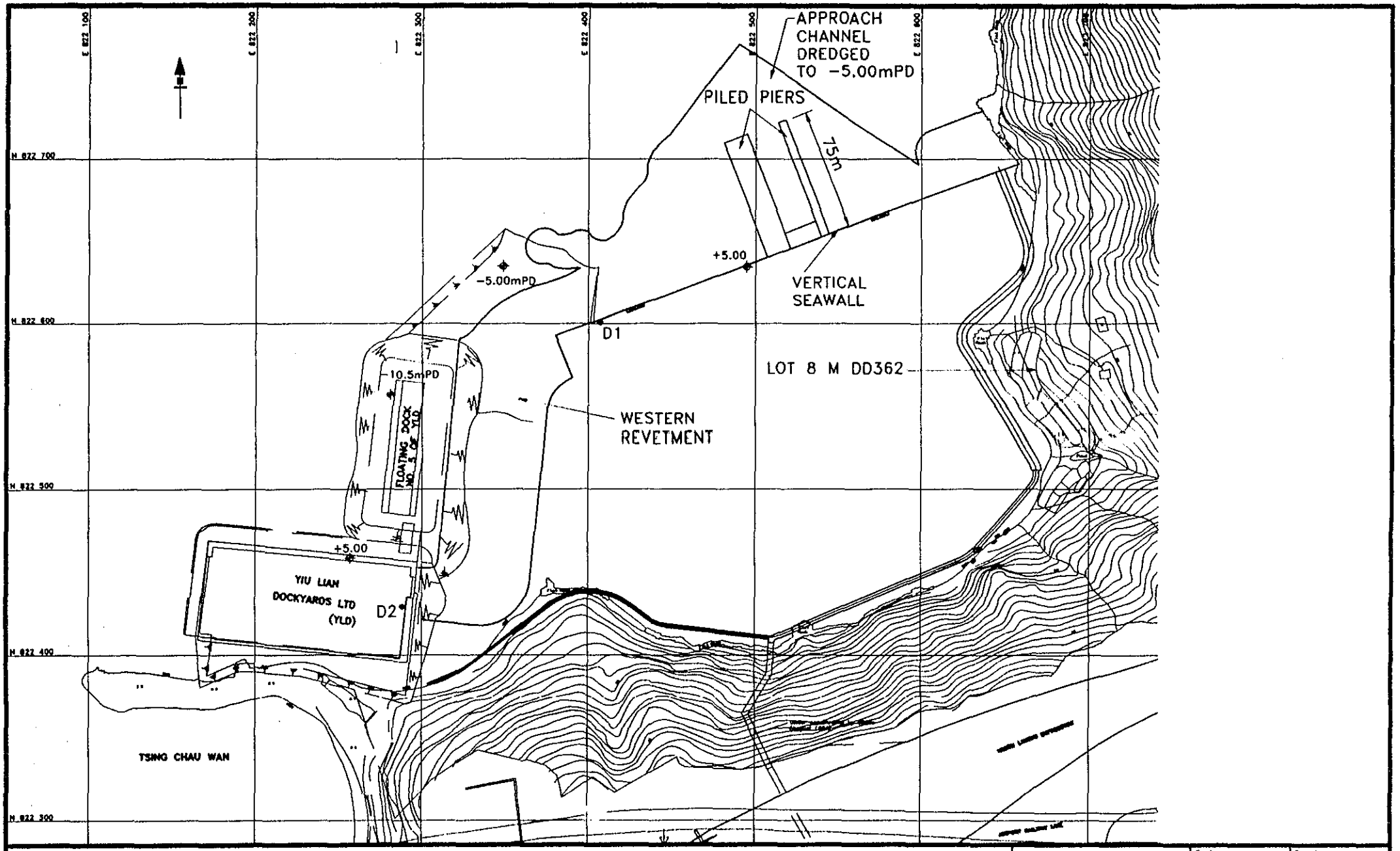
Table 8.3A Dust Sampling Station Locations

Monitoring Stations	Northing	Easting	Latitude	Longitude
D1	822600	822410	22°20'38.44"	114°2'23.67"
D2	822425	822286	22°20'32.75"	114°2'19.34"

TAT Levels

Table 8.3B TAT Levels for Dust EM&A

	Trigger	Action	Target
TSP (24 hours)	Baseline + 30%	The average of the Trigger and Target Levels	260 $\mu g/m^3$
TSP (1 hour)	Baseline + 30%	The average of the Trigger and Target Levels	500 $\mu g/m^3$



TO KAU WAN RECLAMATION EIA

PROPOSED DUST MONITORING STATIONS

賓尼工程顧問有限公司 賓尼	Date: SEP.94	Scale: 1:300
土木工程署 Civil Engineering Department	Initial: YPS	Figure No.: 8.1B

EM&A Programme Organisation

Identification of Key Responsibilities

8.43 The Contractor shall be responsible for:

- implementing environmental controls and mitigation as set out in this manual as well as any additional measures necessary for compliance with the environmental control standards; and
- following any reasonable directions given by the Engineer or the Engineer's Representative particularly as the result of the implementation of event/action plans.

8.44 The Engineer shall be responsible for:

- making arrangements to carry out a programme of environmental monitoring and auditing during the construction period and a post construction period as set out in this manual;
- ensuring that environmental reports and data generated reaches the Engineer's Representative as quickly as possible;
- overseeing the Engineer's Representative (ER) and ensuring that directions given for environmental protection by the ER are implemented by the Contractor;
- implementing a stop work action if repeated exceedance of target levels justifies this action.

In order to carry out the programme of environmental monitoring and auditing the Engineer will arrange two teams. The first team will comprise a group of professional staff who will be responsible for the managing and auditing role. This team will be known as the Environmental Management Team. The second team will be responsible for collecting and testing samples. It is most likely that this role will be undertaken by a commercial laboratory who will utilise equipment already owned by them. For the purpose of this manual of the team will be known as the Monitoring Team.

8.45 The Environmental Management Team will hold a key position with the EM&A programme, undertaking:

- directing the Monitoring Team;
- the auditing role;
- the main reporting function; and
- the liaison and communication function.

8.46 The Environmental Management Team will be responsible for:

- reviewing the monitoring data produced taking into account any factors which may influence this data;
- interpreting the reviewed data with reference to TAT levels and baseline and control data;
- implementing event/action plans when exceedances of TAT levels occur;
- liaising and consulting with all relevant parties during the implementation of action plans;
- modifying the EM&A programme in consultation with the Engineer and EPD if necessary;
- producing and circulating reports on:

  (i) a regular monthly basis;
  (ii) when action plans are implemented;
  (iii) when responding to public complaints;

- assessing control procedures are in place to mitigate identified effects outside the acceptance criteria;
- acting as an intermediate between all relevant parties so that all parties are kept informed of all relevant information regarding the EM&A programme;
- conducting a post construction review to compare the environmental impacts predicted in the EIA with those observed; and
- responding to public complaints via a formal procedure outlined in this manual.

8.47 The Engineer's Representative (ER) also has a key role to play with the EM&A programme, undertaking:

- an engineering audit of environmental reports;
- site liaison; and
- implementing and enforcing event/action plans when exceedances of TAT levels occur.

8.48 Figure 8.2 presents a flowchart of lines of authority for the project EM&A programme.

The Reporting Function

8.49 The manager of the Monitoring Team, shall issue data reports as quickly as possible to:

- the ER; and
- the Contractor.

8.50 The format of these reports shall be agreed in consultation between the Environmental Management Team, the Monitoring Team and the ER. Presentation of data via modem or on disk will be preferred.

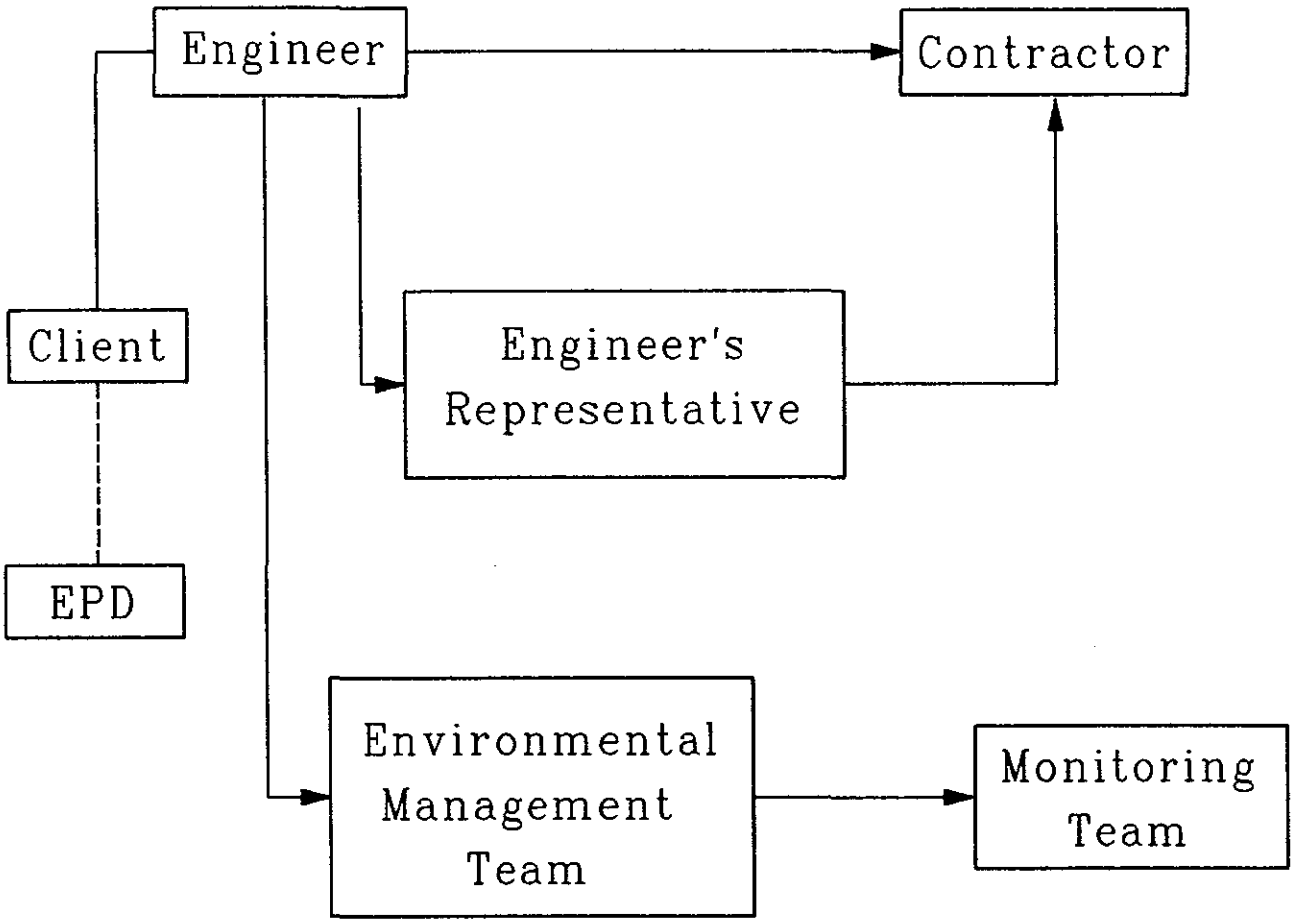
8.51 The Environmental Management Team shall be responsible for the main reporting function. Both regular monthly and unscheduled incident reports shall be circulated as appropriate to:

- the ER;
- the Contractor;
- the Monitoring Team;
- the Engineer;
- the Client; and
- EPD.

8.52 The flowchart presented in Figure 8.3 summarises the lines of communication for the reporting function.

Complaints Procedures

8.53 A formal procedure for handling complaints about environmental matters is outlined below. All complaints need sensitive handling.



TO KAU WAN RECLAMATION EIA

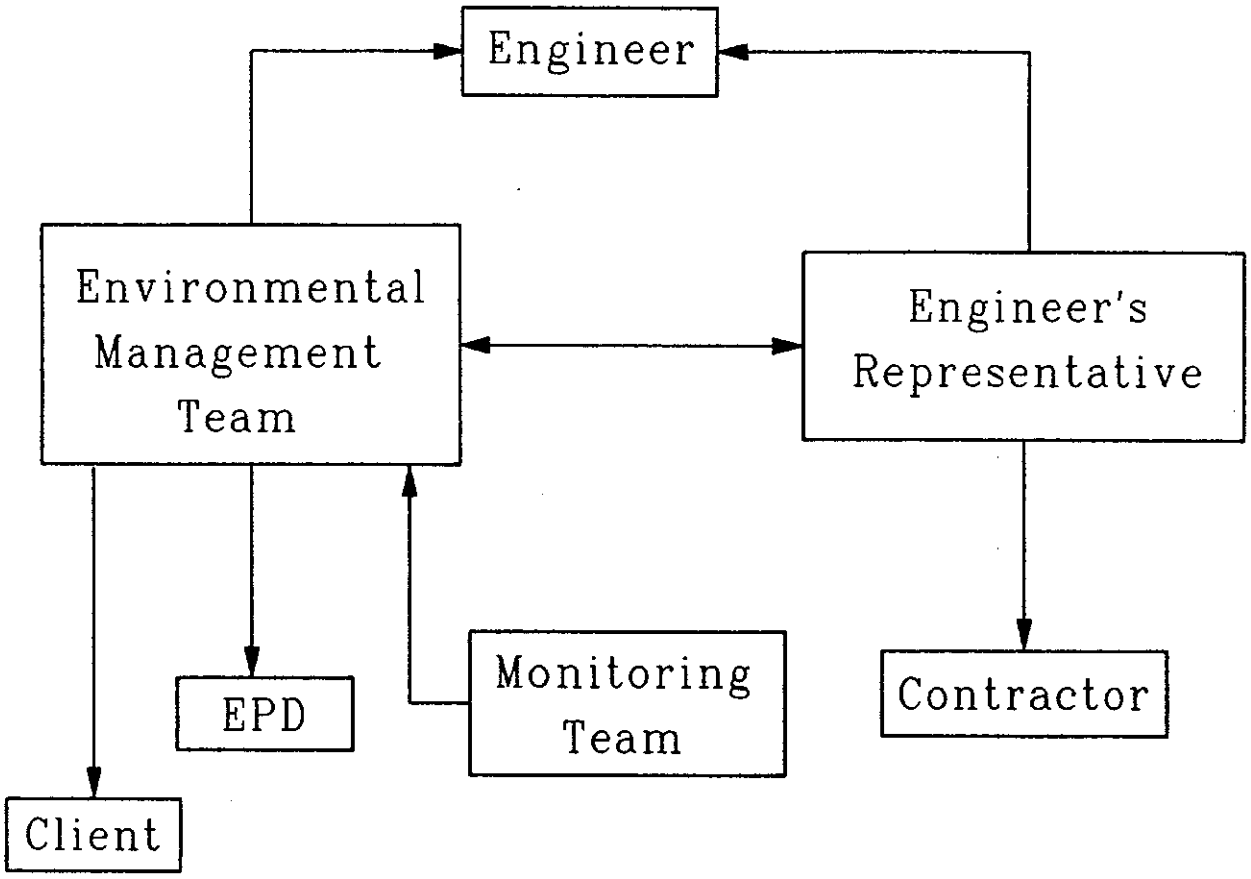
Title :

LINES OF AUTHORITY

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼

土木工程署 Civil Engineering Department

Date	Scale
May 94	
Initial	Drawing No.
	8.2



TO KAU WAN RECLAMATION EIA

Title :

THE REPORTING FUNCTION

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼

土木工程署 Civil Engineering Department

Date: May 94

Scale:

Initial:

Drawing No. 8.3

8.54 The Environmental Monitoring Team will be responsible for the implementation of complaints procedures.

8.55 Each complaint shall be logged and shall include:

- date and time;
- source of complaint;
- complainant's name and address;
- nature of the complaint;
- results of investigations into the complaints; and
- records of all communications made and actions taken.

8.56 A copy of this log shall form a part of the regular monthly reports and shall be accompanied by a review of the circumstances including any recommendations necessary to avoid future repetitions of complaints of a similar nature.

8.57 All complainants shall be answered as soon as possible in writing acknowledging receipt of the complaint.

8.58 All complaints shall be investigated.

8.59 The Environmental Management Team shall use discretion and liaise with all relevant parties as necessary.

Event/Action Plans for Use with the EM&A Programme

8.60 Event/action plans to be implemented in the event of non-compliance with TAT levels are given in the following three tables:

Table 8.4 Actions in the Event of Exceedance of Trigger Levels

Event	Actions		
	Environmental Management Team	ER	Contractor
Trigger Level			
Exceedance for one sample at any station	1. Notify ER 2. Check Monitoring data	1. Identify source 2. Notify Contractor 3. Check Contractor's working methods.	1. Rectify any unacceptable practice.
Exceedance for two or more consecutive samples at any station	1. Notify ER 2. Instruct Monitoring Team to repeat measurement to confirm findings 3. Check monitoring data and instruct Monitoring Team to check equipment 4. If remedies required following liaison with ER, inform Engineer and EPD.	1. Identify source 2. Check Contractor's working methods 3. Discuss and agree remedial works with Contractor, if necessary	1. Rectify any unacceptable practice 2. Check all plant and equipment 3. Consider changes to working methods.

Table 8.5 Actions in the Event of Exceedance of Action Levels

Event	Actions		
	Environmental Management Team	ER	Contractor
Action Level			
Exceedance for one sample at any station	1. Notify ER 2. Instruct Monitoring Team to repeat measurements to confirm finding 3. Check monitoring data and instruct Monitoring Team to check equipment.	1. Identify source 2. Check Contractor's working methods.	1. Rectify any unacceptable practice 2. Check all plant and equipment 3. Amend working methods if appropriate.
Exceedance for two or more consecutive samples at any station	1. Notify ER 2. Instruct Monitoring Team to repeat measurement to confirm findings 3. Check monitoring data and instruct Monitoring Team to check equipment 4. Instruct Monitoring Team to increase monitoring frequency Dust: three times a week for two weeks Marine Water: four times a week for two weeks 5. If exceedance continues, arrange meeting with ER, Engineer and EPD 6. Report to the Engineer and EPD the situation after implementation of remedial actions.	1. Identify source 2. Check Contractor's working methods 3. Discuss and agree with Contractor for remedial actions to be provided 4. Ensure remedial actions properly implemented	1. Confirm notification of the exceedances in writing to the ER 2. Submit proposals for remedial actions to the ER within 3 working days upon notification 3. Implement the agreed proposals 4. Amend proposals if appropriate and report to the ER.

Table 8.6 Actions in the Event of Exceedance of Target Levels

Event	Actions		
	Environmental Monitoring Team	ER	Contractor
Target Level			
1. Exceedance for one sample at any station	1. Notify ER 2. Inform EPD and the Engineer immediately 3. Instruct Monitoring Team to repeat measurement to confirm finding 4. Check monitoring data and instruct Monitoring Team to check equipment 5. Instruct Monitoring Team to increase monitoring frequency to daily 6. Report to the Engineer and EPD the situation after implementation of remedial actions.	1. Identify source 2. Check Contractor's working methods 3. Discuss and agree with Contractor for remedial actions to be provided and report to Engineer and EPD 4. Ensure remedial actions properly implemented	1. Confirm notification of the exceedance in writing to the ER 2. Take immediate action to avoid further exceedances 3. Check all plant and equipment to ensure compliance 4. Submit proposals for remedial actions to the ER within 3 working days upon notification 5. Implement the agreed proposals 6. Amend proposals if appropriate and report to the ER.
Exceedance of two or more consecutive samples at any station	1. Notify ER 2. Inform EPD and the Engineer immediately 3. Instruct Monitoring Team to repeat measurement to confirm finding 4. Check monitoring data and instruct Monitoring Team to check equipment 5. Instruct Monitoring Team to increase monitoring frequency to daily 6. Arrange meeting with EPD to discuss the remedial actions to be taken 7. Report to the EPD and the Engineer the situation after implementation of remedial actions	1. Identify source 2. Check Contractor's working methods 3. Carry out thorough investigation of the causes for the exceedance 4. Discuss and agree with Contractor for remedial actions to be provided and report to EPD and the Engineer 5. Ensure remedial actions properly implemented 6. Discuss with the Engineer and EPD on the necessity of stopping the dredging works or other offending construction activity if the impacts persist. (The Engineer will discuss the need to stop work with the Client).	1. Confirm notification of the exceedance in writing to the ER 2. Take immediate action to avoid further exceedances 3. Check all plant and equipment to ensure compliance 4. Submit proposals for remedial actions to the ER within 3 working days upon notification 5. Implement the agreed proposals 6. Resubmit proposals if problem still not under control 7. As directed by the Engineer stop the dredging works or other offending construction activity.

Environmental Controls and Mitigation Measures

8.61 The Contractor shall comply with and observe all ordinances, by-laws regulations and rules for the time being in force in Hong Kong governing any form of pollution and the protection of the environment.

Water Quality

8.62 The Contractor shall take all such necessary measures as may be reasonably required by and to the satisfaction of the Engineer to ensure that the operation of all plant and construction processes on site will not cause unnecessary or unacceptable pollution of Hong Kong Waters.

8.63 The Contractor shall ensure that the water quality at the specified monitoring locations is within the acceptable range as proposed by the Engineer and approved by DEP. The Contractor shall take action as set out in the Action plans as quickly as possible in the event that any TAT levels are exceeded.

8.64 The Water Pollution Control Ordinance requirements specify that any effluent discharged from the site into waters of Hong Kong, will require to be licensed. The Contractor shall apply for the WPCO license before discharging any effluent from the construction site, including those from any concrete batching plant. The content of effluent to be discharged into the waters near the site shall strictly comply with the limits set in the WPCO. The contractor is encouraged to re-use the washing water from any concrete batching plant.

8.65 Waste water due to construction activities will include runoff from silt and dust suppression activities, washout from concrete mixing/batching, runoff from soil/spoil and fuel and lubricating oil spillage. To prevent the waste water from any concrete mixing/batching plant from contaminating the operation area or the surrounding marine waters, the concrete mixing/batching plant area shall be properly bunded off from the operation area. Waste water within the bunded plant area shall be conveyed to an similarly appropriate treatment system and disposal facility. All other waste water and runoff shall be routed to an appropriate treatment system and disposal facility. The treatment system and disposal facility shall ensure that effluent released to the environment complies with limits set out in the Technical Memorandum on Standards for Effluent Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM).

8.66 The drainage system will be adequately supplied with silt traps. Any muddy and silty water collected from cleaning activities shall be conveyed to a treatment system for settlement/filtering before being discharged.

8.67 The Contractor shall maintain all sanitary facilities in good condition.

8.68 The Contractor shall prevent fuel and lubricating oil leakage from plant and storage sites contaminating the construction site. The Contractor shall prepare and submit to the ER a spill action plan and keep suitable clean-up materials on-site. Layers of sawdust, sand or equivalent material shall be laid underneath and around any construction plant and equipment that may possibly leak oil. The polluted clean-up materials shall be replaced with some clean materials on a regular basis. Any polluted material shall be disposed of in an acceptable and regular manner. Plant and storage sites for fuel and lubricating oil should be formed on bunded and impervious ground. Adequate numbers of oil/petrol interceptors should be provided.

Dredging and Spoil Disposal

8.69 The Contractor shall take all reasonable measures to minimise adverse impacts resulting from his construction activities. These measures shall include ensuring that all plant and equipment and working methods meet the following criteria. The ER 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 ER for this purpose. The Contractor shall:

- minimise disturbance of the seabed while dredging;
- minimise leakage of dredged material during lifting;
- use closed grabs: mechanical grabs shall be designed and maintained to avoid spillage and seal tightly while being lifted;
- prevent the overflowing of any hopper or barge;
- not fill any barge or hopper to a level that can cause overflowing;
- not wash out any hopper or barge while dredging and loading;
- ensure that any barge or any sediment transport vessel is fitted with tight fitting seals to the bottom openings to prevent leakage of material;
- minimise the loss of material during transportation of material;
- ensure that bottom openings are properly closed when vessels are full and on their way to the disposal site;
- ensure that bottom-openings are properly closed when empty and returning to the site;
- remove any excess dredged material from the decks and exposed fittings of barges before the vessel is moved;

- cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds;
- use vessels of such a size that adequate clearance of the vessel with the seabed is maintained at all states of the tide thereby minimising turbidity generation by vessel movement or propeller wash;
- repair all pipe leakages immediately;
- keep the decks of all vessels tidy and free of oil and any other substances or articles which may be washed overboard. Rubbish shall not be dumped in the sea;
- control the loading of barges or hoppers so as to prevent splashing or spillage of dredged material to the surrounding water;
- prevent the unacceptable deterioration of marine water; and
- take any reasonable measures, as directed by the ER, as a response to the action plan given in this document when TAT levels are breached.

8.70 The disposal of dredged material will comply with the following:

- The Contractor shall be responsible for disposing of all dredged material. All material shall be dumped within the designated marine dumping ground;
- The Contractor shall apply for the necessary licence from the Director of Environmental Protection (DEP) for the disposal of marine material, and shall at all times comply with his requirements. All fees in respect of applications for disposal permits shall be borne by the Contractor. A copy of the disposal licence held or obtained by the Contractor shall be given to the Engineer and no disposal may be carried out until a licence permitting such disposal has been obtained; and
- The Contractor shall properly locate and fix the boundaries of the dumping area to ensure that the material is dumped at the correct location. The Contractor shall dump material in uniform layers over the dumping area under the agreed schedule such that no high spots are formed.
- Before commencing the dumping works, the Contractor shall provide, through the Engineer, to the Director of Environmental Protection (DEP) and the Secretary of the Fill Management Committee (FMC), a programme for the approval of the dumping works. Dumping works shall only be carried out in accordance with the approved programme which may be amended from time to time with the approval of DEP and FMC.

- The Contractor shall provide, through the ER, to the DEP and FMC, a schedule containing details of the work included in, and the frequency of, the dumping works, on a monthly basis. A return showing the number of barge loads and the estimated quantity of surplus mud dumped within the mud disposal site shall be submitted to the DEP and FMC within one week after completion of the dumping works.

Dredging and Spoil Disposal of any Contaminated Marine Mud

8.71 In the event of dredging of contaminated marine mud the following applies:

(1) The Contractor shall ensure that all contaminated marine mud is dredged, transported and placed in approved special dumping grounds in accordance with the provisions in Works Branch Technical Circular No. 22/92 and in such a manner to minimise the loss of material to the water column. The classification on the contamination levels shall comply with the EPD TC No. 1-1-92.

(2) The Contractor shall be responsible for securing a licence for the disposal of contaminated marine mud to a disposal works area. The Contractor shall submit to the Director of Environmental Protection (DEP) a method statement covering the disposal of contaminated mud and this method statement must be approved before a licence to dump can be issued.

(3) The Contractor shall place the contaminated mud at a location and in a manner as stipulated in the disposal licence and as directed by the Engineer. The Contractor shall proceed with the disposal operation in accordance with the relevant sections in the Management Scheme for Contaminated Mud Disposal Pits at East Sha Chau - Guidance Notes for Dumping which may be modified from time to time by the Engineer. The Contractor shall not carry out any dumping without the permission of the Engineer.

(4) Flushing of the hopper is not permitted within the disposal works area.

(5) The Contractor shall maintain detailed daily records of the number of the vessels transporting dredged material to the disposal works area, including details of the vessels capacities, the approximate volumes of material transported, the vessels' registration numbers, and the location, time and duration of all disposal operations. The daily records shall be submitted to the Engineers Representative on the following day.

(6) When dredging, transporting and disposing of contaminated marine mud, the Contractor shall implement additional special procedures for the avoidance of pollution which shall include but not be limited to the following:

(a) Dredging of contaminated marine mud shall only be undertaken by a suitable grab dredger using a closed watertight grab.

(b) Transport of contaminated marine mud shall be by split barge of not less than 750 m^3 capacity, well maintained and capable of rapid opening and discharge at the disposal works area.

(c) Discharge from split barges shall be placed in the contaminated mud disposal pit by bottom dumping, at a location within the pit to be specified, from time to time, by the Secretary of the Fill Management Committee (FMC) and Geotechnical Engineering Office of Civil Engineering Department.

(d) The dumping vessel shall be stationary throughout the dumping operation. Discharge shall be undertaken rapidly and the hoppers shall remain closed until the barge next returns to the disposal works area.

(e) Any substance which is found dumped by the Contractor outside the contaminated mud disposal pit shall be removed by the Contractor at his own cost.

(f) The Contractor shall install an automatic self monitoring device on the dumping barges as required by the Director of Environmental Protection. The device should be maintained functional at all times, and the equipment together with its stored record should not be tampered with.

Dust

8.72 Work shall be carried out in such a manner that avoidance dust is not generated. Areas of the Site in which dust is likely to be generated shall be sprayed with water regularly. Screens, dust sheets, tarpaulins or other methods agreed by the Engineer shall be used to prevent generation of dust. Materials, including earthworks material, from which dust may be generated when being transported to or from the Site shall be sprayed with water or covered.

8.73 Dirt moving operations should be carefully controlled when winds are strong particularly when blowing towards nearby sensitive receivers. Sheltered areas of the site shall be used for dusty operations during these periods. During high winds, dust moving activities may need to be curtailed unless all materials handled and transport routes are very damp.

8.74 Raising moisture content is an extremely effective means of suppressing dust. If natural levels of moisture become low enough for dust to be generated, the use of sea water shall be considered. The equipment necessary to pump sea water onto the reclamation shall be available on Site at all times.

8.75 If any dry mix batching is undertaken on the site, the truck batching aperture shall be shrouded and fitted with water suppression sprays.

Noise

8.76 The following measures would minimise noise caused by the reclamation and site formation of the To Kau Wan site.

8.77 The conventional seawall construction method is less noisy. If vibrational piling is used, extra care should be taken by the Contractor to ensure nearby workers are not subjected to excessive noise levels.

8.78 Night time seawall construction, with or without piling, should be avoided to prevent excessive noise.

8.79 Dredging and seawall construction near Yiu Lian Dockyards should be carried out as early as possible. This way, later in the programme when several activities are occurring simultaneously, the noise sources will be placed further away from the Yiu Lian Dockyards.

8.80 Silenced equipment and quieter construction methods should be chosen whenever possible. Particular care should be taken to ensure that vibratory piling equipment is well-maintained.

8.81 The construction workers will also be affected by the noise from this reclamation project and other construction works in the area. The level of noise they experience is dependent on their own activity. If the seawall is to be built without piling then the they are exposed to noise levels ranging from 65 to 105 dB(A). If there is piling for the seawall, the noise level then the workers could experience may be as high as 84 to 124 dB(A).

8.82 At these noise levels the average construction worker working an 8-hour day and 5-day week is exposed to noise levels much higher than that recommended for safety without threat of long term hearing damage at speech frequencies.

8.83 Ear protection is recommended for all workers at the reclamation site.

8.84 There is no mandatory necessity for noise monitoring.

8.85 Only if construction work is planned during restricted hours, and after the issue of a Construction Noise Permit should monitoring be considered by the Contractor.

Construction Waste

8.86 Construction waste would be generated from site clearance upon the completion of the reclamation. Such site clearance waste will likely include packaging materials, used wooden blocks and boards, concrete debris, disposed soil or sand, etc. In order to comply with the 'New Disposal Arrangement for Construction Waste' set by the EPD in 1992, no construction waste more than 20% inert material by volume shall be disposed of at two older operational landfills, Tseung Kwan O Landfill Stage III and Shuen Wan Landfill, or the new Strategic Landfills. Inert material like rock, sand, concrete debris should be sorted out from construction waste before disposal and buried within the reclamation. Pillar Point Valley Landfill still accepts all kinds of construction wastes.

8.87 Formworks that are established around the construction site will be dismantled upon the completion of the reclamation. Wooden boards should be sorted and grouped out from other non-inert waste and recycled as much as possible. A number of private collectors will collect such used formwork materials for local reuse or for export to China.

Cleared Vegetation

8.88 A small area of the coastal fringe will be buried under the reclamation. It will need to be cleared and the material treated as municipal waste. The amount is not significant and should be barged and then disposed of at Pillar Point Valley Landfill or new strategic landfill WENT by private contractors. On site incineration should be strictly prohibited as it would cause serious air pollution and could cause grass fires in the dry season.

Domestic-Type Sewage

Sewage generated from toilets, washing facilities and any temporary canteen provided for staff should be separately collected and suitable treatment should be provided before discharge. The total workforce could be up to 150 people. This estimate includes the staff on dredges and barges. Such domestic sewage is characterised with high BOD, high S.S. and is enriched with nutrients, moreover, the bacterial count would also be elevated. It should not be discharged into the sea. The Contractor should be responsible for supplying adequate, suitable temporary arrangements such as sufficient chemical toilets and ensuring the waste generated is properly handled. The quantities will be relatively small.

Should any washwaters or other wastewaters be discharged into the sea, it is necessary for their composition to comply with the requirements specified by the *Technical Memorandum on Effluent Standards*.

Domestic-Type Solid Waste

Waste of this type will be generated by the construction crews. It is defined as commercial waste[14]. The quantity of municipal waste generated by these crews is estimated to be 1.3 kg/person/day[14]. A refuse collection station should be established for the collection and temporary storage of municipal waste. All municipal waste should be collected in black refuse bags and barged to the nearest Regional Services Department refuse collection point or directly barged and disposed of at Pillar Point Valley Landfill or WENT by private contractors.

REFERENCE LIST

1. APH Consultants (1991)
Lantau Port and Western Harbour Development Studies Final Report - Addendum C - Cheoy Lee Shipyard Study for Civil Engineering Department, Hong Kong Government

2. Greiner - Maunsell (1991)
New Airport Master Plan - Environmental Impact Assessment for Hong Kong Provisional Airport Authority

3. Mott MacDonald Hong Kong Limited (1991)
North Lantau Expressway, Agreement No. CE/18/81 - Environmental Assessment Report Yam O and Tai Ho Sections Final Report for Highways Department, Hong Kong Government

4. Mott MacDonald Hong Kong Limited (February 1993)
Lantau Fixed Crossing, Agreement No. CE 20/92, Lantau Toll Plaza and E & M Services for the Lantau Fixed Crossing, Preliminary Design Review Report (Draft) - Volume 1 for Highways Department, Hong Kong Government

5. Norwegian Geotechnical Institute (5th May 1993)
Hong Kong Seawall Design Study

6. Mott MacDonald Hong Kong Limited (1992)
Lantau Fixed Crossing, Agreement No. CE 11/78, Environmental Assessment, Final Report, Volume 1, Topic Report No. 2 - Air Quality, prepared for Highways Department, Hong Kong Government.

7. Prepared for United States Environmental Protection Agency (1985, 1988)
Supplement E to Compilation of Air Pollutant Emission Factor Volume 1 : Stationary Point and Area Sources - known as AP-42 Volume 1 Supplement E, reviewed by Office of Air Quality Planning and Standards Research Triangle Park, NC 27711.

8. Letter written for Project Director/Lantau Fixed Crossing Project Management Office, Highways Department, Hong Kong Government (Hy FX FX/35-18/2/93)
Lantau Fixed Crossing, Lantau Toll Plaza and E&M Services for the LFC, Airport and Lantau Railway to Mass Transit Railway Corporation

9. Kingsler, L.E., Austin R. Frey, Alan B. Coppens, James V. Sanders
Fundamentals of Acoustics, 3rd ed., pp. 299-302
John Wiley & Sons, Inc., 1982

10. Environmental Protection Department (1993)
Marine Water Quality in Hong Kong for 1991, Water Policy Group, Environmental Protection Department, Hong Kong Government

11. Planning Department, Hong Kong Government
Chapter 9, Environment, Hong Kong Planning Standards and Guidelines

12. Hong Kong Testing Company Limited (14th January 1994)
Laboratory Testing Report - Works Order No. PW6/3/30.110, Reclamation for Cheoy Lee Shipyard, To Kau Wan, North Lantau

13. Hong Kong Testing Company Limited (29th January 1993)
Laboratory Testing Report - Job Reference: S/019/94(TB-30), Reclamation for Cheoy Lee Shipyard, To Kau Wan, North Lantau

14. Environmental Protection Department (1993)
Monitoring of Municipal Solid Waste for 1991-1992, Hong Kong Government

15. Newbury, R.W., (1984)
Hydrological Determinants of Aquatic Insect Habitats, p. 323-357. In Resh, V.H. and Rosenberg, D.M. (Ed.), *The Ecology of Aquatic Insects*, Praeger Publishers, New York, 625 pp.

16. Morton, B. (1979)
The Future of the Hong Kong Seashore - Oxford University Press, 192 pp.

17. Tomlinson, P.B. (1986)
The Botany of Mangroves, Cambridge University Press, London, 413 pp.

18. Muller-Dombois, D. and H. Ellenberg (1974)
Aims and Method of Vegetation Ecology, John Wiley & Sons, New York

19. Anonymous (1913)
The Hong Kong Government Gazette, July 11, 1913

20. ERM Hong Kong (1994)
Lantau and Airport Railway: Environmental Impact Study: Final Report, Volume 2: Main Report
Prepared for the Mass Transit Railway Corporation

21. CES & Binnie, 1993
East Sha Chau Monitoring Programme, Agreement No.CE4/92 Environmental Project Office (ENPO), West Kowloon Project Area
Prepared for the Environmental Protection Department, Hong Kong Government

22. Greiner - Maunsell (December 1991)
New Airport Master Plan EIA
Prepared for Provisional Airport Authority, Hong Kong

23. Richards, J. and R.S.S.Wu (1985)
Inshore fish community structure in subtropical estuary
Asian Marine Biology 2:57-68

24. Shin, K.S. (1977)
A quantitative and qualitative survey of the benthic fauna of the territorial waters of Hong Kong.
M. Phil. thesis. University of Hong Kong

25. Wu, R.S.S. and J.Richards (1981)
Variations in benthic community structure in a sub-tropical estuary.
Marine Biology 64: 191-198