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(ACE 42/94)
for information

Quarterly Report on Contaminated Mud Disposal October to December 1993

1. Summary

o The monitoring programme at East Sha Chau has been designed to examine the effect on the environment of contaminated mud disposal operations. The two key issues which the monitoring needs to address is firstly whether any contaminated material is being dispersed during disposal or subsequently leaving the disposal pits and secondly to assess if there is any adverse effect on the environment.

o There is some evidence to suggest that either some material has dispersed from the pits, or that material has been dispersed outside the pit during the dumping operations although at this stage no definite conclusions can be drawn either way. However, it is not yet clear if the elevated levels of metal contents in sediment outside the pits represent an increasing trend.

o The direct impact of the disposal operations on local water quality is often obscured by the impact of other activities in the area. Transient high turbidity plumes have been recorded at the disposal pits, either with or without dumping activity.

o The populations of aquatic biota do not appear to have been seriously affected by the disposal operations. However the occurrence of high metal concentrations in some specimens of seafood requires further urgent investigation. It is strongly recommended that future monitoring looking closely into this issue.

o The monitoring work was handed over to the Director of Civil Engineering at the beginning of January 1994.

2. Project Background

Monitoring of water quality and sediments in the East Sha Chau area was initiated in October 1992 prior to the commencement of dumping of contaminated materials. The monitoring objectives were to determine background water quality at Sha Chau as well as to establish the effects of dumping operations on the local waters and surrounding sediments.

The first contaminated mud pit (CMP I) has been filled to its capacity since mid July 1993. Since then, contaminated mud pit II (CMP II) was used in the reporting period while CMP I was being capped by clean material. With the opening of CMP IIa, b, c and d, an amended monitoring schedule has been implemented from July onward. The objective is broadly the same as before but there has been particular focus on two further aspects, namely :

- investigation of the effects of all pits on the environmental quality of the area on a regional basis (cumulative impact monitoring)

- investigation of local, pit-specific impacts (compliance monitoring).

The current programme can be viewed in terms of elements designed for monitoring of specific locations close to disposal pits and elements designed to investigate impacts on the wider area as a whole.

In mid-July, new pit management programme (which includes a 24 hour site supervision and reporting system) was introduced by Port Works Division of Civil Engineering Department coinciding with the opening of CMP IIa in order to avoid inaccurate dumping.

3. Monitoring Programme

3.1 Cumulative impact monitoring

This part of the programme is designed to be undertaken on a long term basis with as little change as possible in station locations and monitoring methodology over time and includes the following elements :

- Sediment sampling at 37 stations, bi-monthly. Analysis of metals, pH, Eh, organic carbon content, organic contaminants (PAH and PCB) and particle size distribution.

- Water quality monitoring at 1 station, weekly for a full tidal cycle (24+ hours). Analysis of current velocity, turbidity, suspended solids, dissolved oxygen, temperature and salinity.

- Trawling for demersal nekton at 6 stations, monthly. Analysis of species abundance and diversity. Samples collected for the analysis of tissues metal content in selected species of commercial importance.

- Collection of benthic grab samples at 10 stations, monthly. Analysis of macroinfaunal species abundance and diversity.

- Analysis of at least 18 tissues samples monthly (from 3 species at 6 trawl stations) for content of metals

- Bio-monitoring of the uptakes of metals by the indicator species, green-lipped mussel), biannually

3.2 Pit-specific compliance monitoring programme

The pit-specific compliance monitoring involves short-term monitoring around each active pit during the operational period (including the capping phase). This part of the programme involves specific near-field monitoring and consists of the following elements:

- Sediment sampling at 8 stations around each active pit, monthly (bi-weekly during the capping phase). Analysis of metal contaminants, pH, Eh and organic carbon content.

- Water quality monitoring at 4 stations around each operational pit, weekly for a full

tidal cycle and in addition, water column profiling at 5 stations on a transect across each operational pit. Analysis of current velocity, turbidity, suspended solids, dissolved oxygen, temperature and salinity.

- Source material collection from a contaminated mud dredging site, monthly. Analysis for metal concentration, organic contaminants (PAH and PCB) and E. Coli. The results are linked to the collection of suspended solids.

- Suspended solids monitoring at 9 stations, quarterly. Analysis of metals and elemental fingerprinting.

- Dump trials, on an ad hoc basis, to quantify the amount, and to assess the extent of, dispersion losses following bottom dumping of dredged material at a disposal site.

Details of monitoring schedules are shown in Tables 1 and 2.

4. Summary of Main Findings

4.1 Sediment Quality

The measured concentrations of metals in sediments are very variable between stations and dates and are markedly influenced by natural mixing and depositional processes in the region. Some elevated concentrations were recorded and there is some evidence showing that either material has dispersed from the pits or that material has been dispersed outside the pit during dumping operation. However there is no indication at this stage that metal concentrations in sediments are an increasing trend.

On the pit specific monitoring, high lead, cadmium and copper were obtained from sediments collected around CMPI at ENPO's last day of monitoring. This suggests that there may be post capping leakages from CMPI and Director of Civil Engineering has been requested to conduct an investigation to confirm the reason for such high results.

4.2 Water Quality

Monitoring results indicated that suspended solids levels generally increased during strong current flows which was probably due to re-suspension of settled fine sediment as the average depth of water in the area is shallow. Dumping events may also have caused some measurable transient increase in SS level.

4.3 Aquatic Biota

Samples are insufficient to determine whether there are significant differences between stations or over time in the composition or abundance of the bottom living animals caught by trawl. No differences are evident on a gross scale.

Samples retrieved so far have indicated that the species abundance of the aquatic biota caught in trawl samples indicates a degree of turnover in species composition, but there is no evidence of any detrimental changes. The communities as a whole are comprised of

species that are characteristic of the region, and the species are generally those to be expected given the physical nature of the habitat, the polluted nature of the surrounding waters and the coastal estuarine location.

4.4 Eco-toxicology

Specimens of commercially valuable fish and crustaceans were selected from the trawl samples to be analyzed for seven key metals. The results were compared with the criteria set in the Food Adulteration Regulations of the Public Health and Municipal Service Ordinance (no limit has been set for copper, nickel and zinc) of Hong Kong in terms of concentration on a wet weight basis. A number of samples collected within the reporting period were found to contain very elevated concentrations of chromium, copper and nickel. As highlighted by Director of Health, heavy metals accumulate very slowly in marine organisms and it was therefore suspected that these high values could have been as a result of contamination during sample preparation rather than as a result of true uptake by the live animal. However the consultants have been instructed to investigate the problem and confirm the reason for such exceedances. Results of the investigation are awaited.

5. General Conclusion

For some water quality parameters, the range of natural variation at the site is often very large. This factor, together with effects from other activities such as marine traffic and dredging works in the vicinity have impeded interpretation of the impacts to water quality caused by disposal operations at the site. At the end of the reporting period there was some indication that contaminated material may have escaped from the pit. Further monitoring and investigation is required to confirm this possibility. Despite some findings which might be of concern, there is currently no firm evidence of widespread detrimental effect on the health of the ecosystem. The consultants have been instructed to conduct detailed investigation on the likely reasons that led to high metal contents being reported for some biota tissues.

As there were indications of possible leakage of dumped material from the capped contaminated mud pit and also concerns over the impacts on marine biota, it is essential for government to keep a close watch on the dumping activities at East Sha Chau to avoid any adverse environmental impacts. In this regard, a continuous monitoring programme was commenced in January 1994 by the Director of Civil Engineering in order to continue the monitoring which ENPO has done since the end of 1992.

Table 1 - Regional Cumulative Impact Monitoring

Task	Description	Parameters	No. of Stations	Samples per Station	Sampling Frequency & Duration
1	Sediment sampling and testing	Up to 15 elements incl. Cu, Cd, Cr, Pb, Ni, Zn, Hg, pH, Eh, TOC, Particle Size	37	5	Bi-monthly till one year after completion of dumping, then annually for 5 yr and just after typhoon*
		PAH & PCB	10	5	Bi-monthly, same duration
2	Suspended solids sampling and testing	10 elements	9	1	4 sampling events per year, same duration
3	In-situ water quality monitoring	Fixed mode : salinity, conductivity, temperature, turbidity, current	1	2-minute time series	1 24-hr period per week, decrease to once per month for 12 months after completion of dumping
4	Fisheries resources	Demersal nekton	6	4	Night-time trawling once per month till one year after completion of dumping, then twice annually for 5 years
5	Benthos	Macroinfaunal benthos	10, plus 2 pit after capping	2	Monthly till 12 months after completion of dumping, then twice annually for 5 years

6	Eco-toxicology : body loading of metals	10 elements	6	3 species per station	Monthly till 12 months after completion of dumping, then twice annually for 5 years
7	Eco-toxicology : biomonitoring	17 elements	6	To be determined	Twice per year till 6 years after completion of dumping

*5 replicates from 10 stations and a single replicate from the remaining 27 stations were analyzed.

Table 2 - Pit Specific Compliance Monitoring

Task	Description	Parameters	No. of Stations	Samples per Station	Sampling Frequency & Duration
1	Sediment sampling and analysis	Cu, Cd, Cr, Pb, Ni, Zn, Hg + 3 elements, pH, Eh, TOC, Grain size	8	5	Monthly for the duration of the pit, and bi-weekly during capping
2	In-situ water quality monitoring	Salinity, turbidity, temperature, DO, pH, conductivity, current velocity	4 stations fixed mode, 5 stations profilin g mode	2-min and 1 sec time series	1 24-hr period (1 full tidal cycle) per week for the duration of the pit
3	Source material elutriate testing, E. Coli, organics	15 metals, PAH, PCB, E. Coli	1 per source	2 compo-site samples	Est. once per month

Table 3 - Prosecution Statistics - October to December 1993

Month	Company/Person	Date of Offence	Nature of Offence	Fine HK$	Record of Offence
October	Every On Ltd. - Main contractor	24/3/93	Permit dumping of about 1000 lbs of metallic sand at sea north of Tsing Yi without dumping licence	3,000	1st
	Kei Hing Shot Blast & Painting Co. - Subcontractor	24/3/93	Dumping of about 1,000 lbs of metallic sand at sea north of Tsing Yi without dumping licence	3,000	1st
	China Fujian Corp. for International Techno-Economic Cooperation - Licensee	8/4/93	Permit dumping of about 750m^3 of mud at sea east of Ninepin Group not in compliance with the licence conditions	4,000	4th
	Fanta (CFC) Co. Ltd.- Waste Disposal Contractor	48/4/93	Permit dumping of about 750m^3 of mud at sea east of Ninepin Group not in compliance with the licence conditions	4,000	5th
November	Everdevelop Co. Ltd. - Licensee	20/5/93	Dumping contaminated marine mud at sea of the Rambler Channel not in compliance with the licence conditions	3,000	3rd

November	China Harbour Engineering Co. - Licensee	11/6/93	Permit dumping approx. 750m³ of marine mud at sea south of Cheung Chau not in compliance with the licence conditions	4.000	3rd
	Fanta (CFC) Co. Ltd.- Waste Disposal Contractor	15/7/93	Dumping approx. 750m³ of contaminated marine mud at sea east of Sha Chau not in compliance with the licence conditions	4.000	6th
December	Fanta (CFC) Co. Ltd.- Waste Disposal Contractor	5/8/93	Dumping approx 750m³ of excavated material at sea of Tseung Kwan O marine work site without licence	5.000	7th
	Fanta (CFC) Co. Ltd.- Waste Disposal Contractor	9/8/93	Dumping approx. 750m³ of excavated material at sea of Tseung Kwan O marine work site without licence	5.000	8th

Table 4 - Illegal Dumping Statistics - October to December 1993

	October	November	December
No. of Cases of Illegal Dumping Observed	1	0	0

Environmental Protection Department
August 1994

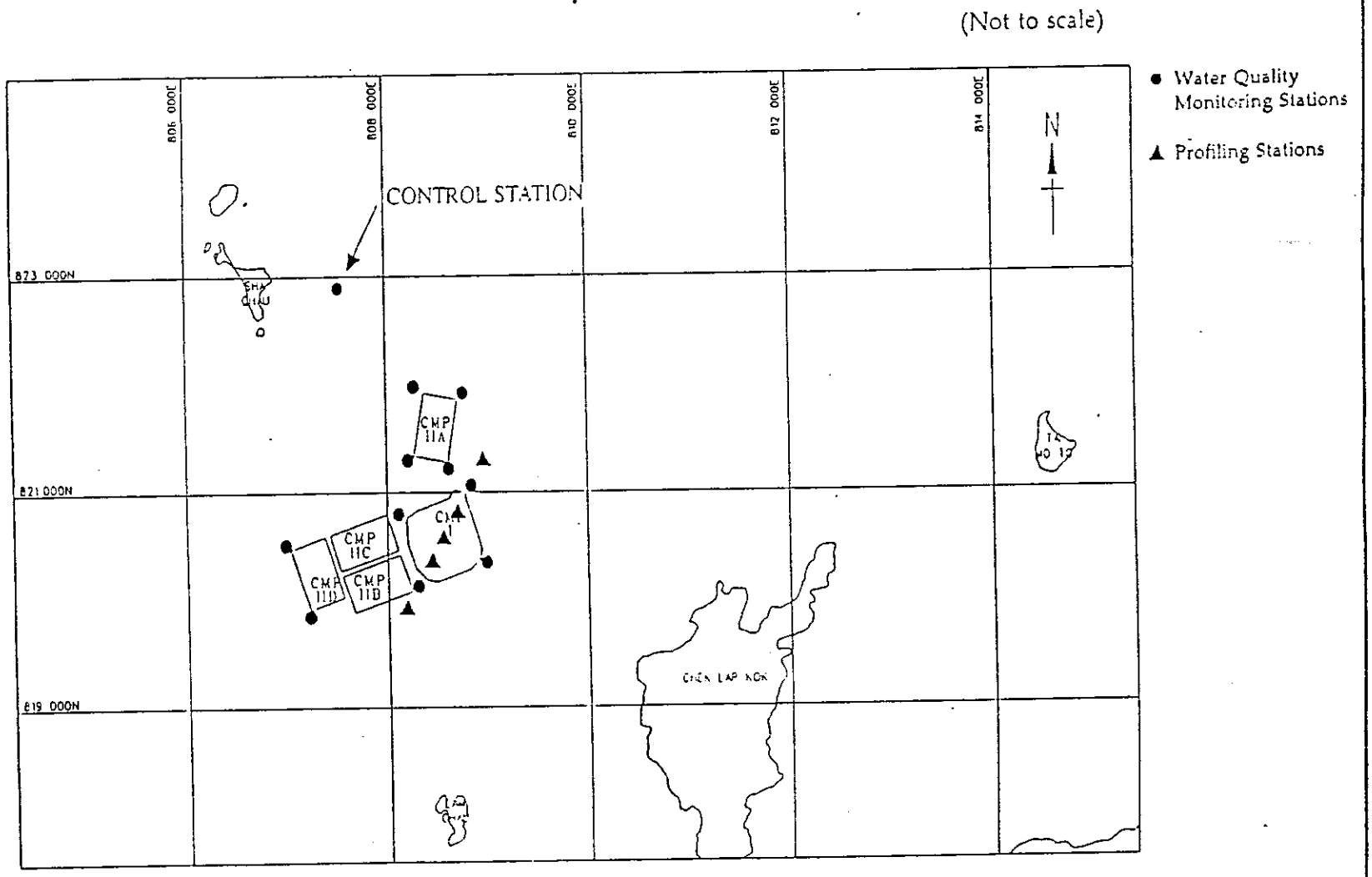

Figure 1 Location of Water Quality Monitoring and Profiling Station

(Not to scale)

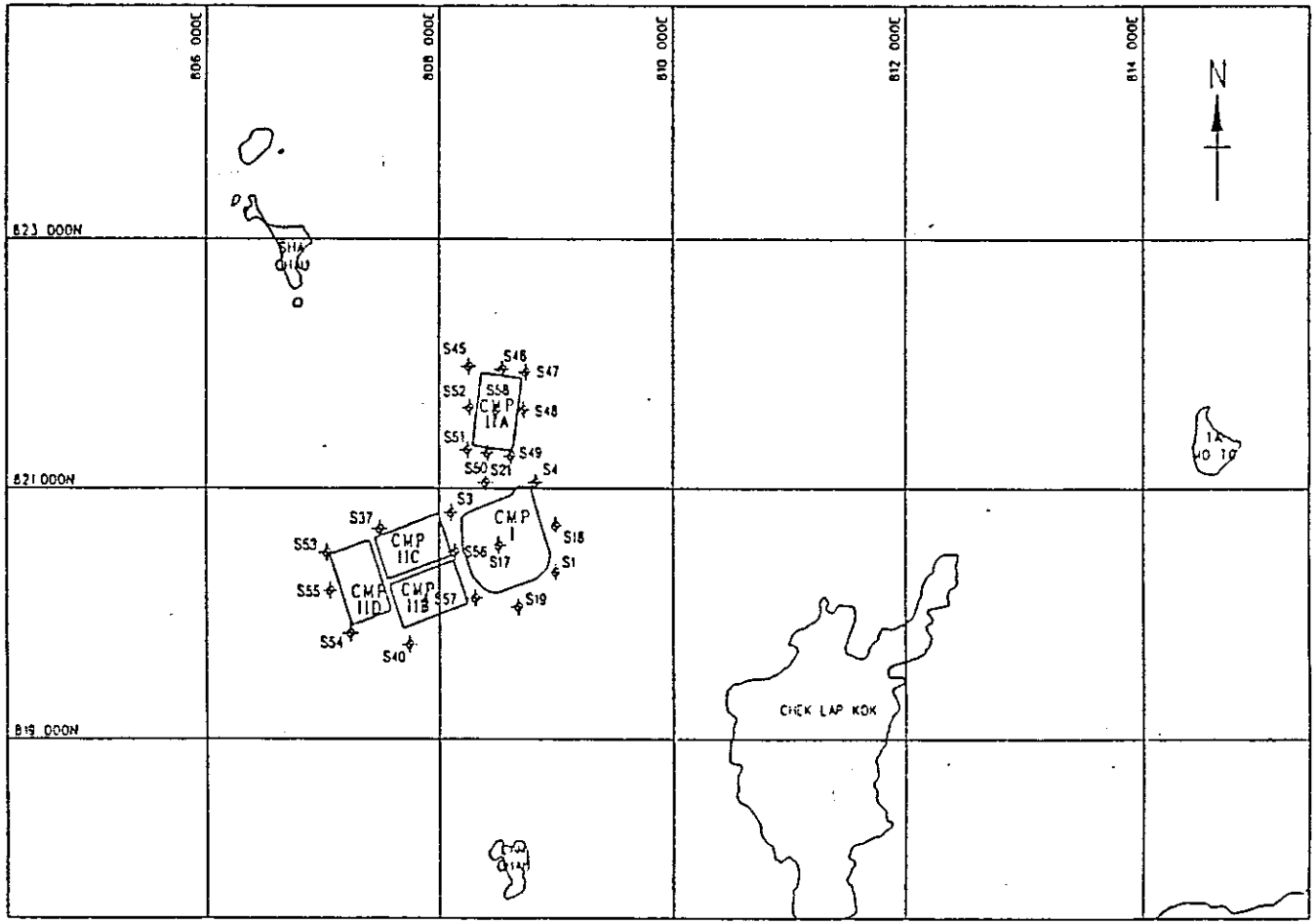

Figure 2 Location of Compliance Sediment Monitoring Stations

(Not to scale)

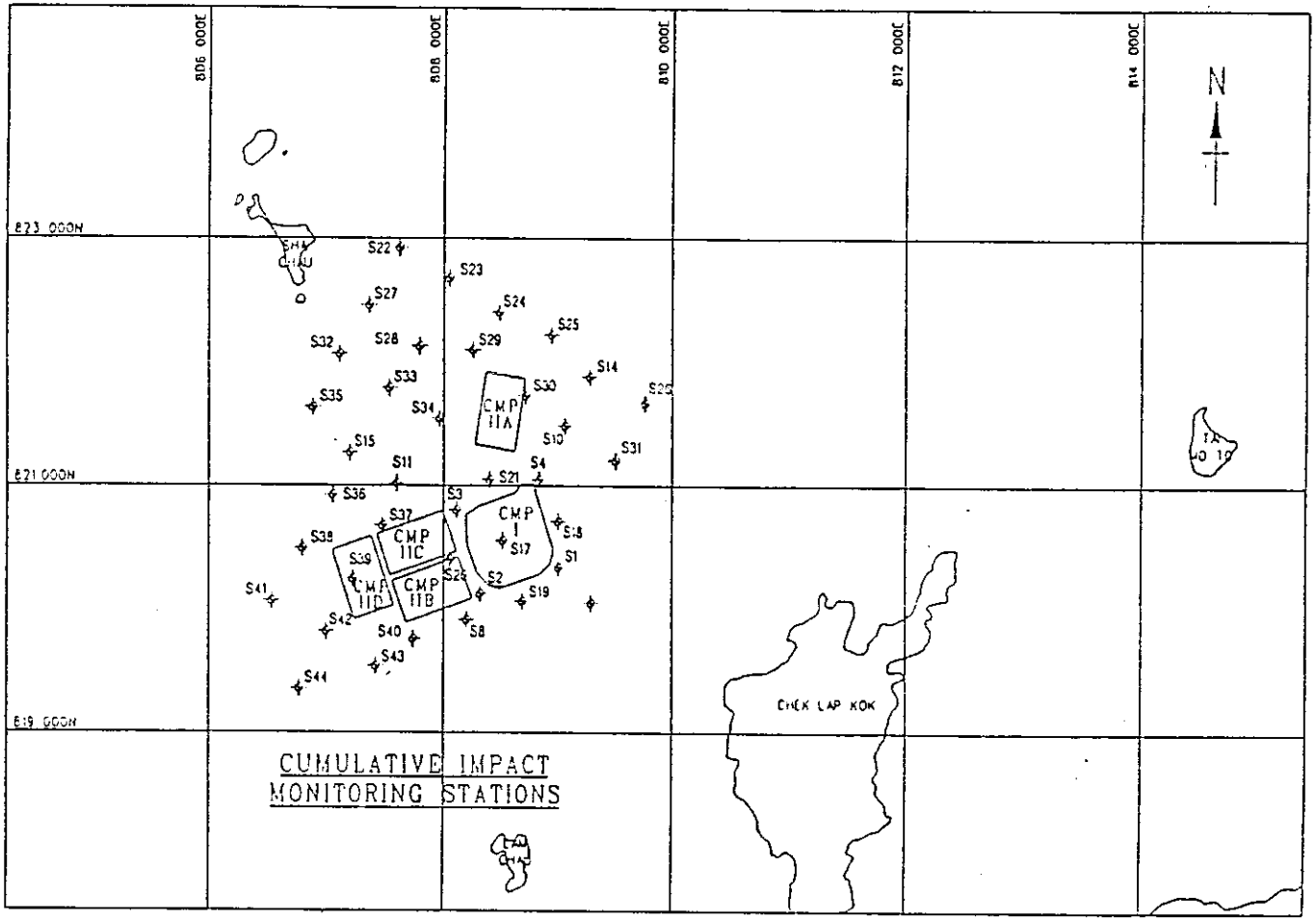

Figure 3 Location of Cumulative Impact Sediment Monitoring Stations

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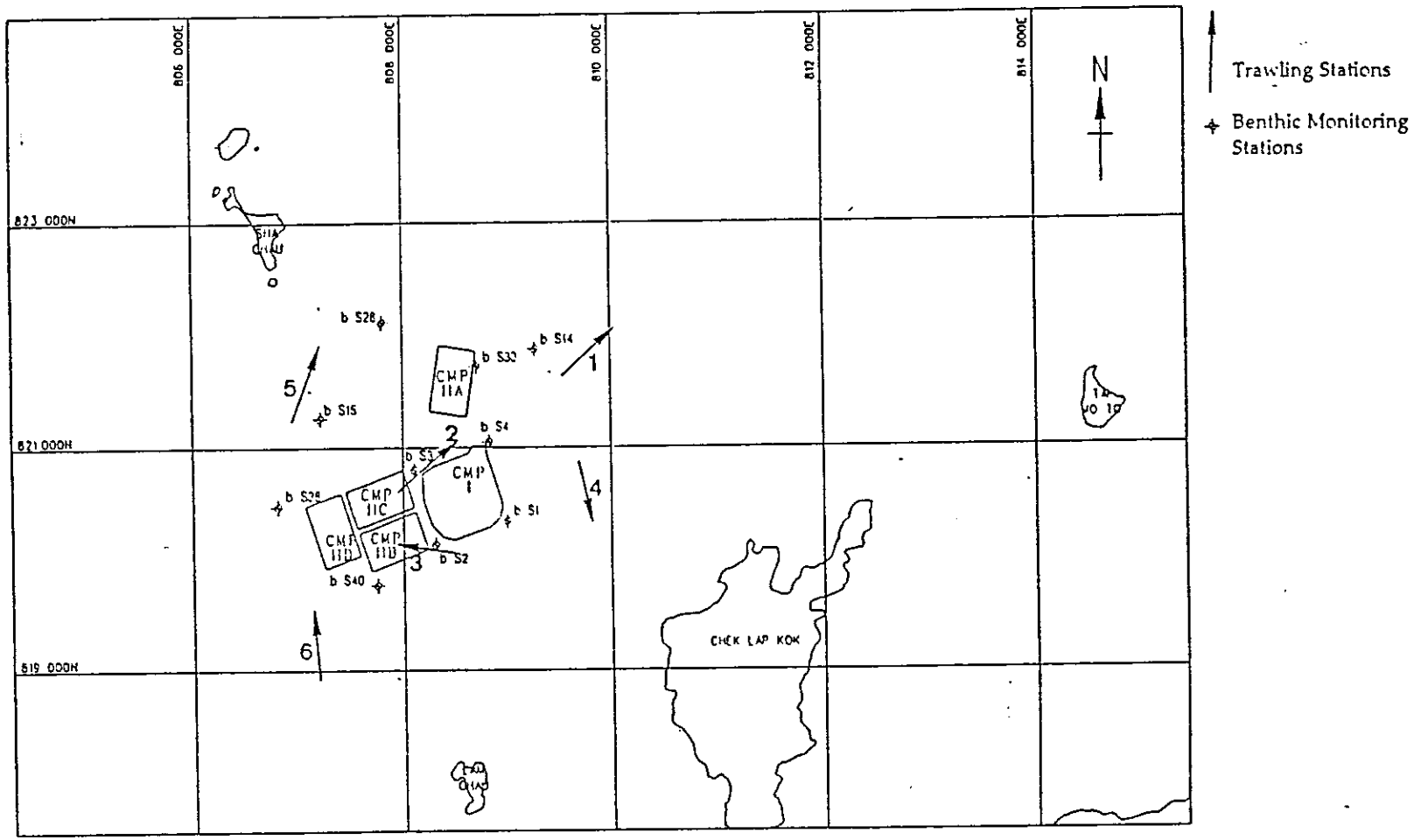

Figure 4 Location of Trawling and Benthic Monitoring Stations