

REPORT ON  
AMBIENT AIR POLLUTION MONITORING DATA  
FOR  
150 MW COMBINED CYCLE POWER PLANT  
AT  
KERAWALAPITIYA

MONTH : JUNE, 1998

REPORT NO. : NBRO/ENV/15050/98/1205  
JOB NO. : AQP 98/91

REPORT TO :  
Tokyo Electric Power Services UENO Center.  
3-3, Higashi - Ueno 3 - chome, Taito-ku,  
Tokyo 110,  
Japan.

ENVIRONMENTAL DIVISION  
NATIONAL BUILDING RESEARCH ORGANISATION  
99/1, JAWATTA ROAD,  
COLOMBO-05.  
SRI LANKA

8 July, 1998

Client: Mr. Zenjiro Tsutsui  
Deputy General Manager  
Tokyo Electric Power Services UENO Center.

### 1. SCOPE :

At the request of the client, the Environmental Division of NBRO carried out the second phase of ambient Air Quality Monitoring programme at the same four locations where monitoring was carried out in the first phase of the programme. This survey was carried out as per the client's requirements, to provide data for the feasibility study of proposed 150 MW Combined Cycle Diesel Power Plant at Kerawalapitiya.

### 2. SAMPLING :

For the fulfillment of the client's requirement, the monitoring of air quality and meteorological parameters were carried out at 4 distinct locations within about 7.5 km from the proposed power plant site in the approximate directions of N, NE, E & SE. In this event SO<sub>2</sub>, NO<sub>2</sub>, NO<sub>x</sub>, CO, O<sub>3</sub> and meteorological parameters such as Wind Speed, Wind Direction, Vertical Wind Speed, Solar Radiation, Ambient Temperature and Rainfall were monitored continuously, and the averages were compiled from 5 minutes data. However monitoring of SPM was carried out as an average over 8 hours as per the client's requirement.

### 3. DESCRIPTION OF LOCATIONS :

The four locations (B, C, D and E) were selected along with the Ceylon Electricity Board officials to satisfy the clients requirements, approximately 7500 meters away from the proposed construction site of the project in the direction of N, NE, E & SE respectively.

LOCATION	DIRECTION	MONITORED PERIOD
D - Polwatta, Mahara, Nugegoda	East	11-06-98 to 13-06-98
C - Ragama North	North - East	15-06-98 to 20-06-98
E - Hunupitiya South	South - East	22-06-98 to 24-06-98
B - Indivitiya, Mahara	North	25-06-98 to 27-06-98

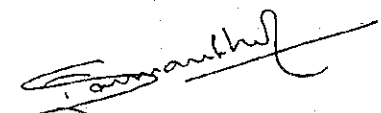
#### 4. METHODOLOGY :

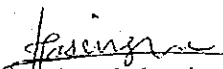
Each location was monitored continuously using fully automated ambient Air Quality monitoring system, for primary and secondary gas pollutants, meteorological parameters & SPM. The monitored data were stored in data acquisition system as 5 minutes and one hour averages except SPM. The SPM was measured manually for 8 hours.


PARAMETER	METHODOLOGY	INSTRUMENT		
		Make	Model No:	Serial No:
Nitric Oxide	Chemiluminisence	Monitor Lab	9841A	2078
Nitrogen Dioxide	Chemiluminisence	Monitor Lab	9841A	2078
Sulphur Dioxide	Flourometric	Monitor Lab	9850	1950
Carbon Monoxide	IR photometric	Monitor Lab	9830	2087
Ozone	Photometric	Monitor Lab	9812	2006
SPM	Gravimetric	Ecotech	HV 2000	314

#### 5. RESULTS:

PARAMETER	LOCATION	TABLES/FIGURES
Nitric Oxide	B, C, D & E	Table. 1
Nitrogen Dioxide	- do -	Table. 2
Oxides of Nitrogen	- do -	Table. 3
Sulphur Dioxide	- do -	Table. 4
Carbon Monoxide	- do -	Table. 5
Ozone	- do -	Table. 6
SPM	- do -	Table. 7
Wind Rose	- do -	Fig. 1
Vertical Wind Speed	- do -	Fig. 2
Solar Radiation	- do -	Fig. 3
Ambient Temperature	- do -	Fig. 4
Rain Fall	- do -	Fig. 5

  
Co-ordinator  
Air Quality Programme

  
Project Scientist  
Air Quality Programme

  
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Fax : 94-1-502611 e-mail : nabro@sit.lk

Parameter : Nitric Oxide  
 Unit : mg/m<sup>3</sup>

Location : D	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
11-Jun-98	0.002	0.002	C/L	0.001	0.001	0.002	0.001	0.006	0.006	0.005	0.002	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.001	0.001	0.001	0.001	0.001	0.003	0.006
12-Jun-98	0.002	0.002	C/L	0.002	0.001	0.004	0.004	0.006	0.010	0.008	0.006	0.002	0.004	0.004	0.006	0.005	0.002	0.002	0.001	0.001	0.001	0.002	0.004	0.002	0.004	0.004	0.010
13-Jun-98	0.001	0.002	C/L	0.001	0.001	0.002	0.002	0.005	0.008	0.006	0.005	0.004	0.002	0.002	0.004	0.002	0.002	0.001	0.001	0.004	0.001	0.002	0.001	0.001	0.001	0.003	0.008

Location : C	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
15-Jun-98	0.001	0.001	C/L	0.001	0.001	0.001	0.002	0.001	0.007	0.008	0.008	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.005	0.005	0.011	0.017	0.005	0.016	0.024	0.005	0.024
16-Jun-98	0.031	0.021	C/L	0.019	0.024	0.018	0.008	0.024	0.016	0.010	0.023	0.017	0.001	0.002	0.001	0.002	0.001	0.001	0.004	0.005	0.004	0.030	0.014	0.004	0.001	0.012	0.031
17-Jun-98	0.001	0.001	C/L	0.001	0.001	0.001	0.002	0.001	0.004	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.005	0.007	0.005	0.010	0.003	0.010
18-Jun-98	0.001	0.001	C/L	0.001	0.001	0.001	0.001	0.011	0.012	0.023	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.005	0.004	0.005	0.006	0.004	0.023
19-Jun-98	0.001	0.002	C/L	0.017	0.001	0.007	0.012	0.008	0.017	0.028	0.006	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.004	0.005	0.004	0.007	0.002	0.002	0.006	0.028
20-Jun-98	0.001	0.002	C/L	0.002	0.001	0.001	0.005	0.004	0.012	0.012	0.004	0.008	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.005	0.004	0.002	0.002	0.003	0.012

Location : E	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
22-Jun-98	0.001	0.001	C/L	0.001	0.002	0.001	0.001	0.001	0.011	0.005	0.007	0.010	0.007	0.004	0.002	0.002	0.002	0.002	0.002	N/D	0.004	0.002	0.001	0.002	0.002	0.003	0.011
23-Jun-98	0.001	0.001	C/L	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.004	0.002	0.002	0.004	0.002	0.001	0.002	0.004
24-Jun-98	0.002	0.005	C/L	0.013	0.005	0.002	0.008	0.024	0.012	0.011	0.008	0.008	0.004	0.001	0.002	0.004	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.007	0.024	

Location : B	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
25-Jun-98	0.002	0.002	C/L	0.001	0.001	0.001	0.002	0.011	0.021	0.031	0.010	N/D	0.008	0.004	0.002	0.002	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.005	0.031
26-Jun-98	0.001	0.001	C/L	0.001	0.001	0.002	0.001	0.001	0.005	0.007	0.005	0.005	0.006	0.004	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.003	0.007
27-Jun-98	0.001	0.001	C/L	0.001	0.002	0.002	0.001	0.001	0.002	0.004	0.002	0.002	0.005	0.004	0.005	0.005	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.003	0.007
																									0.002	0.005	

C/L : Callibration Cycle  
 N/D : Not Detected, Less than 0.001 mg/m<sup>3</sup> or No Data



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 99/1, JAWATTA ROAD, COLOMBO-5.

Tel : 94-1-588946, 501834, 503826 Fax : 94-1-502611 e-mail : nabro@slk.lk

Parameter : Nitrogen Dioxide  
 Unit : mg/m<sup>3</sup>

Location : D	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
11-Jun-98	0.006	0.008	C/L	0.004	0.002	0.002	0.002	0.004	0.008	0.004	0.004	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.004	0.006	0.006	0.004	0.004	0.006
12-Jun-98	0.004	0.002	C/L	0.002	0.002	0.002	0.002	0.004	0.004	0.008	0.004	0.002	0.002	0.002	0.000	0.002	0.002	0.002	0.002	0.002	0.004	0.004	0.004	0.004	0.003	0.006
13-Jun-98	0.004	0.004	C/L	0.004	0.002	0.002	0.004	0.004	0.004	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004	0.006	0.004	0.004	0.003	0.006

Location : C	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
15-Jun-98	0.007	0.007	C/L	0.006	0.007	0.007	0.007	0.007	0.013	0.015	0.013	0.007	0.006	0.004	0.004	0.009	0.009	0.011	0.019	0.019	0.022	0.031	0.019	0.026	0.028	0.031
16-Jun-98	0.028	0.024	C/L	0.022	0.020	0.020	0.019	0.022	0.019	0.015	0.028	0.022	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.013	0.013	0.026	0.022	0.015	0.017	0.028
17-Jun-98	0.013	0.009	C/L	0.002	0.002	0.004	0.004	0.009	0.013	0.004	0.006	0.006	0.002	0.002	0.002	0.004	0.006	0.007	0.015	0.022	0.028	0.024	0.031	0.028	0.010	0.031
18-Jun-98	0.026	0.020	C/L	0.019	0.019	0.020	0.013	0.015	0.017	0.022	0.015	0.007	0.006	0.008	0.004	0.004	0.004	0.004	0.007	0.011	0.020	0.015	0.017	0.022	0.014	0.026
19-Jun-98	0.009	0.011	C/L	0.019	0.009	0.013	0.019	0.011	0.017	0.020	0.013	0.006	0.004	0.002	0.004	0.004	0.004	0.004	0.006	0.009	0.015	0.013	0.019	0.015	0.011	0.020
20-Jun-98	0.011	0.004	C/L	0.006	0.006	0.007	0.020	0.017	0.013	0.017	0.009	0.002	0.006	0.004	0.004	0.004	0.004	0.004	0.004	0.006	0.013	0.019	0.017	0.013	0.007	0.020

Location : E	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
22-Jun-98	0.007	0.007	C/L	0.008	0.008	0.009	0.009	0.011	0.017	0.020	0.015	0.020	0.022	0.017	0.009	0.007	0.007	0.007	N/D	N/D	0.015	0.019	0.017	0.011	0.011	0.022
23-Jun-98	0.011	0.011	C/L	0.008	0.009	0.004	0.007	0.011	0.013	0.013	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.009	0.017	0.007	0.019	0.004	0.017	0.020	0.020
24-Jun-98	0.011	0.017	C/L	0.020	0.017	0.015	0.015	0.015	0.017	0.015	0.015	0.013	0.007	0.006	0.002	0.007	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.013	0.020

Location : B	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
25-Jun-98	0.000	0.002	C/L	0.006	0.020	0.024	0.020	0.017	0.019	0.024	0.013	N/D	0.000	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004	0.002	0.004	0.002	0.024
26-Jun-98	0.002	0.002	C/L	0.002	0.002	0.004	0.006	0.002	0.002	0.002	0.002	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.006
27-Jun-98	0.002	0.002	C/L	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004	0.002	0.002	0.002	0.004

C/L : Calibration Cycle  
 N/D : Not Detected, Less than 0.001 mg/m<sup>3</sup> or No Data

Table 2



ENVIRONMENTAL DIVISION  
NATIONAL BUILDING RESEARCH ORGANISATION  
99/1, JAWATTA ROAD, COLOMBO-5.

Tel : 94-1-588946, 501834, 503826 Fax : 94-1-502611 e-mail : nabro@sil.lk

Parameter : Oxides of Nitrogen  
Unit : mg/m<sup>3</sup>

Location	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
11-Jun-98	0.008	0.008	C/L	0.005	0.003	0.004	0.003	0.010	0.012	0.009	0.006	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.005	0.007	0.007	0.005	0.006	0.012
12-Jun-98	0.008	0.004	C/L	0.004	0.003	0.005	0.005	0.010	0.013	0.014	0.010	0.004	0.005	0.005	0.008	0.007	0.004	0.003	0.003	0.005	0.006	0.006	0.007	0.006	0.006	0.014
13-Jun-98	0.005	0.006	C/L	0.005	0.003	0.004	0.008	0.009	0.012	0.010	0.007	0.005	0.004	0.004	0.005	0.004	0.004	0.003	0.003	0.005	0.008	0.005	0.005	0.005	0.006	0.012

Location	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
15-Jun-98	0.009	0.009	C/L	0.007	0.009	0.009	0.010	0.012	0.020	0.023	0.019	0.010	0.007	0.005	0.005	0.007	0.012	0.016	0.023	0.033	0.048	0.023	0.042	0.052	0.018	0.052
16-Jun-98	0.059	0.045	C/L	0.042	0.044	0.038	0.027	0.046	0.094	0.024	0.049	0.039	0.010	0.012	0.010	0.012	0.010	0.013	0.018	0.017	0.056	0.037	0.018	0.018	0.030	0.059
17-Jun-98	0.014	0.010	C/L	0.003	0.003	0.005	0.006	0.010	0.017	0.008	0.008	0.003	0.003	0.003	0.003	0.005	0.007	0.009	0.009	0.015	0.027	0.035	0.029	0.041	0.013	0.041
18-Jun-98	0.027	0.022	C/L	0.020	0.020	0.022	0.014	0.029	0.029	0.045	0.018	0.010	0.007	0.007	0.005	0.005	0.005	0.005	0.005	0.009	0.015	0.025	0.018	0.021	0.017	0.045
19-Jun-98	0.010	0.014	C/L	0.035	0.010	0.020	0.031	0.020	0.034	0.048	0.019	0.008	0.006	0.003	0.005	0.005	0.005	0.007	0.013	0.020	0.017	0.026	0.017	0.014	0.017	0.048
20-Jun-98	0.012	0.008	C/L	0.008	0.007	0.009	0.025	0.020	0.025	0.029	0.013	0.008	0.008	0.005	0.005	0.005	0.005	0.005	0.005	0.007	0.018	0.023	0.020	0.015	0.010	0.029

Location	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
22-Jun-98	0.009	0.009	C/L	0.007	0.008	0.010	0.012	0.018	0.031	0.020	0.028	0.032	0.024	0.013	0.010	0.010	0.010	0.010	N/D	0.018	0.021	0.018	0.014	0.014	0.016	0.032
23-Jun-98	0.012	0.012	C/L	0.010	0.010	0.005	0.009	0.012	0.015	0.014	0.008	0.007	0.007	0.007	0.010	0.009	0.010	0.012	0.020	-0.005	0.021	0.007	0.019	0.022	0.011	0.022
24-Jun-98	0.014	0.021	C/L	0.034	0.021	0.017	0.023	0.041	0.027	0.028	0.021	0.019	0.011	0.007	0.004	0.011	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.020	0.041

Location	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
25-Jun-98	0.002	0.004	C/L	0.007	0.022	0.025	0.023	0.028	0.039	0.035	0.023	N/D	0.008	0.007	0.004	0.004	0.005	0.004	0.004	0.004	0.006	0.004	0.006	0.004	0.013	0.055
26-Jun-98	0.003	0.003	C/L	0.003	0.003	0.006	0.007	0.003	0.007	0.009	0.007	0.009	0.008	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.005	0.009
27-Jun-98	0.003	0.003	C/L	0.003	0.004	0.004	0.003	0.003	0.004	0.005	0.004	0.004	0.007	0.005	0.007	0.007	0.004	0.004	0.004	0.004	0.003	0.005	0.004	0.004	0.004	0.007

C/L : Calibration Cycle  
N/D : Not Detected, Less than 0.001 mg/m<sup>3</sup> or No Data



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**NATIONAL BUILDING RESEARCH ORGANISATION**  
 99/1, JAWATTA ROAD, COLOMBO-5.

Tel : 94-1-588946, 501834, 503826 Fax : 94-1-502611 e-mail : nabro@st.lk

Parameter : Sulphur Dioxide  
 Unit : mg/m<sup>3</sup>

Location : D	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
11-Jun-98	0.003	0.003	C/L	0.003	0.003	0.003	0.003	0.005	0.005	0.003	0.003	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.005	0.005	0.005	0.005	0.004	0.005
12-Jun-98	0.005	0.003	C/L	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.003	0.003	0.003	0.008	0.005	0.003	0.003	0.003	0.005	0.005	0.003	0.005	0.003	0.003	0.004	0.008
13-Jun-98	0.003	0.003	C/L	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.005	0.005	0.005	0.003	0.005

Location : C	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
15-Jun-98	0.008	0.008	C/L	0.003	0.003	0.003	0.003	0.003	0.005	0.015	0.010	0.008	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.008	0.015	0.015	0.015	0.028	0.028
16-Jun-98	0.044	0.033	C/L	0.033	0.036	0.031	0.015	0.026	0.023	0.021	0.015	0.028	0.013	0.010	0.010	0.010	0.008	0.008	0.008	0.008	0.005	0.010	0.021	0.008	0.008	0.044
17-Jun-98	0.010	0.010	C/L	0.005	0.003	0.003	0.003	0.003	0.006	0.005	0.003	0.005	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.010	0.013	0.015	0.018	0.018
18-Jun-98	0.018	0.015	C/L	0.013	0.010	0.010	0.008	0.018	0.031	0.036	0.013	0.010	0.005	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.005	0.005	0.010	0.036
19-Jun-98	0.005	0.003	C/L	0.003	0.005	0.003	0.008	0.003	0.010	0.021	0.013	0.008	0.010	0.010	0.015	0.015	0.015	0.015	0.015	0.018	0.044	0.021	0.023	0.021	0.015	0.044
20-Jun-98	0.018	0.005	C/L	0.005	0.005	0.008	0.010	0.013	0.013	0.021	0.013	0.008	0.005	0.005	0.003	0.003	0.003	0.005	0.003	0.003	0.005	0.003	0.003	0.003	0.007	0.021

Location : E	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
22-Jun-98	0.003	0.008	C/L	0.008	0.015	0.018	0.008	0.010	0.013	0.018	0.021	0.021	0.013	0.018	0.015	0.010	0.013	0.005	N/D	0.005	0.008	0.008	0.008	0.010	0.012	0.021
23-Jun-98	0.010	0.003	C/L	0.003	0.005	0.003	0.003	0.005	0.008	0.008	0.005	0.005	0.005	0.008	0.005	0.008	0.008	0.008	0.008	0.023	0.123	0.015	0.098	0.008	0.016	0.123
24-Jun-98	0.003	0.005	C/L	0.023	0.023	0.018	0.033	0.028	0.008	0.015	0.015	0.018	0.013	0.005	0.046	0.008	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.017	0.046

Location : B	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
25-Jun-98	0.005	0.005	C/L	0.005	0.005	0.005	0.005	0.005	0.013	0.039	0.013	N/D	0.005	0.005	0.005	0.005	0.003	0.003	0.005	0.005	0.005	0.005	0.003	0.003	0.007	0.039
26-Jun-98	0.003	0.005	C/L	0.003	0.003	0.003	0.005	0.005	0.003	0.003	0.003	0.005	0.005	0.005	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.003	0.003	0.003	0.005
27-Jun-98	0.003	0.005	C/L	0.005	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.005	0.005	0.005	0.003	0.003	0.003	0.005	0.005	0.005	0.003	0.003	0.003	0.003	0.005

C/L : Calibration Cycle  
 N/D : Not Detected, Less than 0.002 mg/m<sup>3</sup> or No Data



ENVIRONMENTAL DIVISION  
NATIONAL BUILDING RESEARCH ORGANISATION  
99/1, JAWATTA ROAD, COLOMBO-5.

Tel : 94-1-588946, 501834, 503826 Fax : 94-1-502611 e-mail : nabro@slk.lk

Parameter : Carbon Monoxide  
Unit : mg/m<sup>3</sup>

Location : D	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
11-Jun-98	0.018	0.008	C/L	0.068	0.031	0.024	0.010	0.069	0.008	0.002	0.012	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.084	0.021	0.015	0.057	0.030	0.084	
12-Jun-98	0.164	0.288	C/L	0.295	0.333	0.281	0.269	0.002	0.021	0.025	0.014	0.068	0.070	0.095	0.587	0.014	0.008	0.025	0.069	0.032	0.035	0.038	0.062	0.060	0.121	0.567	
13-Jun-98	0.028	0.010	C/L	0.009	0.018	0.011	0.020	0.014	0.044	0.002	0.006	0.008	0.012	0.011	0.062	0.147	0.029	0.020	0.089	0.007	0.006	0.021	0.005	0.154	0.032	0.154	
Location : C	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
15-Jun-98	0.029	0.076	C/L	0.040	0.042	0.040	0.041	0.115	0.044	0.046	0.063	0.033	0.052	0.025	0.020	0.033	0.037	0.014	0.014	0.025	0.011	0.033	0.043	0.035	0.040	0.115	
16-Jun-98	0.031	0.002	C/L	0.034	0.033	0.041	0.043	0.033	0.215	0.160	0.114	0.101	0.014	0.058	0.101	0.080	0.721	0.050	0.045	0.045	0.033	0.031	0.049	0.112	0.093	0.721	
17-Jun-98	0.072	0.042	C/L	0.064	0.050	0.069	0.008	0.032	0.014	0.082	0.017	0.017	0.018	0.018	0.018	0.170	0.742	0.024	0.052	0.036	0.028	0.032	0.064	0.017	0.072	0.742	
18-Jun-98	0.008	0.005	C/L	0.003	0.003	0.005	0.005	0.010	0.006	0.006	0.008	0.008	0.005	0.021	0.024	0.021	0.023	0.023	0.024	0.025	0.018	0.019	0.033	0.034	0.015	0.034	
19-Jun-98	0.010	0.009	C/L	0.046	0.019	0.009	0.008	0.018	0.019	0.017	0.249	0.052	0.047	0.069	0.031	0.020	0.024	0.026	0.017	0.033	0.171	0.475	0.138	0.037	0.067	0.475	
20-Jun-98	0.051	0.012	C/L	0.016	0.005	0.006	0.054	0.118	0.881	0.442	0.177	0.377	0.301	0.053	0.050	0.041	0.051	0.038	0.054	0.215	0.305	0.244	0.088	0.027	0.158	0.881	
Location : E	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
22-Jun-98	0.102	0.090	C/L	0.042	0.043	0.044	0.068	0.106	0.371	0.150	0.129	0.324	0.218	0.082	0.077	0.144	0.078	0.085	N/D	N/D	0.301	0.251	0.396	0.129	0.153	0.152	0.396
23-Jun-98	0.138	0.124	C/L	0.110	0.081	0.052	0.139	0.179	0.140	0.118	0.060	0.075	0.134	0.156	0.113	0.116	0.173	0.118	0.087	0.070	0.947	0.254	0.112	0.276	0.190	0.947	
24-Jun-98	0.120	0.068	C/L	0.055	0.040	0.041	0.054	0.212	0.417	0.596	0.313	0.137	0.064	0.054	0.154	0.045	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.158	0.596	
Location : B	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum	
25-Jun-98	0.281	0.051	C/L	0.078	0.069	0.073	0.141	0.486	0.548	0.437	0.483	N/D	0.592	0.127	0.070	0.086	0.061	0.077	0.063	0.067	0.097	0.141	0.087	0.072	0.190	0.592	
26-Jun-98	0.069	0.043	C/L	0.040	0.042	0.042	0.046	0.042	0.081	0.053	0.051	0.052	0.045	0.054	0.049	0.051	0.051	0.049	0.051	0.052	0.045	0.047	0.071	0.060	0.050	0.071	
27-Jun-98	0.053	0.084	C/L	0.063	0.064	0.028	0.059	0.075	0.095	0.082	0.082	0.036	0.089	0.112	0.113	0.114	0.078	0.092	0.098	0.121	0.132	0.106	0.090	0.071	0.089	0.132	

C/L : Calibration Cycle  
N/D : Not Detected, Less than 0.001 mg/m<sup>3</sup> or No Data

NBRO/ENV/15050/98/1205

Table 5





**ENVIRONMENTAL DIVISION  
NATIONAL BUILDING RESEARCH ORGANISATION  
99/1, JAWATTA ROAD, COLOMBO-5.**

Tel: 94-1-588946, 501834, 503826 Fax: 94-1-502611 e-mail: nabro@slk.lk

Parameter : Ozone  
Unit : mg/m<sup>3</sup>

Location : D	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
11-Jun-98	0.044	0.029	C/L	0.033	0.023	0.054	0.044	0.035	0.056	0.042	0.039	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.029	0.044	0.035	0.027	0.036	0.056
12-Jun-98	0.039	0.042	C/L	0.042	0.042	0.035	0.021	0.035	0.039	0.066	0.065	0.064	0.067	0.050	0.052	0.054	0.081	0.050	0.062	0.054	0.052	0.037	0.021	0.035	0.050	0.087
13-Jun-98	0.039	0.025	C/L	0.039	0.064	0.068	0.083	0.081	0.079	0.046	0.091	0.035	0.044	0.062	0.068	0.058	0.041	0.039	0.019	0.035	0.029	0.035	0.062	0.062	0.052	0.091

Location : C	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
15-Jun-98	0.056	0.075	C/L	0.069	0.064	0.068	0.083	0.021	0.060	0.058	0.054	0.125	0.054	0.067	0.081	0.089	0.075	0.079	0.087	0.075	0.042	0.154	0.060	0.052	0.073	0.154
16-Jun-98	0.035	0.014	C/L	0.000	0.010	0.012	0.015	0.017	0.066	0.102	0.042	0.110	0.091	0.116	0.098	0.097	0.062	0.073	0.077	0.062	0.050	0.035	0.041	0.033	0.055	0.116
17-Jun-98	0.052	0.025	C/L	0.050	0.033	0.060	0.062	0.068	0.025	0.068	0.058	0.073	0.069	0.075	0.069	0.079	0.056	0.062	0.058	0.054	0.041	0.048	0.073	0.029	0.056	0.079
18-Jun-98	0.008	0.012	C/L	0.012	0.015	0.008	0.012	0.015	0.019	0.023	0.046	0.046	0.058	0.054	0.058	0.050	0.050	0.046	0.044	0.071	0.068	0.029	0.137	0.110	0.043	0.137
19-Jun-98	0.084	0.027	C/L	0.008	0.004	0.041	0.023	0.031	0.017	0.088	0.081	0.041	0.095	0.017	0.025	0.062	0.084	0.139	0.027	0.037	0.029	0.021	0.012	0.017	0.042	0.139
20-Jun-98	0.016	0.028	C/L	0.023	0.025	0.021	0.010	0.012	0.035	0.023	0.042	0.023	0.093	0.108	0.102	0.091	0.108	0.097	0.079	0.066	0.068	0.068	0.069	0.124	0.058	0.124

Location : E	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
22-Jun-98	0.012	0.012	C/L	0.014	0.012	0.012	0.010	0.008	0.008	0.014	0.012	0.012	0.017	0.025	0.035	0.025	0.025	0.023	N/D	0.015	0.033	0.079	0.060	0.039	0.023	0.079
23-Jun-98	0.042	0.025	C/L	0.035	0.021	0.037	0.044	0.046	0.044	0.044	0.056	0.064	0.068	0.062	0.058	0.058	0.100	0.108	0.041	0.071	0.039	0.004	0.010	0.010	0.047	0.108
24-Jun-98	0.015	0.010	C/L	0.004	0.004	0.006	0.006	0.012	0.066	0.079	0.044	0.037	0.077	0.058	0.050	0.151	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.041	0.151

Location : B	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Average	Maximum
25-Jun-98	0.019	0.010	C/L	0.035	0.015	0.014	0.015	0.029	0.052	0.006	0.058	N/D	0.015	0.041	0.066	0.066	0.089	0.077	0.083	0.083	0.110	0.010	0.079	0.124	0.049	0.124
26-Jun-98	0.031	0.056	C/L	0.064	0.052	0.052	0.048	0.056	0.064	0.079	0.114	0.081	0.071	0.106	0.073	0.065	0.079	0.085	0.083	0.083	0.048	0.066	0.095	0.048	0.070	0.114
27-Jun-98	0.042	0.056	C/L	0.058	0.060	0.097	0.002	0.052	0.064	0.098	0.069	0.050	0.060	0.068	0.078	0.046	0.064	0.064	0.097	0.097	0.095	0.091	0.095	0.095	0.068	0.098

C/L : Calibration Cycle  
N/D : Not Detected, Less than 0.001 mg/m<sup>3</sup> or No Data

NBRO/ENV/15050/98/1205



ENVIRONMENTAL DIVISION  
NATIONAL BUILDING RESEARCH ORGANISATION

99/1, JAWATTA ROAD, COLOMBO-5.

Tel : 94-1-5889

Fax : 94-1-502611

e-mail : nabro@sl.lk

Date	Start Time	Vol. of Air Drawn (m <sup>3</sup> )	Run Time (hrs)	Concentration (mg/m <sup>3</sup> )
<b>Location : D</b>				
Friday, 12-06-98	4:00	551	8.01	0.081
Friday, 12-06-98	12:00	555	8.02	0.092
Friday, 12-06-98	20:00	558	8.09	0.093
Saturday, 13-06-98	4:15	573	8.32	0.095
Saturday, 13-06-98	12:45	551	7.96	0.098
Saturday, 13-06-98	20:45	554	8.01	0.094
<b>Location : C</b>				
Friday, 19-06-98	0:00	520	7.49	0.052
Friday, 19-06-98	8:00	562	8.07	0.096
Friday, 19-06-98	17:00	595	8.56	0.090
Saturday, 20-06-98	2:30	522	7.54	0.062
Saturday, 20-06-98	10:30	537	7.73	0.082
Saturday, 20-06-98	18:30	558	8.06	0.110
<b>Location : E</b>				
Sunday, 21-06-98	1:30	555	8.01	0.103
Sunday, 21-06-98	9:30	574	8.30	0.083
Sunday, 21-06-98	18:00	551	7.99	0.066
Tuesday, 23-06-98	1:30	580	8.34	0.073
Tuesday, 23-06-98	10:00	548	7.93	0.097
Tuesday, 23-06-98	18:00	554	8.03	0.109
<b>Location : B</b>				
Friday, 26-06-98	1:00	558	8.07	0.078
Friday, 26-06-98	9:15	555	7.98	0.077
Friday, 26-06-98	17:20	562	8.10	0.072
Saturday, 27-06-98	1:30	554	8.00	0.068
Saturday, 27-06-98	9:30	554	7.99	0.084
Saturday, 27-06-98	17:30	578	8.35	0.080

NBRO/ENV/15050/98/1205

Table 7

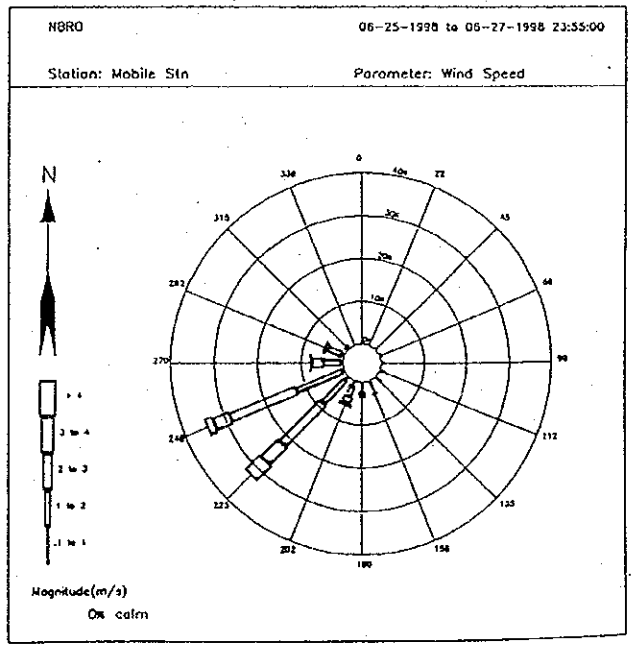
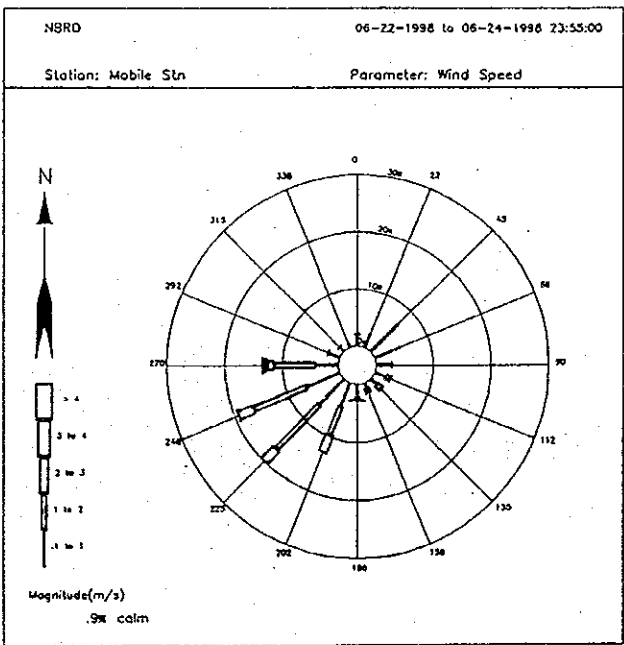
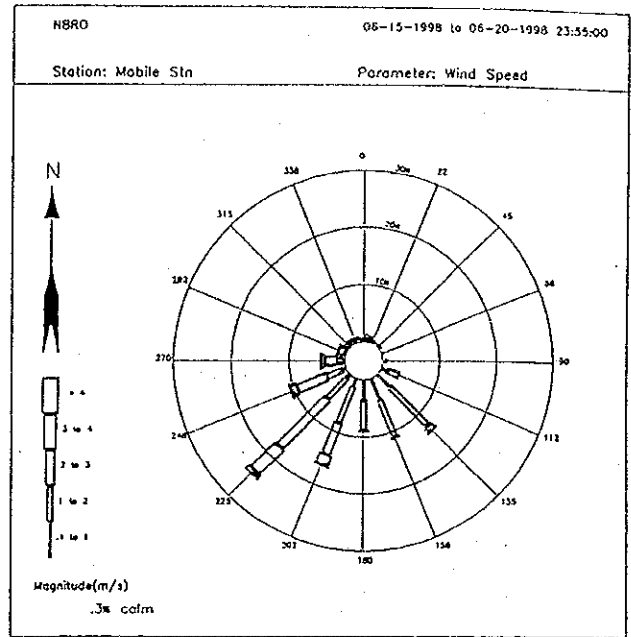
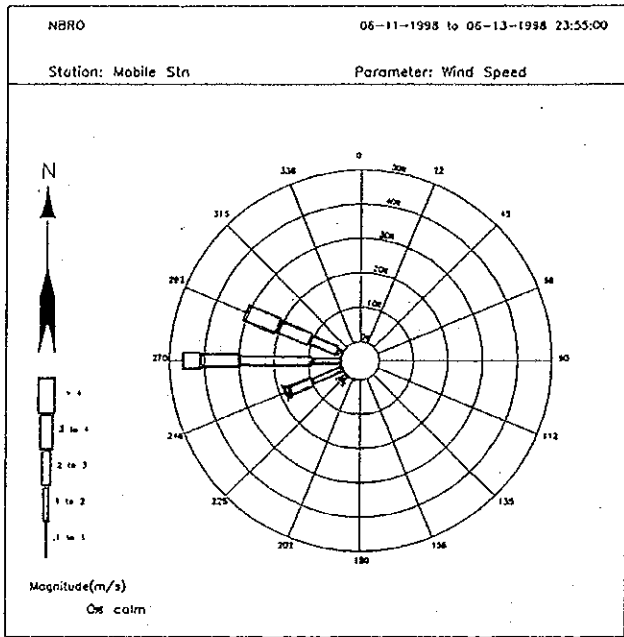
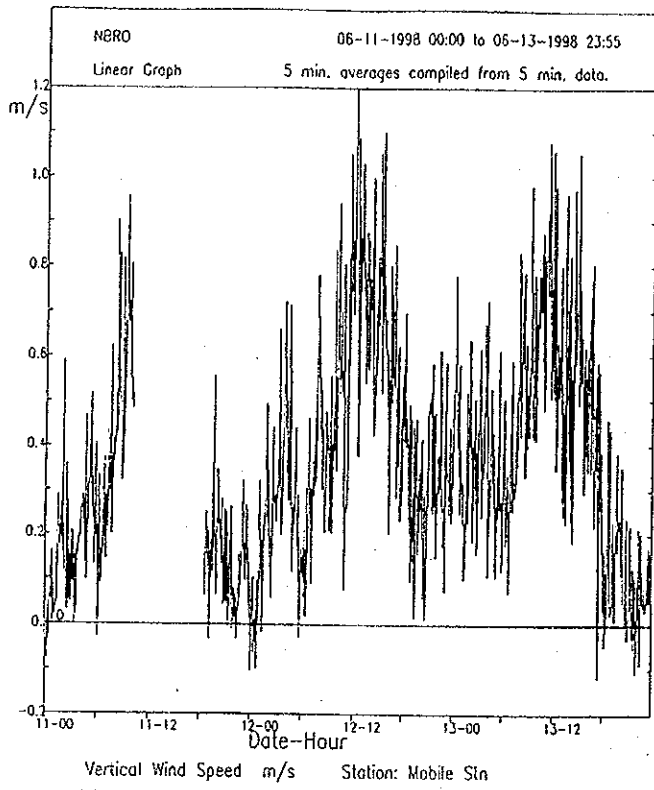
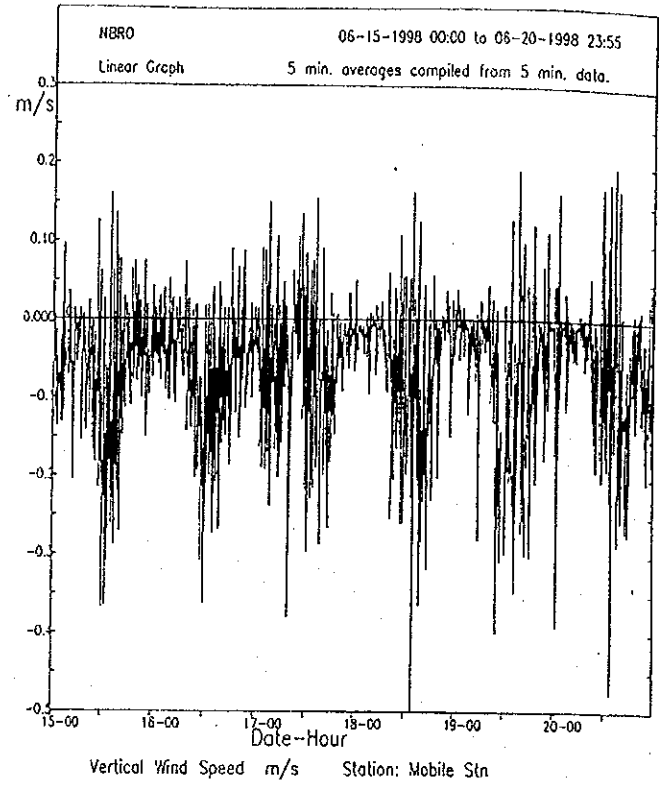


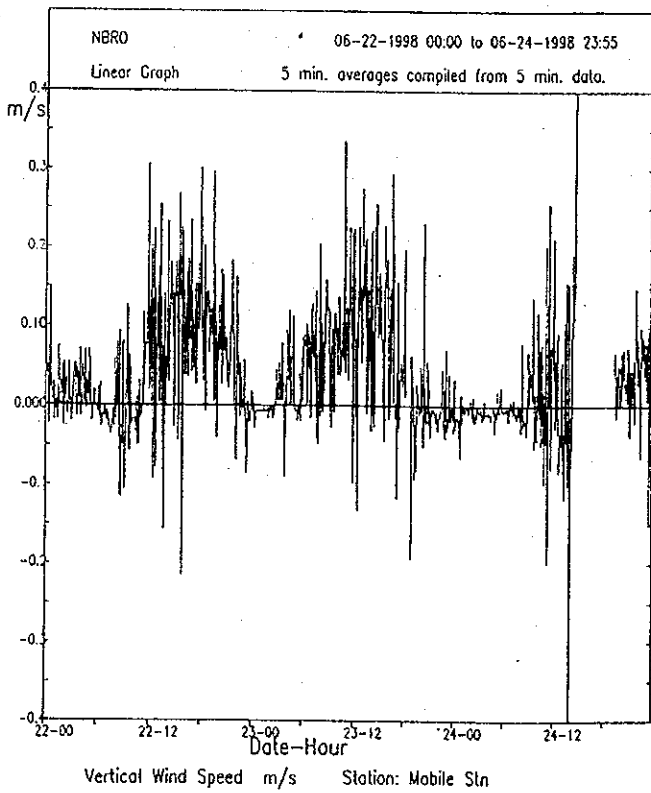
Fig.1



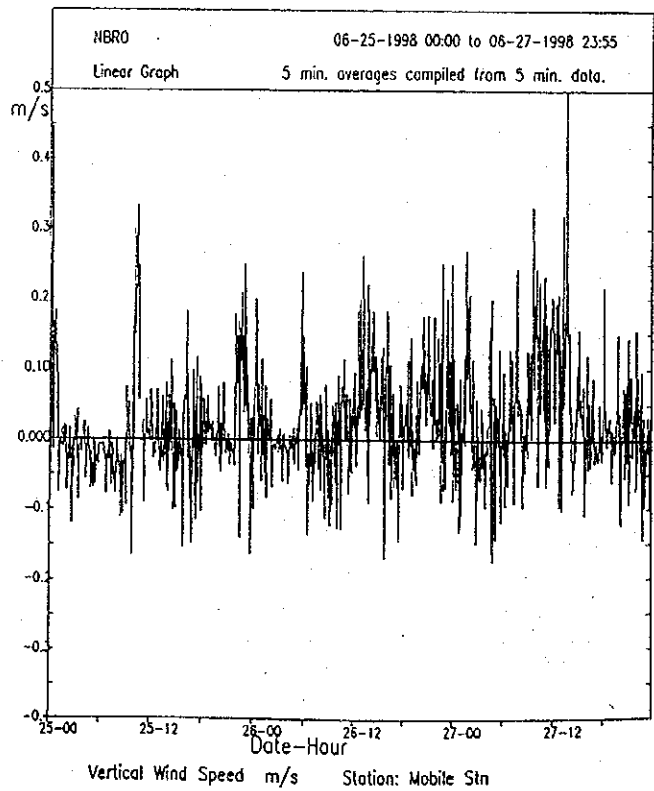
Location : D



Location : C

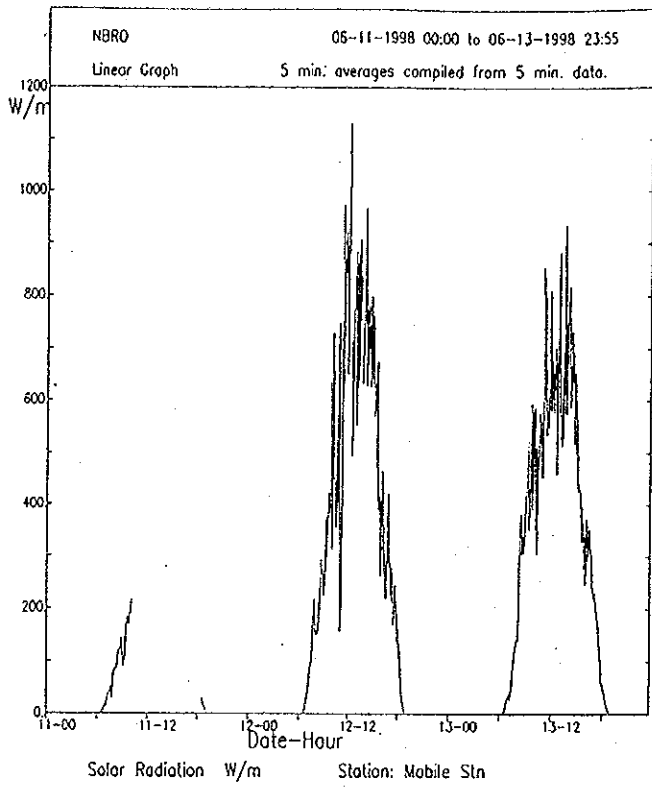


Location : E

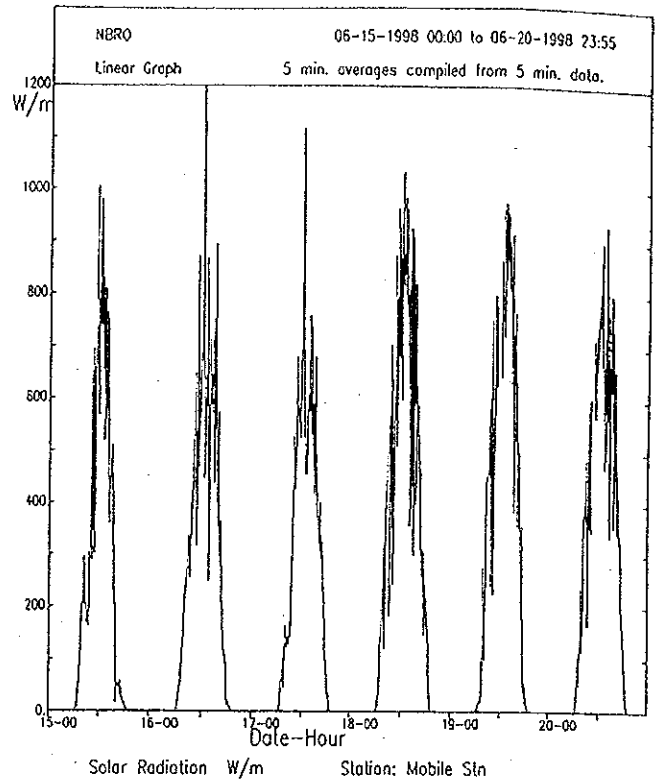


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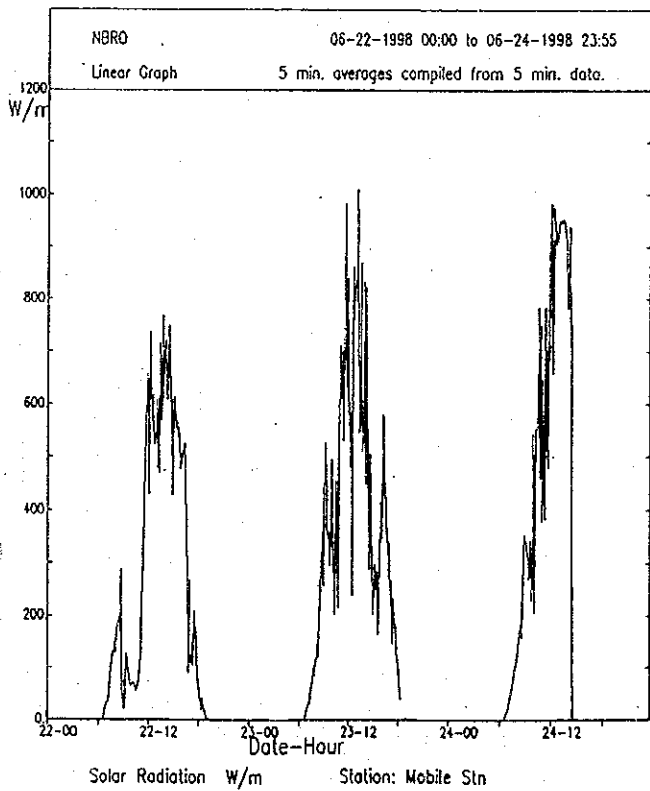
Fig. 2



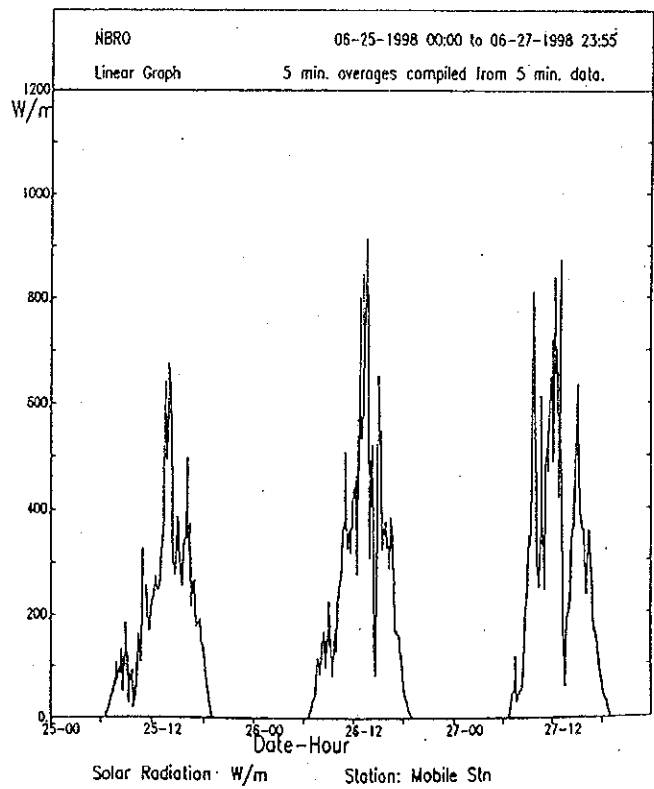
Location : D



Location : C

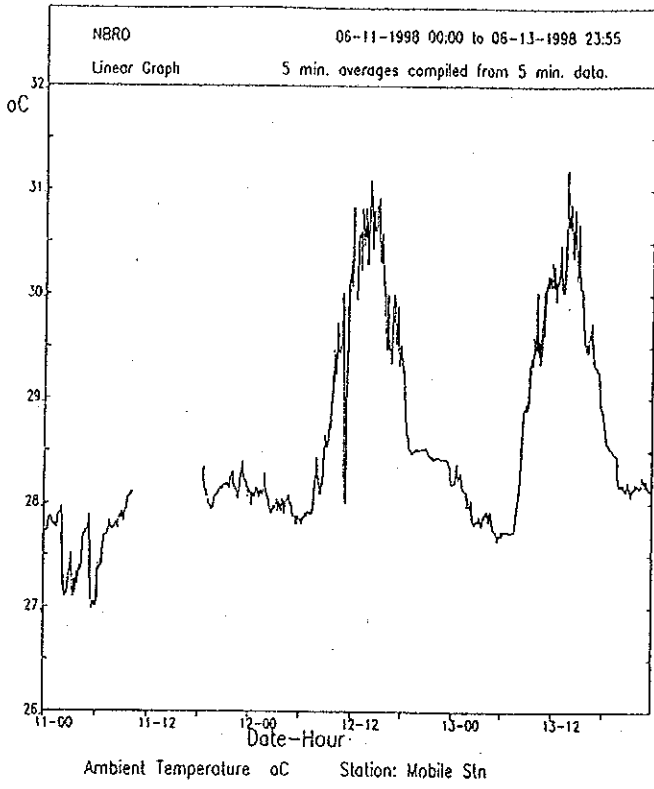


Location : E

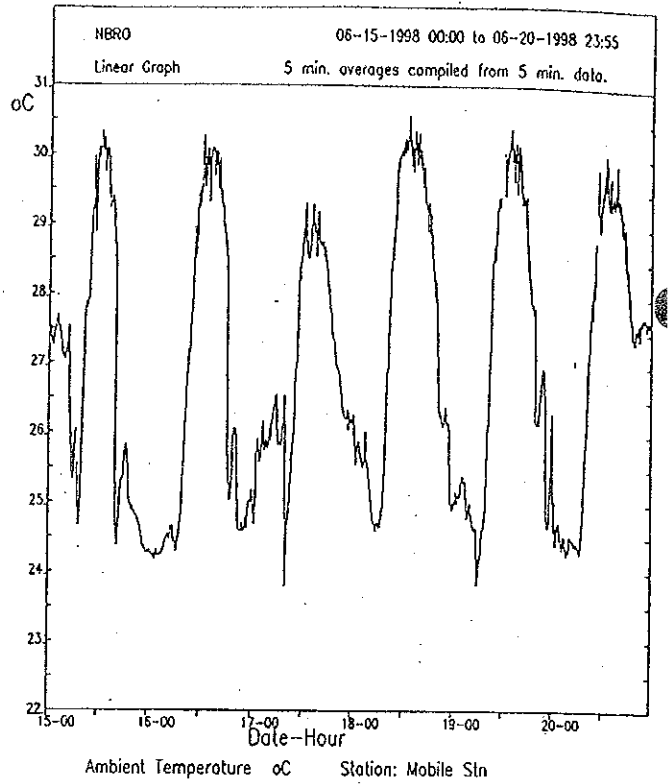


Location : B

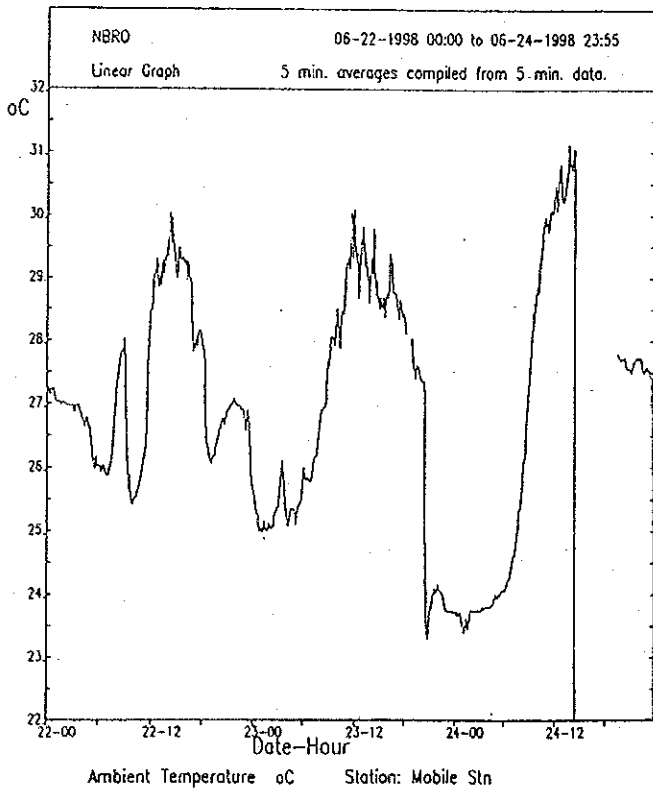
Fig.3



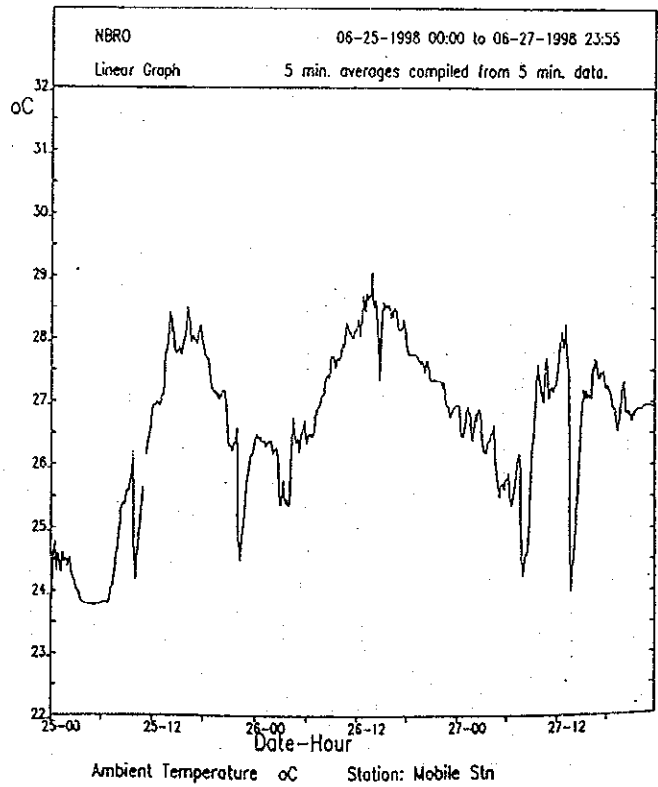
Location : D



Location : C

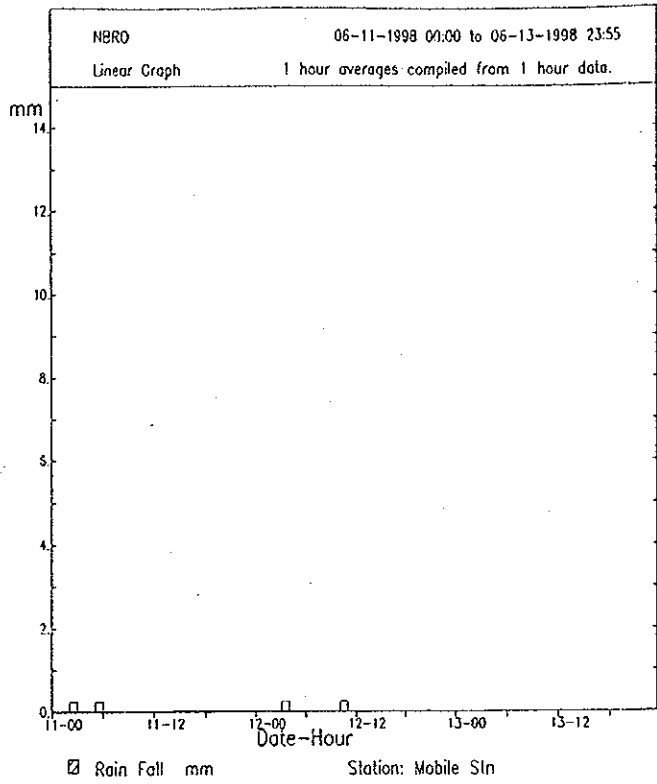


Location : E

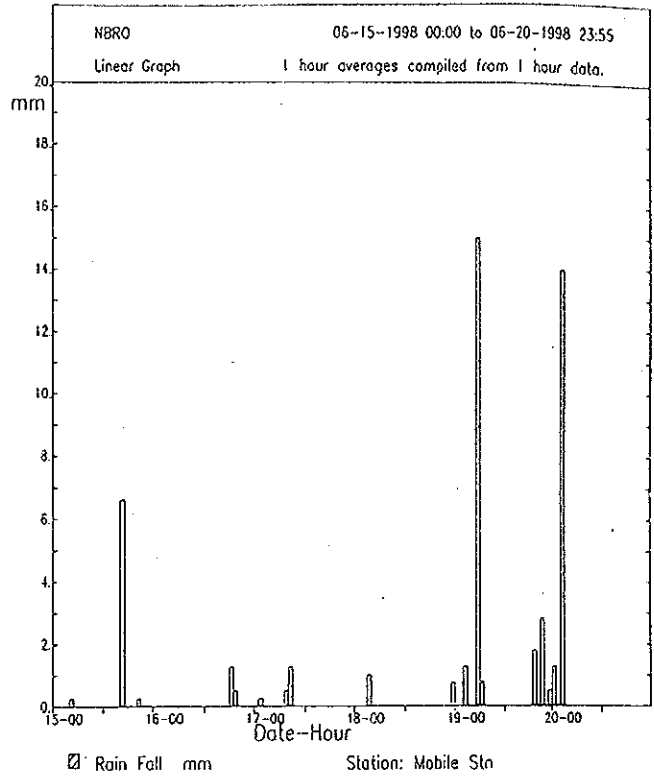


Location : B

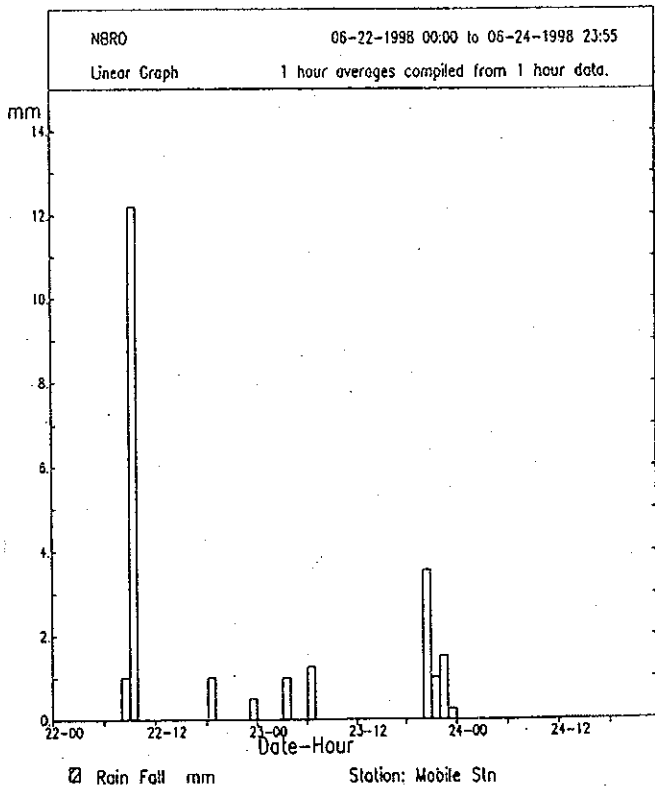
Fig. 4



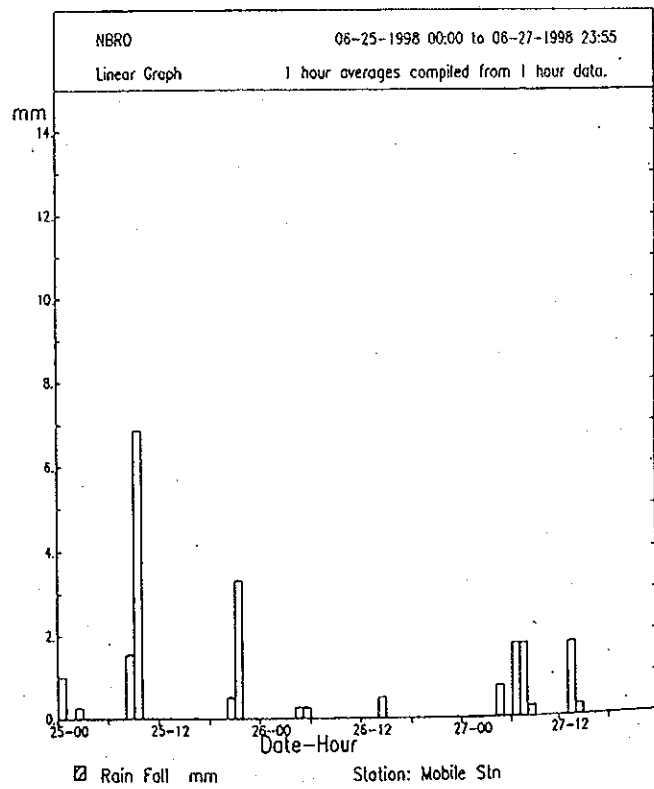
Location : D



Location : C



Location : E



Location : B

Fig.5

**ANNEX 8 Noise Level Measurement (NBRO)**



7

REPORT ON THE AMBIENT NOISE SURVEY  
FEASIBILITY STUDY ON COMBINED CYCLE POWER DEVELOPMENT  
PROJECT AT KERAWALAPITIYA  
SRI LANKA

REPORT No . NBRO/ENV/26101/98/201  
JOB NO. AQP/98/01

REPORT TO :  
MR. ZENIRO TSUTSUI  
PROJECT PLANNING & ENGINEERING DEPT.  
TOKYO ELECTRIC POWER SERVICES CO LTD  
3-3, HIGASHI-UENO 3-CHOME, TAITO-KU  
TOKYO 110, JAPAN

THIS REPORT CONTAINS FIVE PAGES

ENVIRONMENTAL DIVISION  
NATIONAL BUILDING RESEARCH ORGANISATION  
99/1, JAWATTA ROAD  
COLOMBO 05  
SRI LANKA

නිවාස හා නාගරික සංවර්ධන අමාත්‍යාංශය  
විද්‍යාලය, නගර අபිවිලුති අමාත්‍යාංශය  
MINISTRY OF HOUSING AND URBAN DEVELOPMENT



ජාතික ගොඩනැගිලි පර්යේෂණ සංවිධානය  
தேசிய கட்டிட ஆராய்ச்சி நிலையம்  
NATIONAL BUILDING RESEARCH ORGANISATION

99/1, ජාවත්ත පාර, කොළඹ - 5, ශ්‍රී ලංකාව, 99/1, ஜாவத்த வீதி, கொழும்பு - 5, இலங்கை. 99/1, JAWATTA ROAD, COLOMBO - 5, SRI L

අපේ අංකය  
எமது இல.  
OUR REF.

ඔබේ අංකය  
உமது இல.  
YOUR REF.

දුරකථන } 588946  
தொலைபேசி } 501834  
TELEPHONE } 503826  
500354  
Fax } 602611  
E-mail: nabro@sl.lk.

NBRO/ENV/26101/98/201  
AQP/98/01

June 23, 1998

CLIENT : Mr. Zeniro Tsutsui  
Project Planning & Engineering Dept.  
Tokyo Electric Power Services Co Ltd.  
3-3, Higashi-Ueno 3-chome, Taito-ku  
Tokyo 110, Japan.

REPORT ON MONITORING OF NOISE LEVELS FOR THE  
PROPOSED POWER PLANT AT KERAWALAPITIYA

1. SCOPE

The Client, Tokyo Electric Power Services Company Ltd., Japan requested the Environmental Division of NBRO to carry out a noise level survey in order to note current noise levels at the proposed 150 MW combine cycle power plant site at Kerawalapitiya.

2. NOISE LEVEL MEASUREMENTS :

As per the client's requirements, 4 points were selected around the boundary of the proposed site and the noise survey was carried out on 7<sup>th</sup> - 08<sup>th</sup> January 1998 to cover a week day and 07<sup>th</sup> - 08<sup>th</sup> June 1998 to cover a week-end at Kerawalapitiya. Each sampling point, 10 minutes continuous noise level measurement was carried out at every hour for 24 hrs as per the client's request.

Description of Locations (map is attached, herewith)

Location A : Middle of the Southern boundary of the site

Location B : Middle of the Western boundary of the site

Location C : Middle of the Northern boundary of the site

Location D : Middle of the Eastern boundary of the site

## 2.1. MEASURING INSTRUMENTS :

- Sound level meter : Cirrus CR:703 A
- Calibrator : Cirrus CR:513 A

The sound level meter conforms to the requirements of Type 1 of both IEC 651 and IEC 804.

## RESULTS

Table --: Noise Levels around the Site

\* Refer map for the identification of Locations

- Leq - The equivalent noise level generated during the sampling period.

Time : From 9.00 a.m on 7<sup>th</sup> January to 10.00 a.m on 8<sup>th</sup> January 1998.

Location (A)			Location (B)		
Start time (hrs.)	Leq dB(A)	Major contributor or to Leq	Start time (hrs.)	Leq dB(A)	Major contributor to Leq
09.00	41.4		09.15	51.7	Birds
10.00	38.4		10.15	41.0	
11.00	40.1		11.15	42.6	
12.00	44.2		12.15	43.0	
13.00	42.0		13.15	44.1	
14.00	44.1		14.15	40.0	
15.00	38.8		15.15	36.1	
16.00	41.6		16.15	42.4	
17.00	41.2		17.15	41.5	
18.00	43.3		18.15	40.2	
19.00	40.1		19.15	39.5	
20.00	38.8		20.15	38.0	
21.00	37.0		21.15	38.5	
22.00	39.5		22.15	40.0	
23.00	36.0		23.15	37.5	
24.00	40.2		24.15	37.7	
01.00	36.0		01.15	35.2	
02.00	33.7		02.15	36.3	
03.00	34.5		03.15	34.6	
04.00	33.6		04.15	34.9	
05.00	36.6		05.15	36.2	
06.00	40.6		06.15	38.6	
07.00	38.8		07.15	42.3	
08.00	40.6		08.15	47.6	
09.00	42.0		09.15	43.0	



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Location C

Start time (hrs.)	Leq dB(A)	Major contribut or to Leq
09.30	41.5	
10.30	38.8	
11.30	41.0	
12.30	44.1	
13.30	41.0	
14.30	39.5	
15.30	46.1	Airplane
16.30	44.8	
17.30	40.0	
18.30	42.6	
19.30	38.8	
20.30	39.5	
21.30	36.6	
22.30	37.0	
23.30	38.2	
24.30	40.3	
01.30	34.6	
02.30	36.4	
03.30	37.3	
04.30	41.5	
05.30	40.5	
06.30	42.2	
07.30	41.8	
08.30	42.0	
09.30	39.8	

Location D

Start time (hrs.)	Leq dB(A)	Major contribut or to Leq
09.45	39.4	
10.45	42.0	
11.45	41.0	
12.45	40.0	
13.45	42.0	
14.45	44.1	
15.45	47.4	Airplane
16.45	42.7	
17.45	41.5	
18.45	36.6	
19.45	39.4	
20.45	37.0	
21.45	36.0	
22.45	39.5	
23.45	36.6	
24.45	34.1	
01.45	36.0	
02.45	35.2	
03.45	36.7	
04.45	40.0	
05.45	67.1	Airplane
06.45	40.5	
07.45	42.2	
08.45	41.0	
09.45	40.5	

*Al.*

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 AQP/98/01

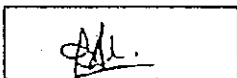
Time : From 9.00 a.m on 6<sup>th</sup> June to 10.00 a.m on 7<sup>th</sup> June 1998.

Location (A)

Start time (hrs.)	Leq dB(A)	Major contributor to Leq
09.00	40.0	
10.00	39.7	
11.00	44.1	
12.00	40.3	
13.00	41.7	
14.00	44.9	
15.00	46.3	Birds
16.00	47.6	Birds
17.00	44.0	
18.00	44.2	
19.00	41.5	
20.00	46.8	Factory
21.00	51.6	Factory
22.00	52.7	Factory
23.00	51.3	Factory
24.00	46.2	Factory
01.00	40.2	
02.00	41.2	
03.00	55.8	Dogs
04.00	38.7	
05.00	70.6	Airplane
06.00	46.4	
07.00	46.3	
08.00	44.2	
09.00	42.5	

Location (B)

Start time (hrs.)	Leq dB(A)	Major contributor to Leq
09.15	48.1	
10.15	46.2	Birds
11.15	42.5	
12.15	43.0	
13.15	45.3	
14.15	44.8	
15.15	46.0	
16.15	42.4	
17.15	44.4	
18.15	45.8	
19.15	45.7	Factory
20.15	50.5	Factory
21.15	48.9	Factory
22.15	51.6	Factory
23.15	41.3	Factory
24.15	52.5	Factory
01.15	38.4	
02.15	35.7	
03.15	56.0	Dogs
04.15	39.8	
05.15	57.2	Dogs
06.15	56.3	Dogs
07.15	48.5	
08.15	44.3	
09.15	45.1	



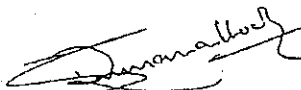
NBRO/ENV/26101/98/201  
AQP/98/01

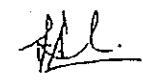
Location C

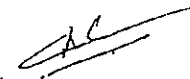
Start time (hrs.)	Leq dB(A)	Major contributor to Leq
09.30	41.5	
10.30	42.3	
11.30	38.6	
12.30	37.9	
13.30	47.5	
14.30	45.7	
15.30	53.9	People
16.30	41.6	
17.30	45.8	
18.30	42.0	
19.30	39.5	
20.30	46.0	
21.30	37.0	
22.30	45.6	
23.30	39.5	
00.30	43.6	
01.30	47.2	Dogs
02.30	45.7	
03.30	59.4	Airplane
04.30	40.5	
05.30	67.1	Airplane
06.30	41.8	
07.30	42.0	
08.30	41.5	
09.30	44.0	

Location D

Start time (hrs.)	Leq dB(A)	Major contributor to Leq
09.45	39.7	
10.45	39.8	
11.45	44.6	
12.45	51.7	Airplane
13.45	43.7	
14.45	44.1	
15.45	47.0	
16.45	43.9	
17.45	42.9	
18.45	39.9	
19.45	48.9	
20.45	46.1	
21.45	39.5	
22.45	49.6	Dogs
23.45	38.7	
00.45	36.6	
01.45	51.8	Dogs
02.45	46.8	
03.45	41.0	
04.45	46.7	Dogs
05.45	56.9	Airplane
06.45	41.4	
07.45	42.0	
08.45	42.5	
09.45	44.2	

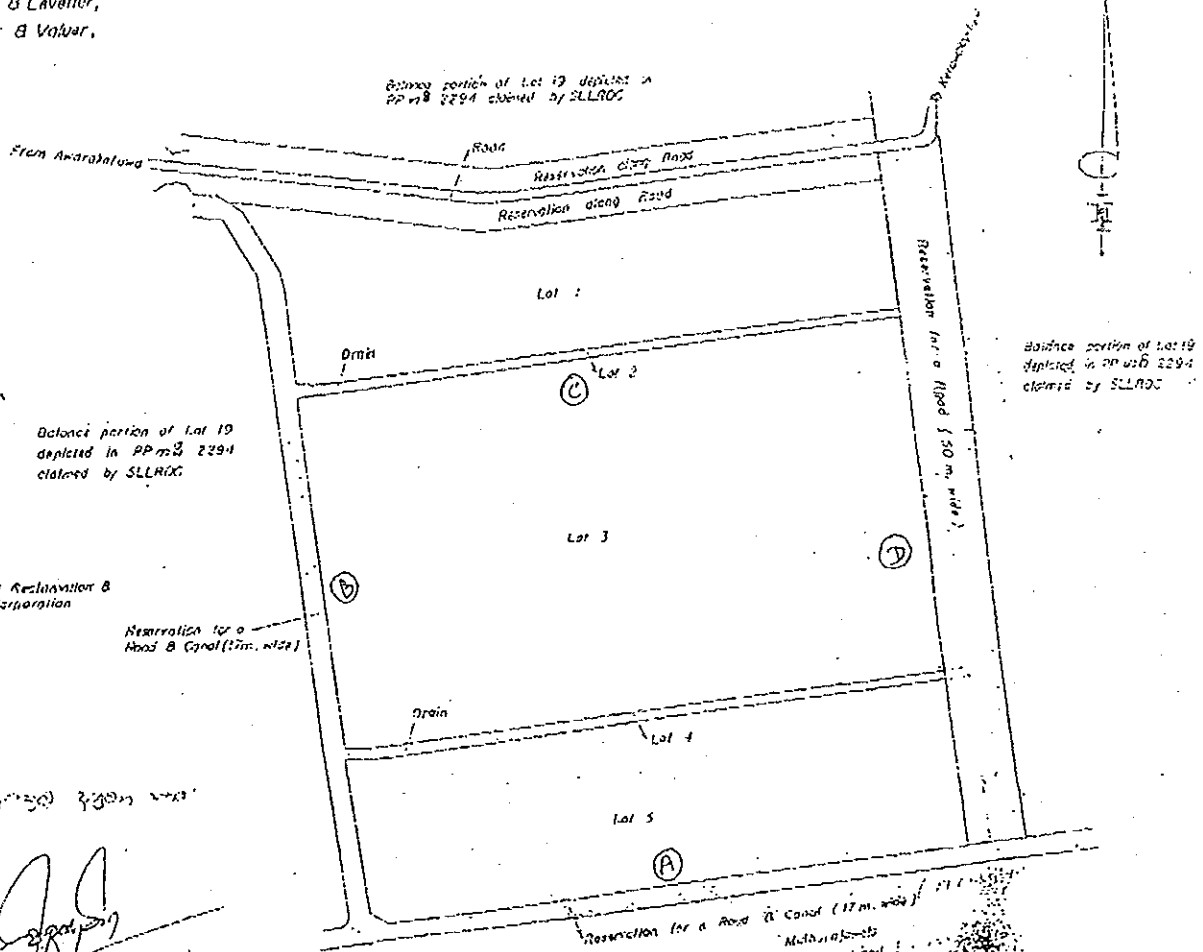
  
Coordinator/Air Quality

  
Scientist/Air Quality

  
Head/Environmental Division  
National Building Research Organisation  
HEAD/ENVIRONMENTAL DIVISION  
National Building Research Organisation  
99/1, Jawatta Road  
COLOMBO-5,

L. P. A. Shunika Perera, M.S.I.  
 Licensed Surveyor & Valuer,  
 Court Commissioner & Valuer,  
 351, Wulkole,  
 Rajagiriya.  
 Tel. 862438

PLAN No. 92/SLLRDC



Balance portion of Lot 19 depicted in P.P. No. 2294 claimed by SLLRDC

Balance portion of Lot 19 depicted in P.P. No. 2294 claimed by SLLRDC

Agency  
 SLLRDC - Sri Lanka Land Reclamation & Development Corporation

Reservation for a Road & Canal (17 m. wide)

Reservation for a Road & Canal (17 m. wide)  
 Mutually-occupied Land claimed not known

*[Signature]*  
 16-09-06

Scale 1 = 1 : 4000

**PLAN**

of five (05) allotments of land marked lot 1-5 (being a portion of Lot 2 depicted in my Plan No. 75/SLLRDC and originally being a portion of Lot 19 depicted in Plan No. P.P. No. 2294 authenticated by Surveyor General) of the land called Mutturajawala situated at Malagoda Village in Ragam Pattu of Ath Kurumale GAMPAHA DISTRICT WESTERN PROVINCE

## **ANNEX 9 Flora and Fauna Profile**



TABLE A9.1 PROFILES OF VEGETATION ALONG THE DUTCH CANAL, DRAINAGE CHANNELS AND IRRIGATION CHANNELS AT MUTHURAJAWELA

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>Acrosticum aurium</i> l.	Karan Koku		
<i>Annona glabra</i> l.	Wel atha		
<i>Bruguiera sexangula</i> (lour) poir.			
<i>Calapogonium</i> sp.			
<i>Calophyllum</i> l.	Domba		
<i>Carex indica</i> l.			
<i>Cerbera manghas</i> l.	Kaduru, Gon Kaduru		
<i>Commelina diffusa</i> burm f.	Gira Pola		
<i>Cyperus spiralis</i> (Rottab.) Roem & Shult			
<i>Dolichandrone spathesia</i> (L.F.) K. Shum			
<i>Eleocharis geniculata</i> (L.) Roem & Shult			
<i>Eupatorium odoratum</i> l.			
<i>Fimbristylis consanguinea</i> kunth			
<i>Hanguana malayana</i> (Jack) merr.			
<i>Ischaemum rugosum</i> salisb	Kudu Kedu		
<i>Jussiaea repens</i> l.			
<i>Lygodium microphyllum</i> (cavi.) R.BR	Pumba		
<i>Mikania scandens</i> l. willd			
<i>Osbeckia aspera</i> (L.) Blume	Bowitiya		
<i>Pandanus odoratissimus</i> LF.	Watakeiya		
<i>Nymphaea stellata</i> willd (Blue)	Kumudu, Manel Nilupul (Blue)		
<i>Nymphaea stellata</i> willd (White)	Kumudu, Manel Nilupul (White)		
<i>Pandanus odoratissimus</i> lf.			
<i>Panicum repens</i> l.	Atora		
<i>Paspalum vaginatum</i> sw.	Lunu Atora		
<i>Phragmites karka</i> (Retz.) Trin exsteud	Nala gas Wal-Uk		
<i>Salvinia molesta</i> d.s. mitchell	Salvinia		
<i>Schoenoplectus grossus</i> (L.F.) Palla			
<i>Syzygium caryophyllatum</i> (L.) alston	Heen dan Dan		
<i>Typha angustifolia</i> l.	Hombupon		

\* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown  
\*\* END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance

Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.2 PHYTOPLANKTON SPECIES RECORDED FROM THE MUTHURAJAWELA

SCIENTIFIC NAME	STATUS*	REMARKS**
BLUE GREEN ALGAE		
<i>Anabaena sp.</i>		
<i>Chroococcus sp.</i>		
<i>Lyngbya sp.</i>		
<i>Merismopedia sp.</i>		
<i>Microcystis sp.</i>		
<i>Oscillatoria sp.</i>		
<i>Rivularia sp.</i>		
BLUE ALGAE		
<i>Chlorella sp.</i>		
<i>Chladophora sp.</i>		
<i>Closterium sp.</i>		
<i>Cosmerium sp.</i>		
<i>Mougeotia sp.</i>		
<i>Pediastrum sp.</i>		
<i>Scenedesmus sp.</i>		
<i>Spirogyra sp.</i>		
<i>Volvox sp.</i>		
DIATOMS		
<i>Amphora sp.</i>		
<i>Achnanthes sp.</i>		
<i>Biddulphia sp.</i>		
<i>Campylosira sp.</i>		
<i>Coscinodiscus sp.</i>		
<i>Cyclotella sp.</i>		
<i>Cymbella sp.</i>		
<i>Diatoma sp.</i>		
<i>Diploneis sp.</i>		
<i>Granatophora sp.</i>		
<i>Licnophora sp.</i>		
<i>Melosida sp.</i>		
<i>Navicula sp.</i>		
<i>Nitzschia sp.</i>		
<i>Pinnularia sp.</i>		
<i>Pleurosigma sp.</i>		
<i>Prorocentrum sp.</i>		
<i>Surirella sp.</i>		
<i>Tabellaria sp.</i>		
DINOFLAGELLATES		
<i>Ceratium sp.</i>		
<i>Gymnodinium sp.</i>		
<i>Peridinium sp.</i>		
* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown		
** END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance		

Source ; "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)

**TABLE A9.3 AQUATIC MACROPHYTES RECORDED FROM THE MUTHURAJAWELA**

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>Salvinia molesta</i>	Ferns		
<i>Eichhornia crassipes</i>	Water hyacinth		
<i>Lemna sp.</i>	Duckweed		
<i>Phragmites karka</i>	Reeds		
<i>Typha angustifolia</i>	Cattails		
<i>Hydrilla verticillata</i>	Hydrilla		
<i>Aponogeton crispus</i>	Kekatiya		
<i>Nymphaea stellata</i>	Manel		
* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown			
** END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance			

Source ; "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)

**TABLE A9.4 MARSH VEGETATION RECORDED FROM THE MUTHURAJAWELA**

SCIENTIFIC NAME	STATUS*	REMARKS**
<i>Acrosticum aurium</i>		
<i>Annona glabra</i>		
<i>Carex indica</i>		
<i>Cyclosorus sp.</i>		
<i>Cyperus spiralis</i>		
<i>Eleocharis geniculata</i>		
<i>Fimbristylis sp.</i>		
<i>Fimbristylis sanguinea</i>		
<i>Flagellaria indica</i>		
<i>Fuirena umbellata</i>		
<i>Hydrocera triflora</i>		
<i>Isachne globosa</i>		
<i>Ischaemum rugosum</i>		
<i>Lepironia articulata</i>		
<i>Lygodium micophyllum</i>		
<i>Panicum repens</i>		
<i>Paspalum vaginatus</i>		
<i>Phragmites karka</i>		
<i>Polygonum barbatum</i>		
<i>Schoenoplectus grossus</i>		
<i>Typha angustifolia</i>		
* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown		
** END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance		

Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.5 (1) SHRUB, HERB AND CLIMBING SPECIES RECORDED TO BE PRESENT ALONG THE TRANSMISSION LINE

SCIENTIFIC NAME	REMARKS*
<i>Acrosticum aurium</i>	
<i>Alternanthera sessilis</i>	
<i>Annona glabra</i>	
<i>Antidesma ghaesembilla</i>	
<i>Ardisia willisii</i>	END
<i>Asparagus falcata</i>	
<i>Asteracantha longifolia</i>	
<i>Bacopa monnieri</i>	
<i>Calamus sp.</i>	
<i>Centella asiatica</i>	
<i>Carex indica</i>	
<i>Cassia alata</i>	
<i>Cassia tora</i>	
<i>Ceratopteris sp.</i>	
<i>Cinamomum verum</i>	
<i>Coffea arabica</i>	
<i>Coix sp.</i>	
<i>Commelina diffusa</i>	
<i>Crinum sp.</i>	
<i>Cuscuta chinensis</i>	
<i>Cyperus pilosus</i>	
<i>Cyperus spiralis</i>	
<i>Derris uliginosa</i>	
<i>Dolichandrone spathesia</i>	
<i>Eclipta prostrata</i>	
<i>Eleocharis geniculata</i>	
<i>Eleocharis dulcis</i>	
<i>Eleocharis lankana</i>	END
<i>Ericaulon thwaitzii</i>	
<i>Ericaulon sp.</i>	
<i>Eupatorium odoratum</i>	
<i>Fimbristylis consanguinea</i>	
<i>Fimbristylis Zeylanica</i>	END
<i>Flagellaria indica</i>	
<i>Fuirena sp.</i>	
<i>Hanguana malayana</i>	
<i>Hygrophila spinosa</i>	
<i>Hyptis capitata</i>	
<i>Impatiens sp.</i>	
<i>Ipomoea aquatica</i>	
<i>Ipomoea triloba</i>	
<i>Isachne globosa</i>	
<i>Ischaemum rugosum</i>	
<i>Ixora coccinea</i>	
<i>Loranthus sp.</i>	
<i>Ludwigia decurrens</i>	
<i>Ludwigia peruviana</i>	
<i>Laginandra thwaitzii</i>	
<i>Lantana camera</i>	
<i>Lepironia articulata</i>	
<i>Limnophila repens</i>	
<i>Lygodium microphyllum</i>	
* END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance	

Source ; Survey record by a local consultant

TABLE A9.5 (2) SHRUB, HERB AND CLIMBING SPECIES RECORDED TO BE PRESENT ALONG THE TRANSMISSION LINE

SCIENTIFIC NAME	REMARKS*
<i>Lucas Zeylanica</i>	
<i>Marsilea quadrifolia</i>	
<i>Memecylon umbellatum</i>	
<i>Microcos paniculata</i>	
<i>Mikania scandens</i>	
<i>Mollugo oppositifolia</i>	
<i>Osbeckia aspara</i>	
<i>Pagiantha dichotoma</i>	
<i>Pandanus odoratissimus</i>	
<i>Panicum repens</i>	
<i>Paspalum vaginatum</i>	
<i>Pavetta indica</i>	
<i>Phragmites karka</i>	
<i>Phyllanthus debilis</i>	
<i>Polygonum barbatum</i>	
<i>Pothos scandens</i>	
<i>Premna sp.</i>	
<i>Punica granatum</i>	
<i>Scaviola sp.</i>	
<i>Schoenoplectus grossus</i>	
<i>Scoparia dulcis</i>	
<i>Selaginella sp.</i>	
<i>Sphaeranthus indicus</i>	
<i>Syzigium caryophyllatum</i>	
<i>Typha angustifolia</i>	
<i>Utricularia sp.</i>	
<i>Walidda antidysenterica</i>	END
<i>Xyris indica</i>	
<i>Zizyphus oenoptia</i>	
* END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance	

Source ; Survey record by a local consultant

TABLE A9.6 STATUS OF MAMMALS RECORDED FROM MUTHURAJAWELA

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>Suncus murinus murinus</i>	musk shrew	VC	
<i>S. murinus caerulescens</i>	musk shrew	C	
<i>Peropus g. giganteus</i>	fruit bat	VC	
<i>Rousettus seminudus</i>	fruit bat	VC	END
<i>Rhinolopus r. rouxi</i>	bat	C	
<i>Hipposiderous l. lankadiva</i>	bat	C	
<i>H. galeritus brachyonus</i>	bat	SU	
<i>H. bicolor ater</i>	bat	SU	
<i>Megaderma lyra lyra</i>	bat	C	
<i>Pipistrellus m. mimus</i>	bat	C	
<i>Scotophilus heathi heathi</i>	bat	SU	
<i>Kerivoula picta picta</i>	painted bat	R	THR
<i>Taphozous saccolaimus erassus</i>		C	
<i>Loris tardigradus tardigradus</i>	slender loris	R	THR/PRO
<i>Macaca sinica sinica</i>	toque macaque	VC	END
<i>Lepus nigricollis singhala</i>	black-naped hare	C	
<i>Funambulus palmarum favonicus</i>	Indian palm squirrel	VC	
<i>Hystrix indica</i>	Indian crested porcupine	C	
<i>Bandicota indica indica</i>	larger bandicoot rat	VC	
<i>Mus musculus castaneus</i>	house mouse	C	
<i>M. cervicolor fulvidiventris</i>	fawn coloured mouse	VC	
<i>Rattus rattus rattus</i>	common rat	VC	
<i>R. rattus alexandrinus</i>	browan rat	SU	
<i>R. rattus kandianus</i>	brown rat	C	
<i>R. norvegicus</i>	brown rat	SU	
<i>Lutra lutra nair</i>	Ceylon otter	C	THR
<i>Canis aureus lanka</i>	Asiatic jackal	R	
<i>Viverricula indica mayori</i>	larger Indian civet	R	
<i>Paradoxurus hermaphroditicus</i>	palm civet	C	
<i>Herpestes fuscus rubidior</i>	brown mongoose	C	
<i>H. smithi zeylanicus</i>	ruddy mongoose	C	
<i>Felis (Zibethailurus) viverrina</i>	fishing cat	R	THR/PRO
<i>F. (Prionailurus) rubiginosa</i>	rusty spotted cat	VR	THR/PRO
<i>Tragulus meminna</i>	mouse-deer	R	THR

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Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.7 (1) STATUS OF RESIDENT BIRDS RECORDED FROM MUTHURAJAWELA

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>Podiceps ruficollis capensis</i>	Little Grebe		B
<i>Phalacrocorax fuscicollis</i>	Indian Shag		B
<i>P. niger</i>	Little Cormorant		B
<i>Ardea cineræ rectirostris</i>	Grey Heron		
<i>A. purpurea manilensis</i>	Purple Heron		B
<i>Butorides striatus javanicus</i>	Little Green Heron		B
<i>Ardeola grayii grayii</i>	Pond Heron		B
<i>Bubulcus ibis coromandus</i>	Cattle Egret		
<i>Egretta alba modesta</i>	Large Egret		B
<i>E. intermedia intermedia</i>	Median Egret		B
<i>E. garzetta garzetta</i>	Little Egret		B
<i>E. gularis schistacea</i>	Reef Heron		THR
<i>Nycticorax nycticorax nycticorax</i>	Night Heron		B
<i>Ixobrychus cinnamomeus</i>	Chestnut Bittern		
<i>I. sinensis</i>	Yellow Bittern		B
<i>Dupetor flavicollis flavicollis</i>	Black Bittern		
<i>Ibis leucocephalus</i>	Painted Stork		
<i>Anastomus oscitans</i>	Open-bill Stork		
<i>Threshkiornis melanocephala</i>	White Ibis		
<i>Dendrocygna javanica</i>	Whistling Teal		
<i>Haliastur indus indus</i>	Brahminy Kite		
<i>Accipiter badius badius</i>	Shikra		
<i>Ichthyophaga ichthyaeus plumbeiceps</i>	Grey-headed Fishing Eagle		THR
<i>Coturnix chinensis chinensis</i>	Blue-breasted Quail		
<i>Rallus striatus albiventer</i>	Blue-breasted Banded Quail		THR
<i>Amaurornis fuscus zeylonicus</i>	Ruddy Crane		
<i>A. phoenicurus phoenicurus</i>	White-breasted Waterhen		B
<i>Gallinix cinera cinera</i>	Kora		
<i>Gallinula chloropus indica</i>	Indian Moorhen		B
<i>Porphyrio porphyrio poliocephalus</i>	Purple Coot		B
<i>Hydrophasianus chirurgus</i>	Pheasant-tailed Jacana		
<i>Vanellus indicus lankae</i>	Red-wattled Lapwing		B
<i>Rostranula bengalensis bengalensis</i>	Painted Snipe		
<i>Himantopus himantopus ceylonensis</i>	Black-winged Stilt		
<i>Sterna albifrons</i>	Lesser Tern		
<i>S. bergii velox</i>	Swift Tern		
<i>Streptopelia ceylonensis</i>	Spotted Dove		
<i>Psittacula krameri manillensis</i>	Rose-ringed Parakeet		
<i>Clamator jacobinus jacobinus</i>	Pied Crested Cuckoo		
<i>Eudynamis scolopacea scolopacea</i>	Koel		
<i>Centropus sinensis parroti</i>	Common Coucal		
<i>Otus bakkamoena bakkamoena</i>	Collared Scops Owl		
<i>Bubo zeylonensis zeylonensis</i>	Brown Fish Owl		
<i>Ninox scutulata hirsuta</i>	Brown Hawk Owl		
<i>Apus melba pakeri</i>	White-bellied Swift		
<i>Cypsiurus parvus batasiensis</i>	Palm Swift		
<i>Ceryle rudis leucomelanura</i>	Pied Kingfisher		
<i>Alcedo athis taprobana</i>	Common Kingfisher		
<i>Pelargopsis capensis capensis</i>	Stork-billed Kingfisher		
<i>Halcyon smyrensis fusca</i>	White-breasted Kingfisher		

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Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.7 (2) STATUS OF RESIDENT BIRDS RECORDED FROM MUTHURAJAWELA

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>H. pileata</i>	Black-capped Kingfisher		THR
<i>Coracias bengalensis indica</i>	Indian Roller		
<i>Megalaima zeylanica zeylanica</i>	Brown-headed Barbet		
<i>M. rubricapilla rubricapilla</i>	Small Barbet		
<i>Dinopium benghalense psarodes</i>	Red-becked Woodpecker		
<i>Hirundo daurica hyperythra</i>	Sri Lanka Swallow		
<i>Oriolus xanthornus ceylonensis</i>	Black-headed Oriole		
<i>Dicrurus caeruleus leucopygialis</i>	White-vented Drongo		
<i>Artamus fuscus</i>	Ashy Swallow Shrike		
<i>Acridotheres tristis melanosternus</i>	Common Mynah		
<i>Corvus splendens protegatus</i>	House Crow		
<i>C. macrorhynchos culminatus</i>	Black Crow		
<i>Coracina melanoptera sykesi</i>	Black-headed Cuckoo Shrike		
<i>Pericrocotus c. cinnamomeus</i>	Little Minivet		
<i>Aegithina tiphia multicolor</i>	Common Iora		
<i>Pycnonotus cafer haemorrhousus</i>	Red-vented Bulbul		
<i>P. luteolus insulae</i>	White-browed Bulbul		
<i>Turdoides affinis taprobanus</i>	Common Babbler		
<i>Terpsiphone paradisi ceylonensis</i>	Ceylon Paradise Flycatcher		
<i>Cisticola juncidis omalura</i>	Fantail Warbler		
<i>Prinia subflava insularis</i>	Plain Prinia		
<i>P. sylvatica valida</i>	Large Prinia		
<i>Orthotomus sutorius sutorius</i>	Tailor Bird		
<i>Acrocephalus stentoreus</i>	Great Red Warbler		
<i>Copsychus saularis ceylonensis</i>	Maggie Robin		
<i>Saxicoloides fulicata leucoptera</i>	Black Robin		
<i>Parus major maharattarum</i>	Grey Tit		
<i>Anthus novaseelandiae malayensis</i>	Indian Pipit		
<i>Dicaeum erythrorhynchos ceylonense</i>	Tickell's Flowerpecker		
<i>Nectarinia zeylonica zeylonica</i>	Purple-rumped Sunbird		
<i>N. lotenia lotenia</i>	Loten's Sunbird		
<i>Passer domesticus indicus</i>	House Sparrow		
<i>Lonchura striata striata</i>	White-backed Munia		
<i>L. punctulata punctulata</i>	Spotted Munia		
<i>L. malacca malacca</i>	Black-headed Munia		

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Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)



TABLE A9.8 MIGRATORY BIRDS RECORDED FROM MUTHURAJAWELA

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>Phalacrocorax carbo sinensis</i>	Indian Cormorant		THR
<i>Ardea goliath</i>	Goliath Heron		SU
<i>Gorsachius m. melanolophus</i>	Mallay Bittern		
<i>Anas acuta</i>	Pintail		
<i>A. querquedula</i>	Gargany		
<i>Circus macrourus</i>	Pale Harrier		
<i>C. aeruginosus aeruginosus</i>	Marsh Harrier		
<i>Heiraetus pennantus</i>	Booted Eagle		
<i>Rallus eurizonoides amauroptera</i>	Banded Crake		
<i>Pluvialis aquatarola</i>	Grey Plover		
<i>P. Dominica fulva</i>	Eastern Golden Plover		
<i>Charadrius mongolus atrifrons</i>	Lesser Sandplover		
<i>C. leschenaulti</i>	Llarge Sandplover		
<i>Nunenius phaeopus phaeopus</i>	Whimbrel		
<i>Tringa totanus eurithinus</i>	Redshank		
<i>T. nebularia</i>	Greenshank		
<i>T. glareola</i>	Wood Sandpiper		
<i>T. stagnatilis</i>	Marsh Sandpiper		
<i>T. hypoleucos hypoleucos</i>	Common sandpiper		
<i>Capella stenura</i>	Pintail Snipe		
<i>Calidris feruginea</i>	Curlew Sandpiper		
<i>Larus fuscus</i>	Lesser Black-backed Gull		
<i>L. brunicephalus</i>	Brown-headed Gull		
<i>Chlidonias hybrida indica</i>	Indian Whiskered Tern		
<i>Gelochilidon nilotica nilotica</i>	Gull-billed Tern		
<i>Hydroprogne caspia caspia</i>	Caspian Tern		
<i>Sterna hirundo tibetana</i>	Common Tern		THR
<i>S. bengalensis</i>	Lesser Crested Tern		
<i>S. repressa</i>	White-checked Tern		SU
<i>S. sandvicensis</i>	Sandwich Tern		
<i>Merops philippinus philippinus</i>	Bleu-tailed Bee-eater		
<i>Pitta brachyura brachyura</i>	Indian Pitta		
<i>Hirundo rustica gutturalis</i>	Eastern Swallow		
<i>Lanius cristatus cristatus</i>	Brown Shrike		
<i>Mascicapa latirostris</i>	Brown Flycatcher		
<i>Terpsiphone paradisi paradisi</i>	Paradise Flycatcher		
<i>Acrocephalus dumetorum</i>	Blyth's Reed Warbler		
<i>Anthus novaeseelandiae richardi</i>	Richard's Pipit		
<i>Motacilla flava</i>	Grey-headed Yellow Wagtail		
<i>M. caspica caspica</i>	Grey Wagtail		

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Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.9 REPTILES RECORDED FROM MUTHURAJAWELA

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>Cnemaspis k. kandianus</i>	diurnal gecko	R	
<i>Hemadactylus brooki parvimaculatus</i>	jungle gecko	C	
<i>H. frenatus</i>	jungle gecko	C	
<i>Gehyra mutilata</i>	fruit bat	C	
<i>Calotes calotes</i>	green garden lizard	VC	THR
<i>C.versicolor</i>	garden lizard	VC	
<i>Mabuya carinata lankae</i>	skink	VC	
<i>M. macularia</i>	spitted skink	C	END/THR
<i>Sphenomorphus fallax</i>	brown skink	R	END/THR
<i>Riopa punctata</i>	skink	C	
<i>Varanus bengalensis</i>	monitor	C	
<i>V. salvator salvator</i>	monitor	C	PRO
<i>Crocodylus porosus</i>	estuarine crocodile	C	THR/PRO
<i>Melanochelys trijuga thermalis</i>	hard-shelled terrapin	C	THR
<i>Lissemys punctata ceylonensis</i>	soft-shelled terrapin	C	THR
<i>Typhlina branina</i>		C	THR
<i>Cylindrophis maculatus</i>	Sri Lankan pipe snake	R	END/THR
<i>Python molurus</i>	rock python	R	THR
<i>Acrochordus granulatus</i>		C	
<i>Lycodon striatus</i>	wolf snake	C	
<i>L. aulicus</i>	wolf snake	C	
<i>Oligodon arnensis</i>	kukri snake	R	
<i>Ptyas mucosus</i>		VC	
<i>Boiga ceylonensis</i>	cat snake	C	
<i>Dendrelahis tristis</i>	bronze back	C	
<i>Ahaetulla nasuta</i>		C	
<i>Aspidura guentheri</i>	Guether's roughside	VR	END/THR
<i>Xenochrophis piscator</i>	common pond snake	C	END/THR
<i>Amphiesma stolata</i>		C	
<i>Xenochrophis piscator</i>	pond snake	C	
<i>Atretium schistosum</i>		C	
<i>Cerberus rhynchops</i>	dog-faced water snake	VC	THR
<i>Gerada prevostiana</i>		VR	THR
<i>Naja naja naja</i>	cobra	C	
<i>Bungarus caeruleus</i>	krait	R	
<i>Vipera russelli</i>	Russel's viper	R	
<i>Hypnale hypnale</i>	Merrem's hump-nosed viper	C	THR

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Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.10 AMPHIBIANS RECORDED FROM MUTHURAJAWELA

SCIENTIFIC NAME	ENGLISH NAME	STATUS*	REMARKS**
<i>Bufo melanostictus</i>	toad	VC	
<i>B. stomaticus</i>	toad	R	
<i>B. atukoralei</i>	Atukorali's dwarf toad	C	END/THR
<i>Rana hexadactyla</i>	frog	VC	
<i>R. c. cyanophlyctis</i>	frog	VC	
<i>R. tigrina crassa</i>	frog	C	
<i>R. l. limocharis</i>	frog	VC	
<i>R. (Tomoptera) breviceps</i>	frog	C	
<i>R. (Hylarana) temporalis</i>	frog	C	
<i>Rhacophorus (polypedates) cruciger</i>	greater hourglass tree frog	C	END/THR
<i>R. (P.) leucomystax maculatus</i>	tree frog	VC	
<i>Philautus sp. (P. hayli ?)</i>	tree frog	VC	
<i>Kaloula pulchra taprobanica</i>		C	
<i>Uperodon systoma</i>		C	
<i>Microhyla rubra</i>		C	
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Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.11 FISH SPECIES RECORDED FROM THE MUTHURAJAWELA SWAMP

SCIENTIFIC NAME	STATUS*	REMARKS**
Ambassis dayi		
Anabas testudineus		
Aplocheilichthys dayi		
A. parvus		
Caranx sexfasciatus		
Channa orientalis		
C. striatus		
Eleotris fusca		
Elops echinata		
Etroplus suratensis		
Etroplus maculatus		
Gerres abbreviatus		
Heteropneustes fossilis		
Hyporhamphus gaimardi		
Lates calcarifer		
Leiognathus equulus		
Lutjanus argentimaculatus		
Liza macrolepis		
L. tade		
Megalops cyprinoides		
Oligolepis acutipennis		
Ophiocephalus striatus		
Panchax melastigma		
Panchax pancha		
Puntius vittatus		
P. filamentosus		
Rasbora diniconius		
R. caverii		
Scatophagus argus		
Sarotherodon mossambicus		
Trichgaster pectoralis		
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Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

"Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)

TABLE A9.12 BUTTERFLIES OF MUTHURAJAWELA

FAMILY NAME	TOTAL SPP	ENDEMIC SUBSPP	THREATENED SPP
DANEIDAE	8	4	-
SATYRIDAE	4	1	-
AMATHUSIDAE	-	-	-
NYMPHALIDAE	17	1	-
LYCAENIDAE	14	-	-
PIERIDAE	9	-	-
PAPILIONIDAE	9	3	1
HESPERIIDAE	6	-	-
TOTAL	67	9	1

Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.13 DRAGONFLIES OF MUTHURAJAWELA

FAMILY NAME	TOTAL SPP	SPP	ENDEMIC SUBSPP
EUPHAEIDAE	-	-	-
CHLOROCYPHIDAE	2	2	-
CALOPTERYGIDAE	-	-	-
LESTIDAE	-	-	-
PLATYSTICTIDAE	2	2	-
PROTONEURIDAE	3	3	-
PLATYCNEMIDAE	1	-	-
COENAGRIONIDAE	12	1	-
GOMPHIDAE	1	-	-
AESHNIDAE	-	-	-
CORDULIIDAE	-	-	-
LIBELLULIDAE	13	-	-
TOTAL	34	8	-

Source ; "Environmental Profile of Muthurajawela and Negombo Lagoon" (1991)

TABLE A9.14 ZOOPLANKTON SPECIES RECORDED FROM MUTHURAJAWELA

SCIENTIFIC NAME	STATUS*	REMARKS**
COPEPODS :		
<i>Canthocamptus sp.</i>		
<i>Onchocamptus sp.</i>		
CLADOCERANS :		
<i>Leptodora sp.</i>		
<i>Ceriodaphnia sp.</i>		
<i>Daphnia sp.</i>		
ROTIFERS :		
<i>Keratella sp.</i>		
<i>Brachionus sp.</i>		
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Source ; "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)

TABLE A9.15 FAUNAL SPECIES RECORDED FROM THE PELAGIC MARINE ENVIRONMENT OF THE PROJECT AREA

SCIENTIFIC NAME	STATUS*	REMARKS**
COELENTERATES :		
<i>Physalia sp.</i>		
<i>Medusae</i>		
ARTHROPODS :		
<i>Penaeus monodon</i>		
<i>Penaeus indicus</i>		
<i>Metapenaeus dobsoni</i>		
<i>Portunus pelagicus</i>		
<i>Calanus sp.</i>		
<i>Tigriopus sp.</i>		
<i>Acartia sp.</i>		
<i>Metacaprella sp.</i>		
<i>Sphaeronema sp.</i>		
MOLLUSCS :		
<i>Loligo sp.</i>		
<i>Sepia sp.</i>		
FISH :		
<i>Sardinia melanura</i>		
<i>S. albella</i>		
<i>Chirocentrus nudus</i>		
<i>Amblygaster sirm</i>		
<i>Anchoviella commersoni</i>		
<i>Lates calcarifer</i>		
<i>Tylosurus strongylurus</i>		
<i>Epinephelus tauvina</i>		
<i>Lutjanus argentimaculatus</i>		
<i>Leiognathus splendens</i>		
<i>Otolithus ruber</i>		
<i>Mugil cephalus</i>		
<i>Liza ceramensis</i>		
<i>L. oligolepis</i>		
<i>Siganus vermiculatus</i>		
<i>Caranx sp.</i>		
<i>Chorinemus tala</i>		
* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown		
** END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance		

Source : "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)

TABEL A9.16 PHYTOPLANKTON SPECIES RECORDED IN THE MARINE ENVIRONMENT OF THE PROJECT AREA

SCIENTIFIC NAME	STATUS*	REMARKS**
DIATOMS		
Melosira		
Biddulphia		
Nitzchia		
Gyrosigma		
Pleurosigma		
Chaetoceros		
Navicula		
Coscinodiscus		
DINOFLLAGELLATES		
Ceratium		
Peridinium		
* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown		
** END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance		

Source : "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)

TABLE A9.17 THE SPECIES OF MOLLUSCS THAT INHABIT THE OFF SHORE BENTHIC ENVIRONMENT

SCIENTIFIC NAME	STATUS*	REMARKS**
<i>Afrocardium latum</i>		
<i>Anadra maculosa</i>		
<i>A. pilula</i>		
<i>A. satowi</i>		
<i>A. troscheli</i>		
<i>Arca boucardi</i>		
<i>Architectonica laevigata</i>		
<i>Barbatia bicolorata</i>		
<i>Cardita variegata</i>		
<i>Chama dunkeri</i>		
<i>Decatopecten striatus</i>		
<i>Erronea erronea</i>		
<i>Fulvia asiatica</i>		
<i>Hydatina physis</i>		
<i>Murex ternispina</i>		
<i>Neohaustator columnaris</i>		
<i>Olivia ispidula</i>		
<i>Pitar striata</i>		
<i>Peribolus depressus</i>		
<i>Trochus callicoccus</i>		
<i>T. radiatus</i>		
<i>Turritella duplicata</i>		
<i>Vartocardium lacunosum</i>		
<i>Virroconus ebraeus</i>		
* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown		
** END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance		

Source : "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)



TABLE A9.18 ORGANISMS RECORDED FROM THE NEAR SHORE REEF

ENGLISH NAME	STATUS*	REMARKS**
<b>MARINE MACROPHYTES</b>		
Ulva		
Laminaria		
Sargassum		
Chaetomorpha		
Velonia		
Halimeda		
Valoniopsis		
<b>CRUSTACEANS</b>		
Balanus sp.		
Amphipod		
Isopod		
<b>ANNELIDS</b>		
Nereid worm		
<b>MOLLUSCS</b>		
Mytilus edulis		
Clypidina notata		
Trochus radiatus		
Cellana radiata		
Drupa granulata		
D. serrialis		
<b>ECHINODERMS</b>		
Echinus sp.		
Star fishies		
Sea cucumbers		
Brittle stars		
<b>FISH</b>		
Banded moray eel		
Goby		
* E = Endangered, VR = Very Rare, R = Rare, C = Common, VC = Very Common, SU = Status Unknown		
** END = Endemic species, THR = Threatened species, PRO = Protected under Wildlife Ordinance		

Source : "Proposed LPG Import Terminal - Sri Lanka at Kerawalapitiya EIA Report" (1996)

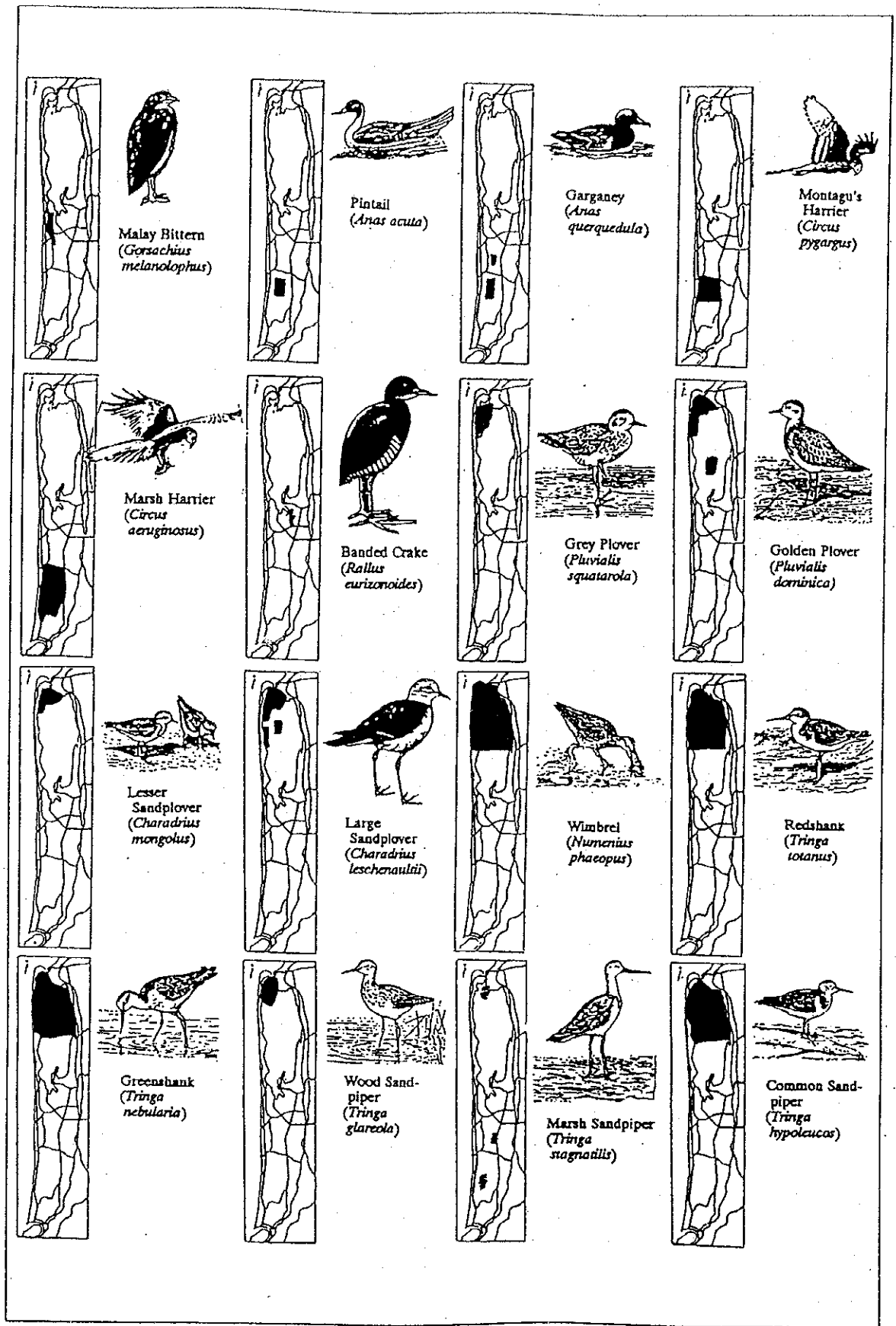


Figure A9.1 (1) Distribution of Migrant Birds in the Muthurajawela Marsh - Negombo Lagoon Wetland (De Silva 1990)

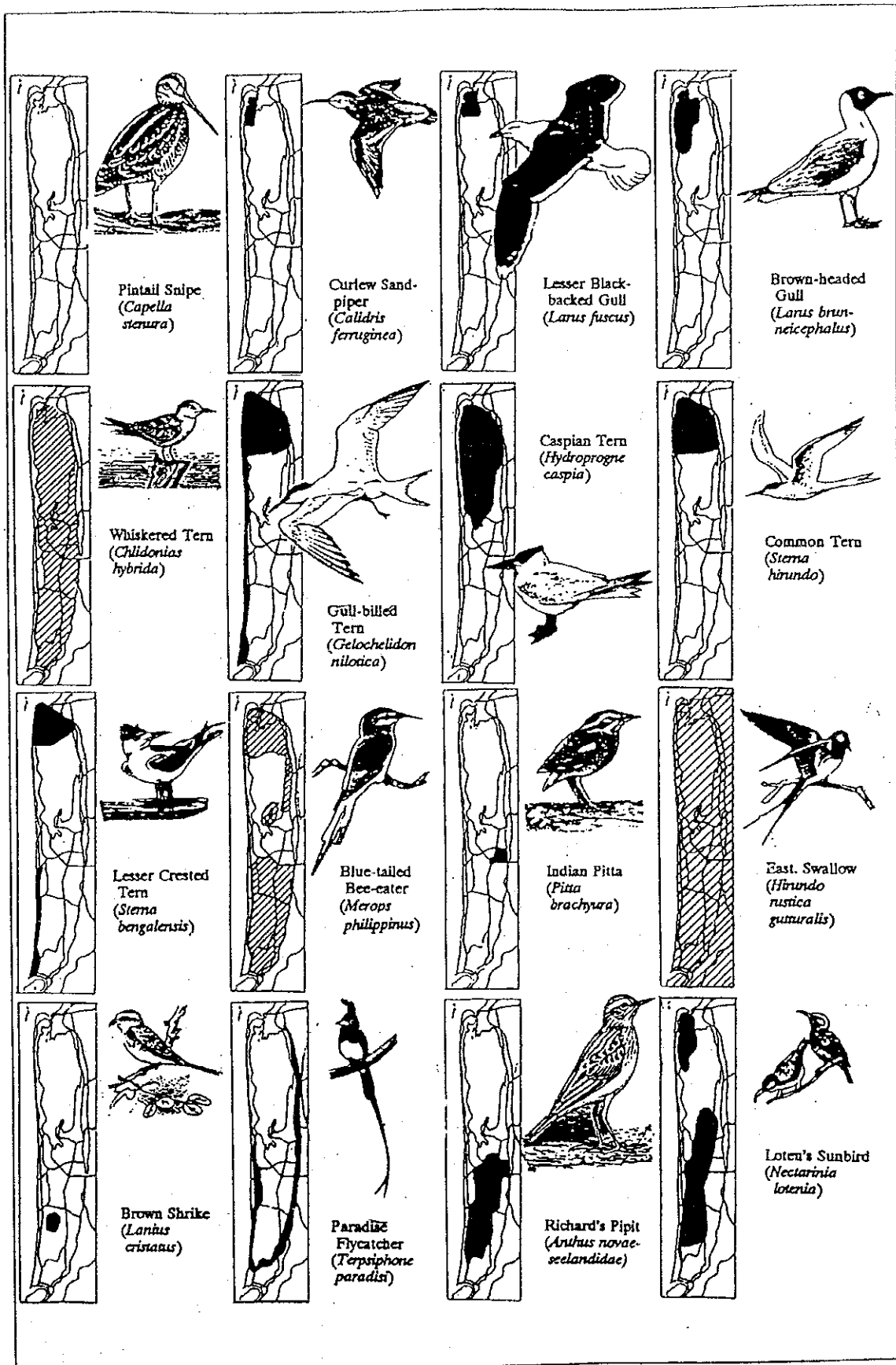


Figure A9.1 (2) Distribution of Migrant Birds in the Muthurajawela Marsh - Negombo Lagoon Wetland (De Silva 1990)

## **ANNEX 10 Air Quality Estimation**

## **ANNEX 11 Noise Level Estimation**



**NOISE LEVEL ESTIMATION WORK FOR  
COMBINED CYCLE POWER PLANT PROJECT  
AT KERAWALAPITIYA**

**JAPAN INTERNATIONAL COOPERATION AGENCY  
(JICA)**

# NOISE LEVEL ESTIMATION WORK FOR COMBINED CYCLE POWER PLANT PROJECT AT KERAWALAPITIYA

## 1. Construction Phase

### 1.1 Noise from Traffic

During the construction, proportion on the current traffic rate by vehicles related to the project is estimated less than 0.5 % as shown below in Table 1.1. Therefore, the construction vehicles will not give significant impact on the ambient noise level.

**Table 1.1 Increase Ratio by Construction Vehicles During Construction Phase**

	Current Traffic			Construction Vehicles			Increase Ratio (%)		
	Large	Other	Total	Large	Other	Total	Large	Other	Total
to Colombo	1,539	19,463	21,002	70	20	90	4.5	0.1	0.43
to Pattiam	1,448	18,993	20,441	70	20	90	4.8	0.1	0.44
Both	2,987	38,456	41,443	140	40	180	4.7	0.1	0.43

### 1.2 Noise from Construction activities

#### 1.2.1 Methodology

The estimation work was implemented using the theoretical propagation equation as shown below.

$$L_A = L_{A0} - 20 \log_{10} \left( \frac{r}{r_0} \right)$$

- Notice  $L_A$  : Noise Level at the estimation point (dB(A))  
 $L_{A0}$  : Noise Level at the point  $r_0$  m from noise source (dB(A))  
 $r$  : Distance (m) from noise source to the estimation point,  
 $r_0 < r$

The composition of sound was calculated by the equation as shown below.

$$L_A = 10 \log_{10} \left( 10^{\frac{L_{A1}}{10}} + 10^{\frac{L_{A2}}{10}} + \dots + 10^{\frac{L_{Ai}}{10}} \right)$$

- Notice  $L_A$  : Noise Level composed at the estimation point (dB(A))  
 $L_{Ai}$  : Noise Level at the sound received point by sound source  $i$   
 (dB(A))



### 1.2.2 Input Data

Input data to be used for estimation is shown in Table 1.2. These are major noise sources concerned at the maximum construction activity period.

**Table 1.2 Kind of Noise Source and Sound Pressure Level**

No.	Name	No of Vehicles	Sound Pressure Level (dB(A))							
			63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
①	Earth Auger Machine	2	78	87	93	99	96	89	84	74
②	Back Hoe	2	85	94	89	89	84	80	76	67
③	Dump Truck	3	88	99	93	90	91	87	80	17
④	Concrete Truck	2	98	107	101	97	97	96	91	17
⑤	Pile Driver	2	82	88	97	98	104	99	94	90
⑥	Crawler Crane	2	89	86	87	90	84	77	72	69
⑦	Generator	3	98	97	96	87	82	76	72	69
⑧	Vibro Hammer	2	95	100	96	96	95	93	89	17
⑨	Air Compressor	2	92	101	97	92	88	91	92	79

### 1.2.3 Results

The results of estimation from the construction activity are shown in Table 1.3 and Figure 1.1 below.

The estimated noise levels at the boundary of the proposed power plant site satisfy the limit of the noise level at day time which is 70 dB(A).

**Table 1.3 Estimated Noise Level at the Boundary of the Site**

Estimation Point (Survey Point)	Estimated Level (dB(A))	Survey Results (Top : Day, Bottom : Night)	Composed Level (dB(A))
① (B)	64	44	64
		40	64
② (C)	62	43	62
		42	62
③ (D)	58	43	58
		42	58
④ (A)	59	43	59
		40	59

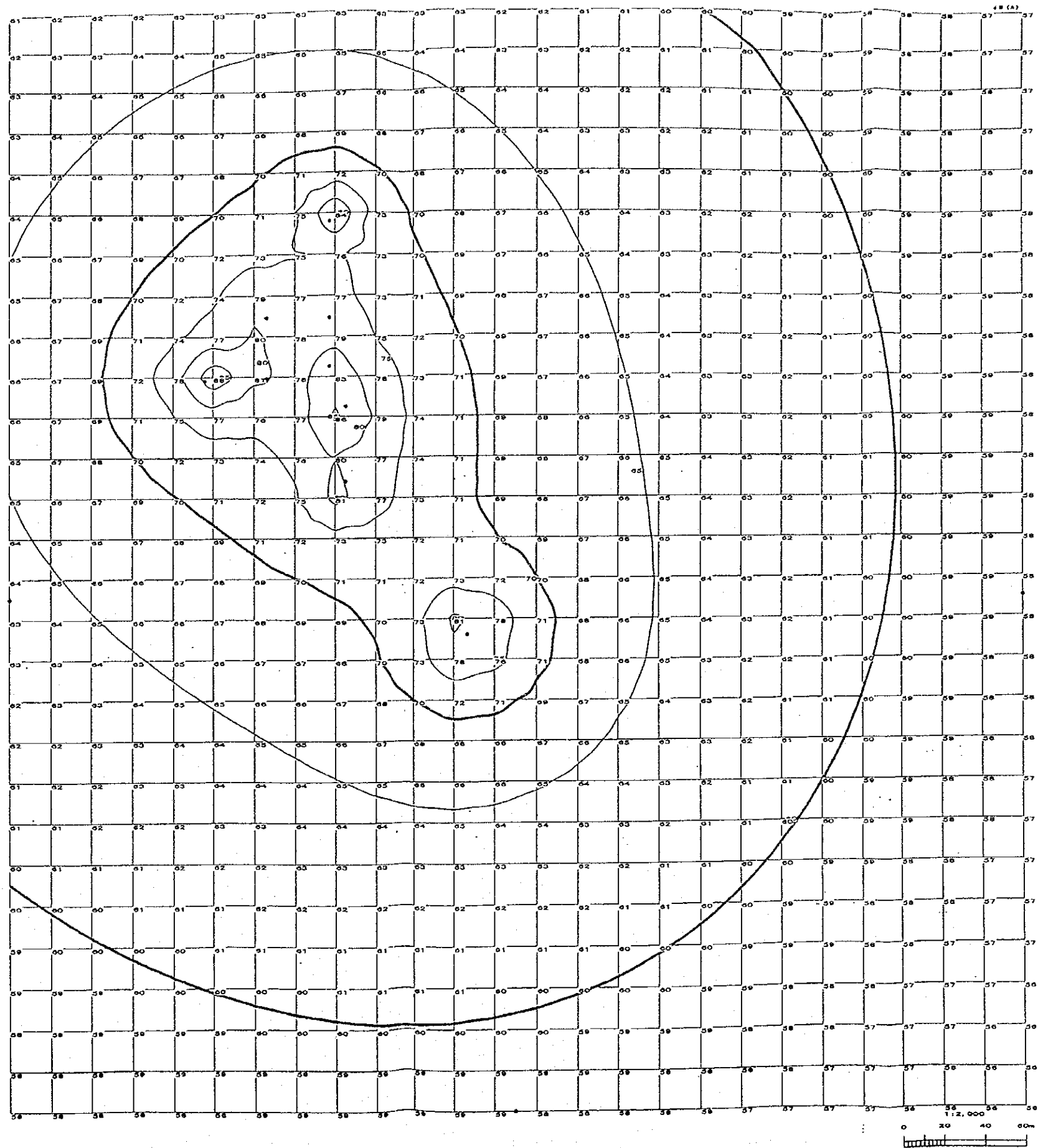


Figure 1.1 Contour of Noise Level Estimation During Construction Phase



## 2. Operational Phase

### 2.1 Noise from Traffic

During the operational phase (Regular Inspection Period), proportion on the current traffic rate by vehicles related to the project is estimated less than 0.2 % as shown below in Table 2.1. Therefore, the vehicles related to the power plant will not give significant impact on the ambient noise level.

**Table 2.1 Increase Ratio by Vehicles at Regular Inspection Period**

	Current Traffic			Vehicles at Regular Inspection Period			Increase Ratio(%)		
	Large	Other	Total	Large	Other	Total	Large	Other	Total
to Colombo	1,539	19,463	21,002	3	32	35	0.2	0.2	0.17
to Pattlam	1,448	18,993	20,441	3	32	35	0.2	0.2	0.17
Both	2,987	38,456	41,443	6	64	70	0.2	0.2	0.17

### 2.2 Noise from Power Plant Facilities

#### 2.2.1 Methodology

The estimation work was implemented using the theoretical propagation equation as shown below.

$$L_A = L_{A0} - 20 \log_{10} \left( \frac{r}{r_0} \right)$$

- Notice  $L_A$  : Noise Level at the estimation point (dB(A))  
 $L_{A0}$  : Noise Level at the point  $r_0$  m from noise source (dB(A))  
 $r$  : Distance (m) from noise source to the estimation point,  
 $r_0 < r$

The composition of sound was calculated by the equation as shown below.

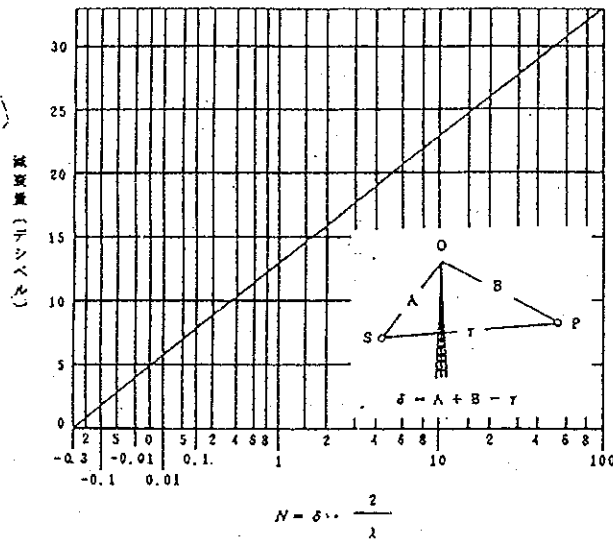
$$L_A = 10 \log_{10} \left( 10^{\frac{L_{A1}}{10}} + 10^{\frac{L_{A2}}{10}} + \dots + 10^{\frac{L_{Ai}}{10}} \right)$$

- Noise  $L_A$  : Noise Level composed at the estimation point (dB(A))  
 $L_{Ai}$  : Noise Level at the sound received point by sound source  $i$   
 (dB(A))

Moreover, Fuel tanks, Fuel Oil Treatment Facility, P.R. Building and Service Building were considered as barriers, and noise reduction was taken into account.

The noise reduction was obtained by the figure below in Figure 2.1 with calculating Fresnel Number on every frequencies from the difference ( $\delta$ ) between the direct route of the source - the estimation point and the barrier diffraction route.

Figure 2.1 Noise Reduction



### 2.2.2 Input Data

Major sources of noise from the power plant during the operational phase are gas turbines, main transformers, heat recovery steam generators, etc. Input data to be used for estimation is shown in Table 2.2.

Table 2.2 Kind of Noise Source and Sound Pressure Level

No.	Name	Sound Pressure Level (dB(A))							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
①	GT. Air Intake	87	88	84	86	88	93	91	89
②	GT. Air Intake	87	88	84	86	88	93	91	89
③	GT. Exhaust	96	93	79	81	84	77	84	85
④	GT. Exhaust	96	93	79	81	84	77	84	85
⑤	Main Transformer 1	48	80	88	84	86	78	71	69
⑥	Main Transformer 2	48	80	88	84	86	78	71	69
⑦	Main Transformer 3	48	80	88	84	86	78	71	69
⑧	HRSG1-1	93	95	90	71	57	53	49	43
⑨	HRSG2-1	93	95	90	71	57	53	49	43
⑩	GT. Building	76	81	78	86	85	72	66	56
⑪	ST. Building	76	81	78	86	85	72	66	56

### 2.2.3 Results

The results of estimation from the power plant during operational phase are shown in Table 2.3 and Figure 2.2.

The estimated noise levels at the boundary of the proposed power plant site satisfy the limit of the noise level which is 70 dB(A) at day time and 60 dB(A) at night time.

**Table 2.3 Estimated Noise Level at the Boundary of the Site**

Estimation Point (Survey Point)	Estimated Level (dB(A))	Survey result (Top : Day, Bottom : Night)	Composed Level (dB(A))
① (B)	49	44	50
		40	50
② (C)	50	43	51
		42	51
③ (D)	45	43	47
		42	47
④ (A)	43	43	46
		40	45

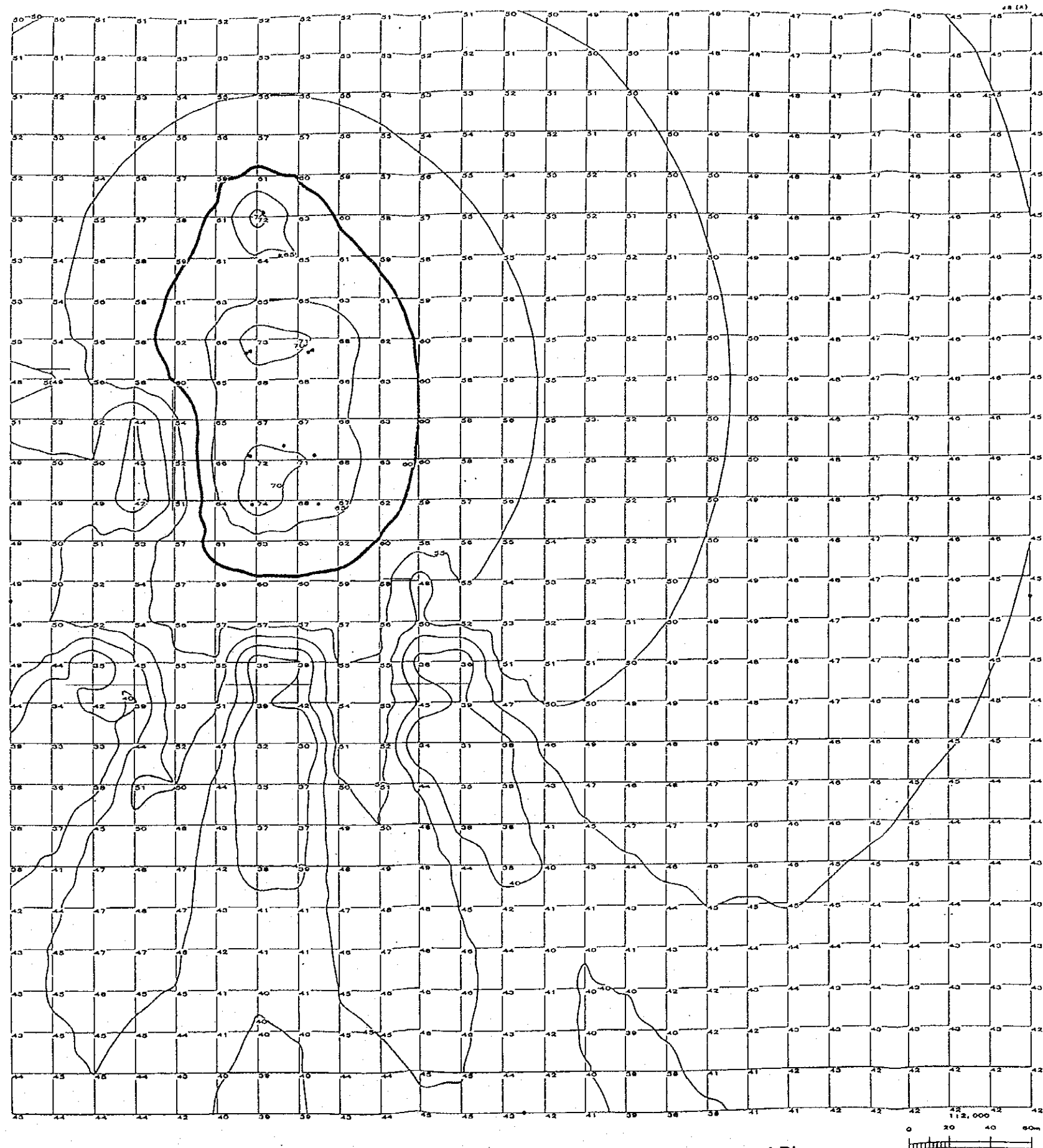


Figure 2.2 Contour of Noise Level Estimation During Operational Phase

## **ANNEX 12 Cooling Water Diffusion Estimation (LHI)**



**COOLING WATER DISPERSION STUDY  
FOR  
THE COMBINED CYCLE POWER PLANT PROJECT  
AT KERAWALAPITIYA**

**August 1998**

**JAPAN INTERNATIONAL AGENCY  
STUDY TEAM OF THE FEASIBILITY STUDY ON KERAWALAPITIYA  
COMBINED CYCLE POWER PLANT DEVELOPMENT**

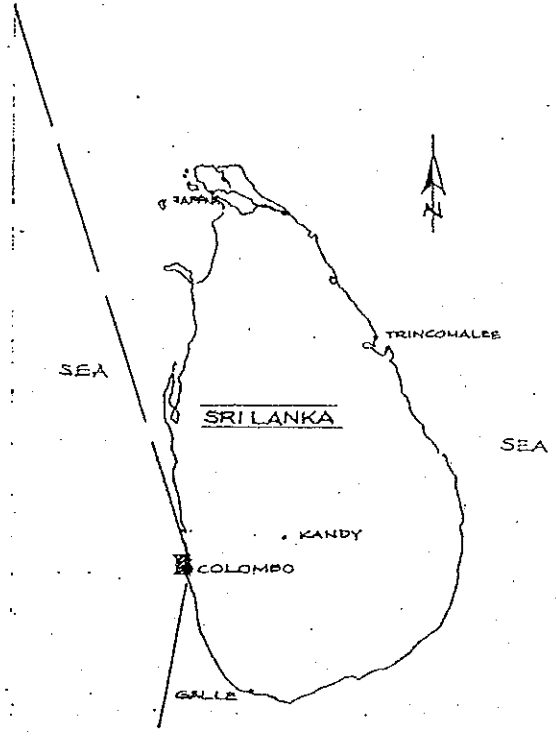
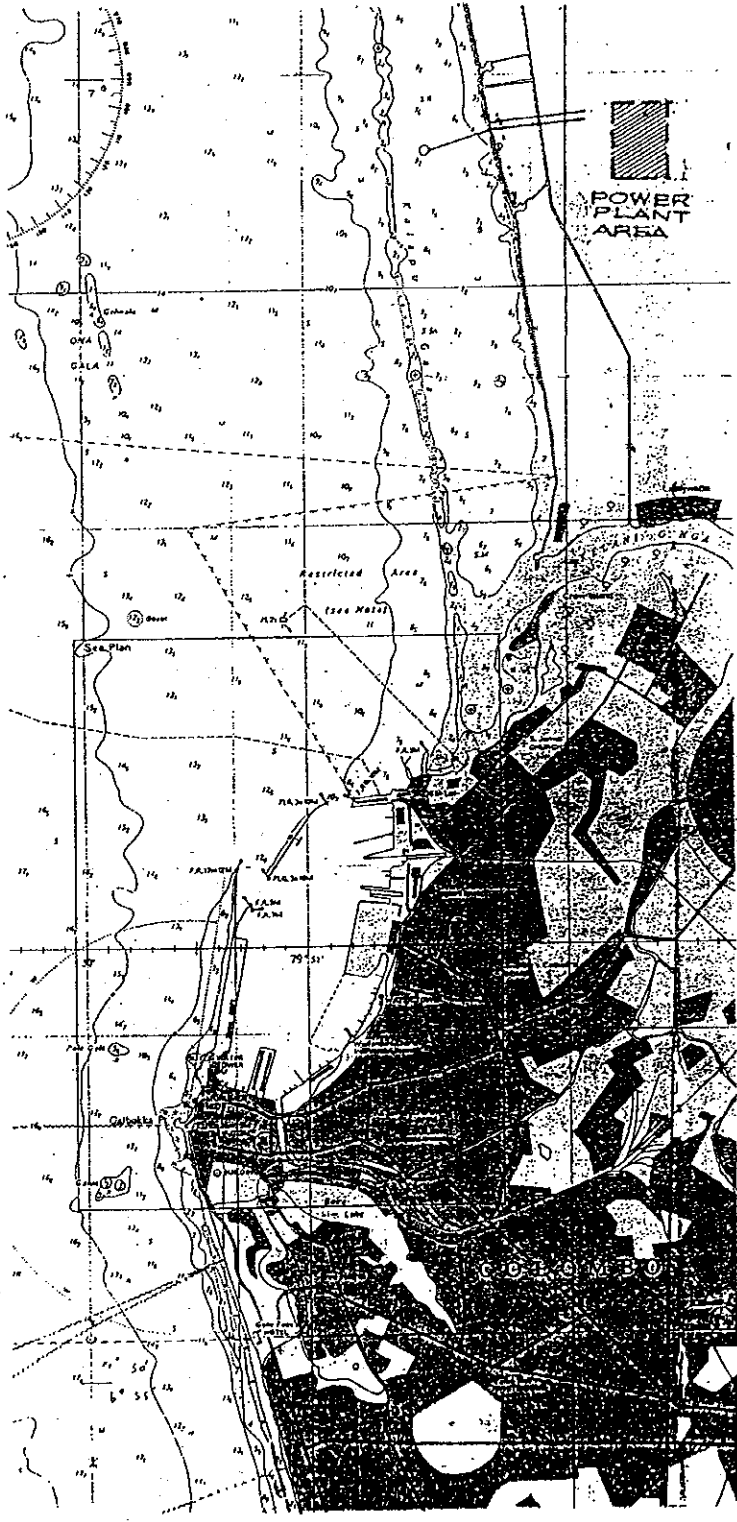
## **1. INTRODUCTION**

### **1.1 Project Background**

It is proposed that a Combined-Cycle Thermal Power Plant be set up at Kerawalapitiya. The feasibility of the proposed plant is being studied by the Tokyo Electric Power Services Co. Ltd. (TEPSCO) of Japan. The study is funded by the Japan International Co-operation Agency (JICA). The location of the proposed power plant on the West Coast is shown in Figure 1.1 . The planned power output is 150 MW.

### **1. 2 Scope of this Report**

The study is carried out using the model CORMIX3, which is recommended by the US EPA for the type of discharge proposed. It should be mentioned here that the model results presented are for the near-field only and are based on a highly simplified representation of the ambient velocity and geometry.



LOCATION MAP

SCALE 1: 60,000.

**Figure 1.1 Proposed Site for the Thermal Power Plant**

## 2. OBJECTIVES AND STUDY PARAMETERS

### 2.1 Objectives

The objective of the study is to obtain the near-field temperature distribution for the cases listed in section 2.4. The results are to be presented as contour plots of surface excess temperature, with the lowest value being 1 degrees above the ambient.

### 2.2 Project Layout

The proposed layout of the project is shown in Figure 2.1. The power plant is located about 1 km from the shore. The cooling water intake is located 400 m from the shore at a location where the depth is around 7 m. The intake head is located 4.5 m below the water surface. The warmed cooling water is discharged through a rectangular culvert located on the shoreline.

### 2.3 Discharge Parameters

The discharge parameters were specified in terms of the discharge flow rate, temperature and dimensions of the discharge channel. These parameters are listed in the table below, together with the discharge velocity, which is a critical parameter when considering the dilution.

Discharge Flow Rate (m <sup>3</sup> /s)	Temperature (deg C above ambient)	Discharge Channel Dimensions	Discharge Velocity (m/s)
3.6	10	5.9 m x 1.2 m	0.5

**Table 2.1 Expected Flows of Cooling Water**

## **2.4 Cases to be Studied**

The case was for the simulation of the following four ambient conditions.

- a) South-west Monsoon - with historical maximum Kelani Ganga discharge
- b) South-west Monsoon - typical conditions
- c) Inter-monsoon Period - typical conditions
- d) North-east Monsoon - typical conditions

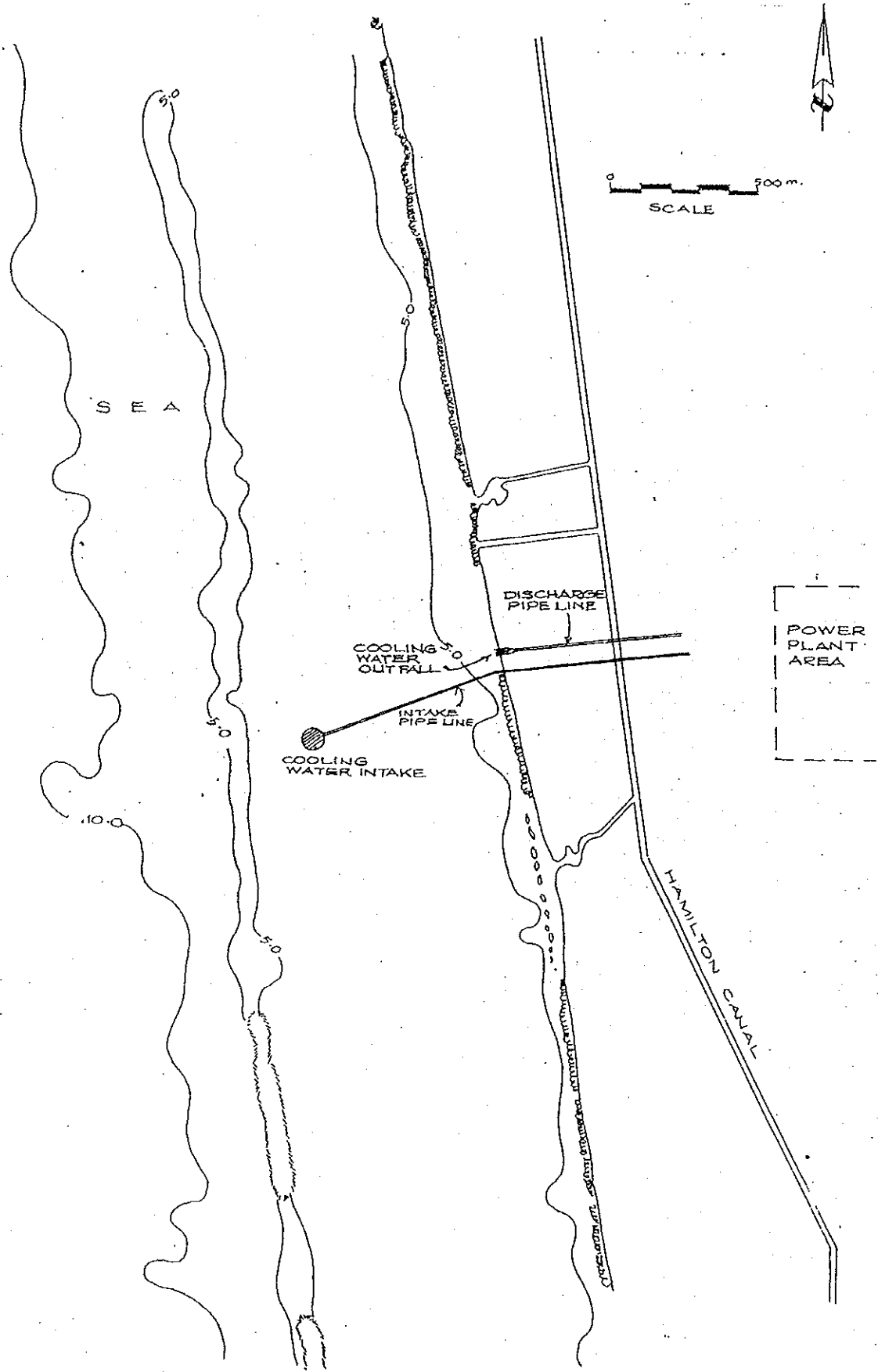
The water temperature and salinity measurements, scheduled for the north-east and south-west monsoon, and water velocity measurements, scheduled for the north-east monsoon only, were to be used to define the ambient conditions.

These four cases were specified to account for the seasonal variability of the ambient conditions. The most important data requirements of CORMIX3, described in detail in Chapter 3, for the ambient conditions are the representative velocity and the density profile. The velocity will differ from season to season based on the wind regime, while the density structure, i.e., whether the ambient fluid is stratified or unstratified will depend primarily on whether the discharge from the Kelani Ganga is high or low and to a lesser extent the wave and wind climate.

Therefore it was decided to use the field data and the results of other studies to estimate parameters for the following flow conditions.

- a) South-west Monsoon - high river discharge
- b) South-west Monsoon - low river discharge
- c) Inter-monsoonal period
- d) North-east monsoon

Flow condition were shown in Table 2.1.



**Figure 2.1 Proposed Layout of Cooling Water Intake and Discharge**

### 3. MODELLING PROCEDURE

#### 3.1 Description of CORMIX3

The Cornell Mixing Zone Expert System (CORMIX) is a general purpose software system for the analysis of aqueous discharges of various types of wastewater into diverse water bodies. The system was developed by researchers from Cornell University, with funding mainly from the U.S Environmental Protection Agency (EPA). Continuous improvement of the system is performed under an on-going EPA contract. The most recent release, Version 3.2, dated December 1996, is used in this study.

The model is recommended by the EPA and distributed by the EPA Centre for Environmental Exposure Modelling. A subset of this system, known as CORMIX3, has been developed for buoyant surface discharges. In general, Jones et al. (1996) estimate that CORMIX3 is applicable to about 90% of the buoyant horizontal discharges found in practice. However, it must be clearly understood that CORMIX 3 is primarily a near-field model. The very simplicity of the model requires input data that may be an over simplification of the actual situation.

#### 3.2 Data Requirements for CORMIX3

The input data required by CORMIX3 can be divided into two sets - ambient data and discharge data. The data requirements for each set, with the values to be used for this study, are given below.

##### Ambient Data

1) Geometry - there are several entries needed here

- a) Laterally Bounded or Unbounded Water Body - as the receiving body is the ocean it seems that an unbounded water body should be specified. However, the presence of the sandstone reef has to be considered. The selection is discussed in the next chapter.
- b) Depth - only a single value of the depth can be specified for the entire water body. The selection of an appropriate representative value will be discussed in the next chapter.

2) Flow - the following information is needed

- a) Steady or Tidally Reversing - CORMIX3 assumes a steady state. Therefore all the simulations will be done for steady flow. The effect of tidally reversing flows on the near-field dilution will be considered separately.
- b) Cross-flow Velocity - only a single value can be specified. This is assumed to apply uniformly everywhere. The selection of an appropriate value is described in the next chapter.

### 3) Fluid

- a) Stratified or Unstratified - The density structure of the water body has to be specified as uniform (unstratified) or stratified (two possible profile shapes). This specification is developed in the next chapter, based on the field data.
- b) Density - the density depends on the salinity and the temperature. The density will be based on the field measurements.

### 4) Other Parameters

- a) Friction Factor - a single value of the friction factor must be specified. A value of 0.025 (Darcy friction factor) was used.
- b) Wind Speed - a single value must be specified. No wind was specified.
- c) Heat Loss Coefficient - a single value must be specified. A value of zero, i.e. no heat loss, was given.

### Discharge Data

- 1) Location - All the cases specify a right bank discharge to aid the comparison of the results.
- 2) Type of Discharge - In the present study the shoreline discharge is a Flush Discharge.
- 3) Angle of Discharge - A value of 90 degrees is used
- 4) Discharge Channel Geometry - Rectangular Channel - the width and depth is given.
- 5) Water Body Geometry near Discharge - as most horizontal discharges are from close to the bank the geometry near the discharge may be quite different from the representative value for the entire water body. Therefore the following specifications are allowed
  - a) Depth near Discharge
  - b) Bottom Slope near Discharge
- 6) Effluent Parameters
  - a) Effluent Density - The effluent density was specified based on the properties of the bottom layer (where the intake is located) and taking into account the specified rise in temperature.



b) Discharge - the discharge was specified by the volume flow rate.

#### 4. SELECTION OF REPRESENTATIVE PARAMETERS FOR CORMIX3

The input data needed by CORMIX3 was described in detail in the preceding chapter. The values for all these parameters that will be used in the present study will be listed and justified in this chapter. The appropriate values are usually quite obvious. The parameters that are the same for all cases, or are fixed by specification, are listed first. The most critical parameters are the ambient depth, velocity and density structure. These have to be derived for the various flow conditions by considering available field data and experience from other projects. This is done in section 4.2 .

##### 4.1 Parameters

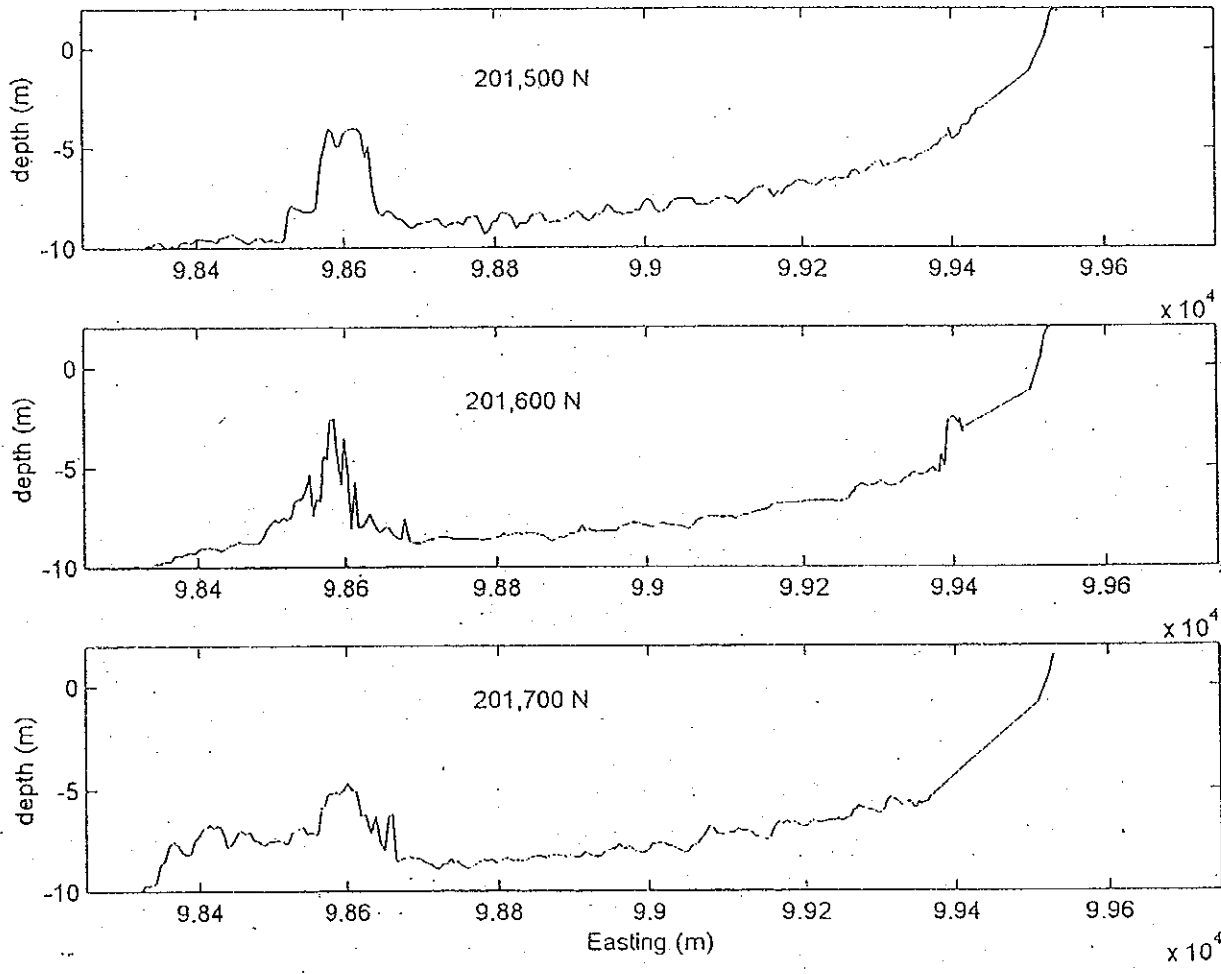
These include the geometry of the receiving body, the geometry and other parameters of the discharge and other physical parameters. All the parameters except the representative velocity and density structure will be considered here.

##### Geometry of the Receiving Body

Three profiles, normal to the shoreline, are shown in Figure 4.1 . The profiles are taken from the region just to the north of the proposed discharge location. This region is considered because the ambient flow is expected to be mostly to the north. The profiles show that the depth drops off quite sharply to about 5 m and then gradually increases to about 8 m . The offshore reef is located about 900 m from the shore and rises up to a depth of 4 m to 5 m .

The first decision is whether the water body should be specified as bounded or unbounded. If the discharge is well mixed over the depth, the presence of the offshore reef may act as a boundary to the flow. However, all the simulations show that the discharge is limited to a surface layer that is only about 1 m to 2 m thick when it reaches the reef. Therefore the water body can be considered to be unbounded.

The depth of the water body is specified by a representative depth, an intermediate depth and a depth near the discharge. Based on Figure 4.1 and previous experience, these values are taken to be 8 m, 6 m and 1.5 m, respectively. Finally, the model also uses a value for the bottom slope near the discharge. The bottom slope can be defined differently by using different distances. The values of the profiles shown range from 0.7 degrees to 1.7 degrees. An average value of 1.2 degrees is selected.



**Figure 4.1 Shore Profiles at 201,500 N, 201,600 N and 201,700 N**

### Geometry of the Discharge

The discharge is flush with the shore and oriented at a 90 degree angle to the shore. The discharge is rectangular with dimensions given by Table 2.1 (which is shown again as Table 4.1 here for convenience). The table also shows the discharge flow rates, velocities and the increase in temperature.

Discharge Flow Rate (m <sup>3</sup> /s)	Temperature (deg C above ambient)	Discharge Channel Dimensions	Discharge Velocity (m/s)
3.6	10	5.9 m x 1.2 m	0.5

**Table 4.1 Expected Flows of Cooling Water**

### Other Parameters

These include the friction factor, the wind speed and the heat loss coefficient. The same values are used for all the simulation. A Darcy-Weisbach friction factor of 0.025 is used. The wind speed and heat loss coefficients are set to zero, thereby making the results for the temperature distribution conservative.

### 4.2 Representative Velocity and Density Structure

These values will be based on field measurements as much as possible. These measurements were made at the location shown in Figure 4.2.

#### Representative Velocity

The velocity was measured for about 17 days from 28/02/1998, i.e., during the north-east monsoon. The time series of the shore-parallel and shore-normal velocities and the water level are shown in Figure 4.3. The velocity is presented in this manner as it is the shore parallel velocity that affects the spread of the plume.

The figure shows that the velocity variation matches the water level change closely, indicating that the velocity is dominated by tidal effects. The first half of the record shows velocity variations with about 0.5 days periods and magnitudes of 5 cm/s while the second half shows variations with periods of about 1 day and magnitudes of 10 cm/s or more.

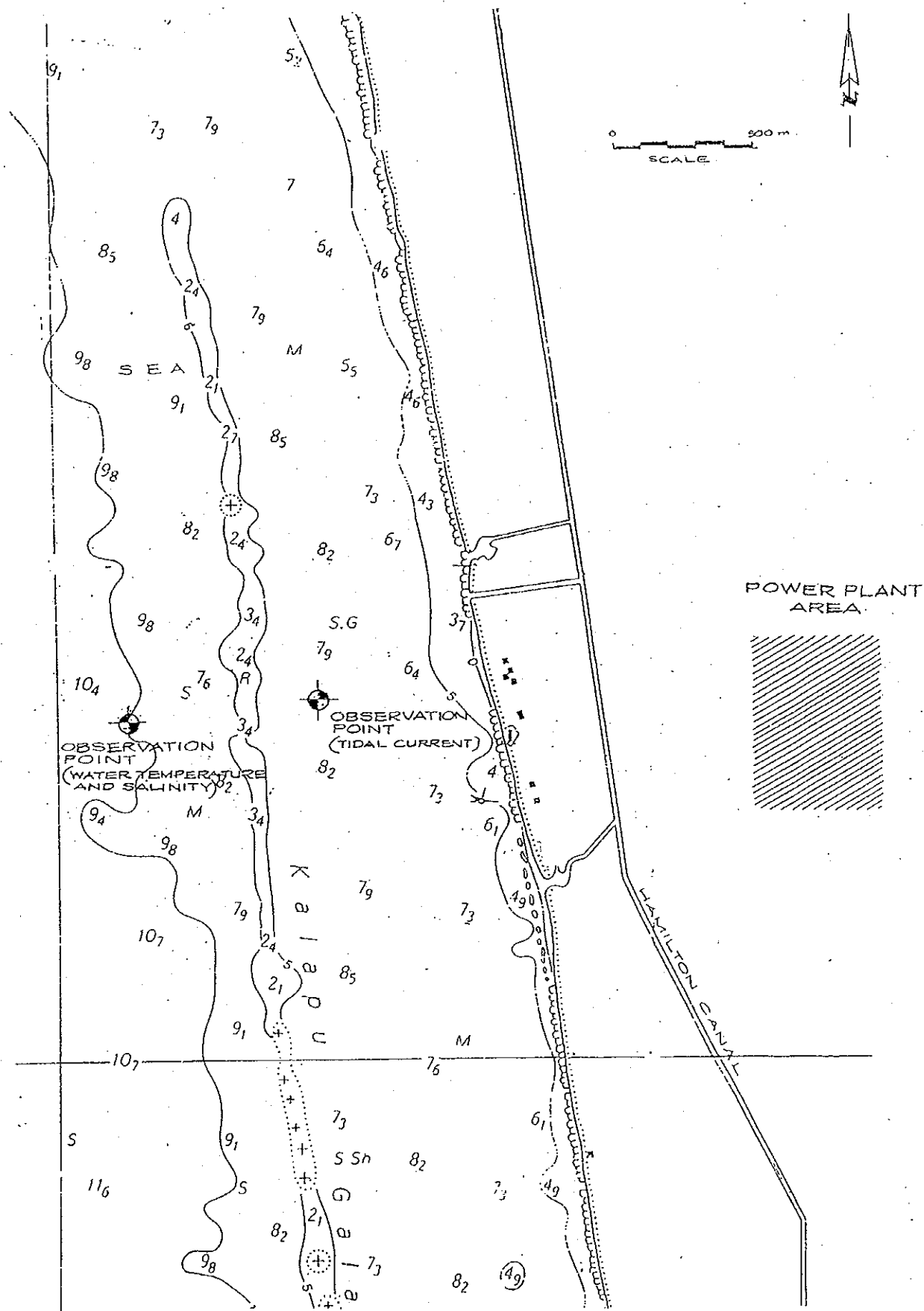
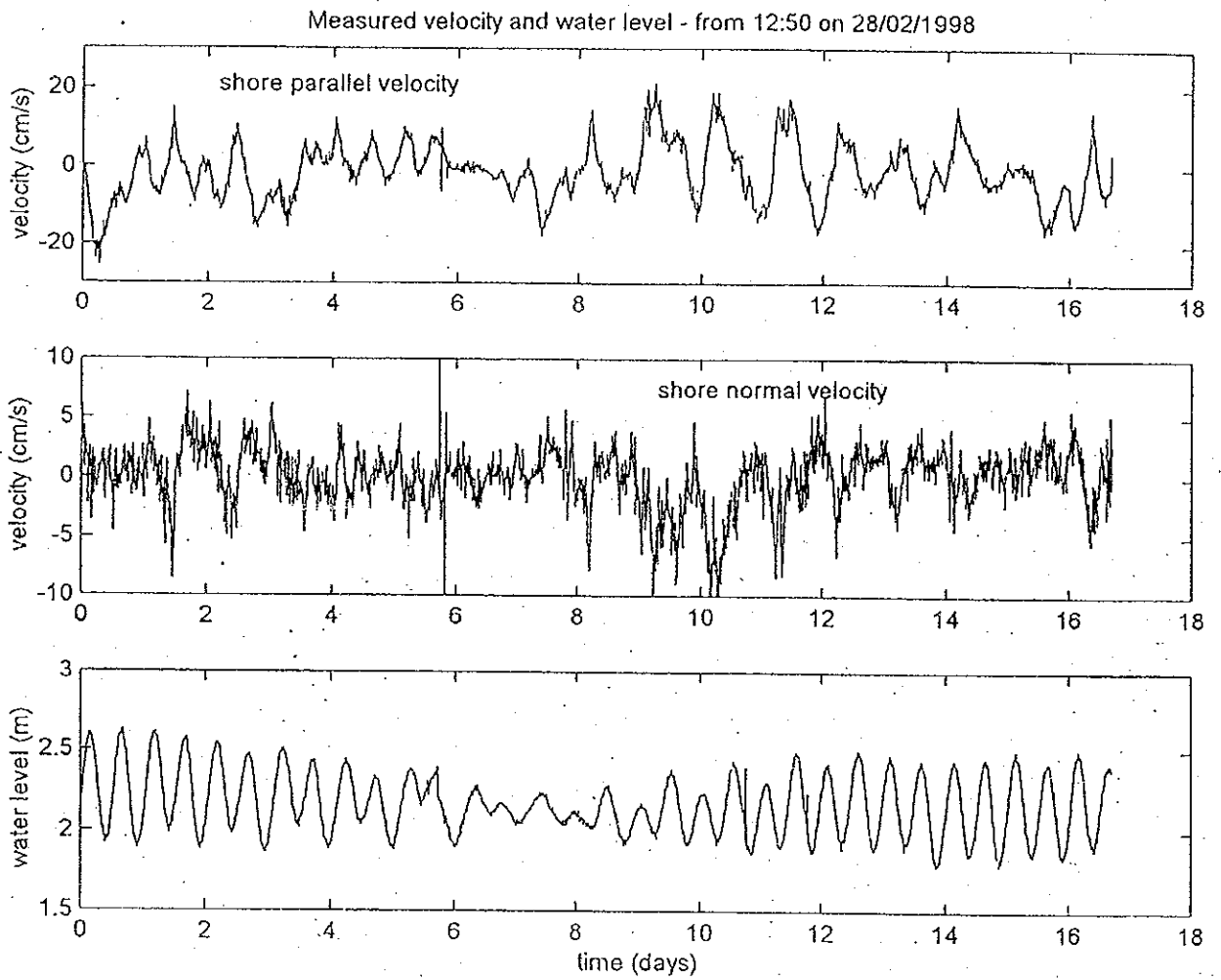


Figure 4.2 Location of Velocity and Temperature/Salinity Measurements



**Figure 4.3 Time Series of Measured Velocity and Water Level**

The overall average shore parallel velocity is about 1.5 cm/s . As CORMIX3 requires an average velocity, this value will be taken as representing the north-east monsoon. However, the domination by tidal effects suggests that a steady state model may not be applicable in this case. The effect of a tidally varying flow on the spread of the plume is shown in section 5 .

As the velocity measurement was not repeated, there is no field data from which the representative velocity for the other three conditions listed in Chapter 2 can be estimated. However, other available data indicate that the average velocities would be higher at other seasons. Based on this information the representative velocity during the Inter-monsoonal periods is taken to be 5 cm/s, while values of 5 cm/s and 10 cm/s are considered representative of the South-west Monsoon period.

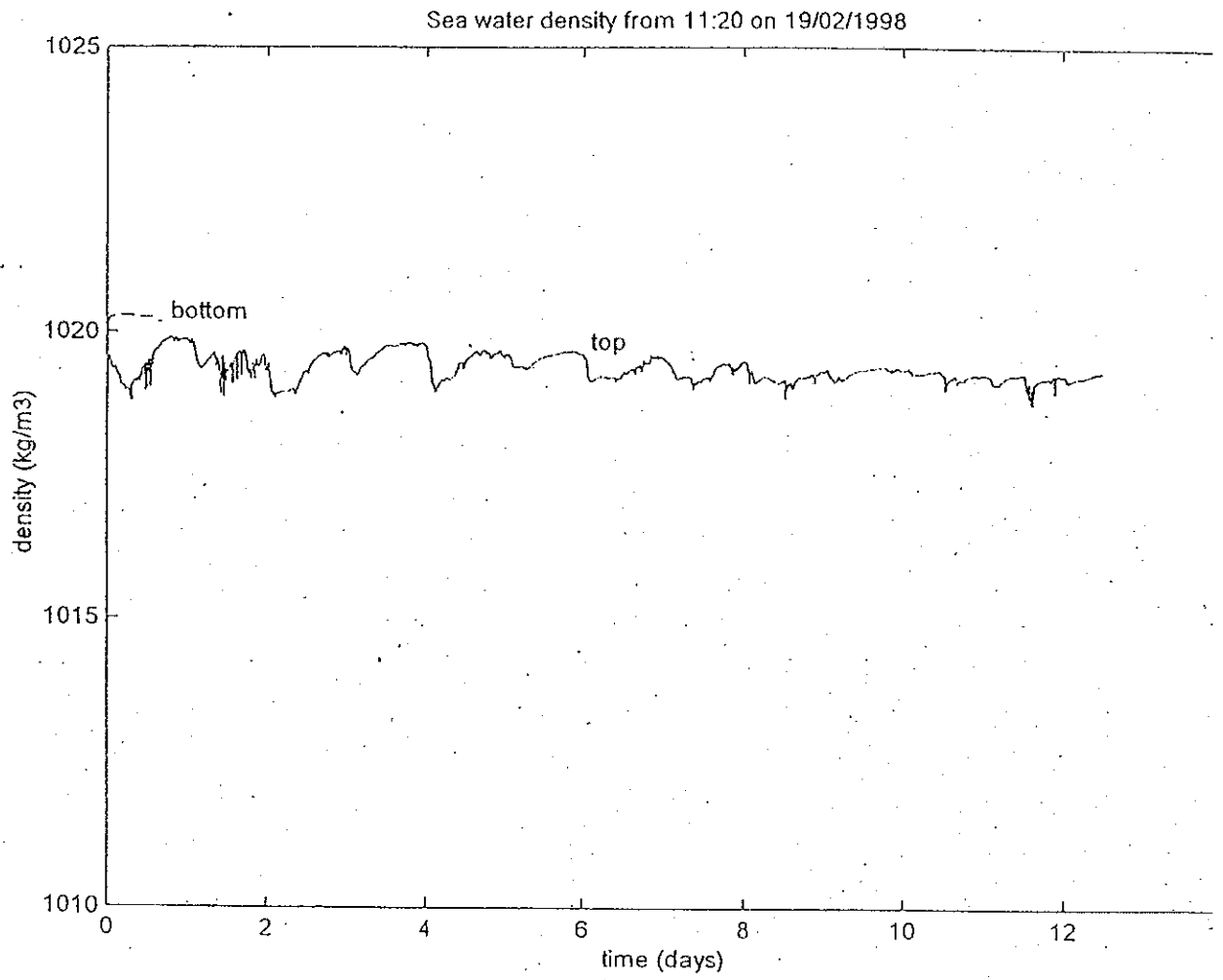
#### Representative Density

The temperature and salinity at the location in Figure 4.2 were measured three times using three sensors at the top, middle and bottom of the water column. The results of the temperature and salinity measurements are converted into time series of density. These are presented in Figures 4.4, 4.5 and 4.6, for the three deployments carried out. The three figures are presented using the same density range to aid comparison.

In the first deployment, Figure 4.4, the middle sensor did not function, while the bottom sensor yielded only one day of data. The figure shows that the density is nearly the same, i.e., the sea is not stratified. In the second deployment, Figure 4.5, the top sensor only worked for one day and the bottom sensor was affected by bottom sediment during the deployment. Nevertheless, the figure shows clearly that three values are nearly the same, showing that the sea is not stratified.

The conclusion that can be made from the data in the first two figures is that the sea is not stratified during the north-east monsoon and the inter-monsoonal period. Therefore a constant density is specified. As the model results depend on the difference in density between the ambient water and the discharge rather than the actual values, the exact value selected is not critical. The specified temperature increase in the discharge will maintain the required density difference. Based on the data from the first two deployments, the ambient sea water is taken to have a salinity of 32.5 units and a temperature of 30 degrees C, so that the ambient density is  $1019.86 \text{ kg/m}^3$  .

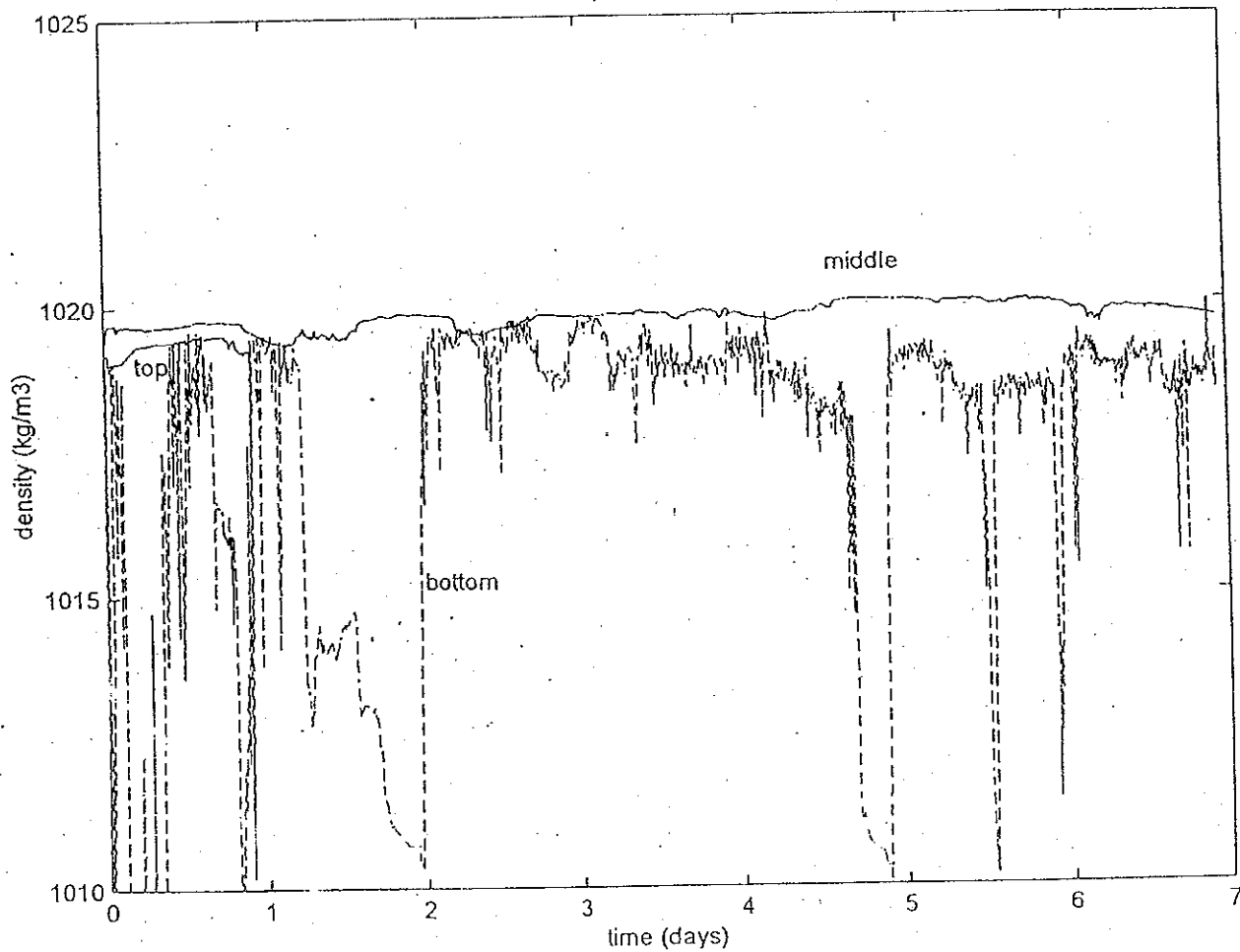
In contrast, the data from the third deployment, Figure 4.6, shows that there is distinct stratification. The density of the top layer falls below  $1015 \text{ kg/m}^3$  on occasion, while the density at the middle is also significantly affected. The occurrence of stratification is clearly correlated with intermittent high discharge from the Kelani Ganga that took place during the measurement period. Therefore, a two layer ambient density structure must be specified for the south-west monsoon.



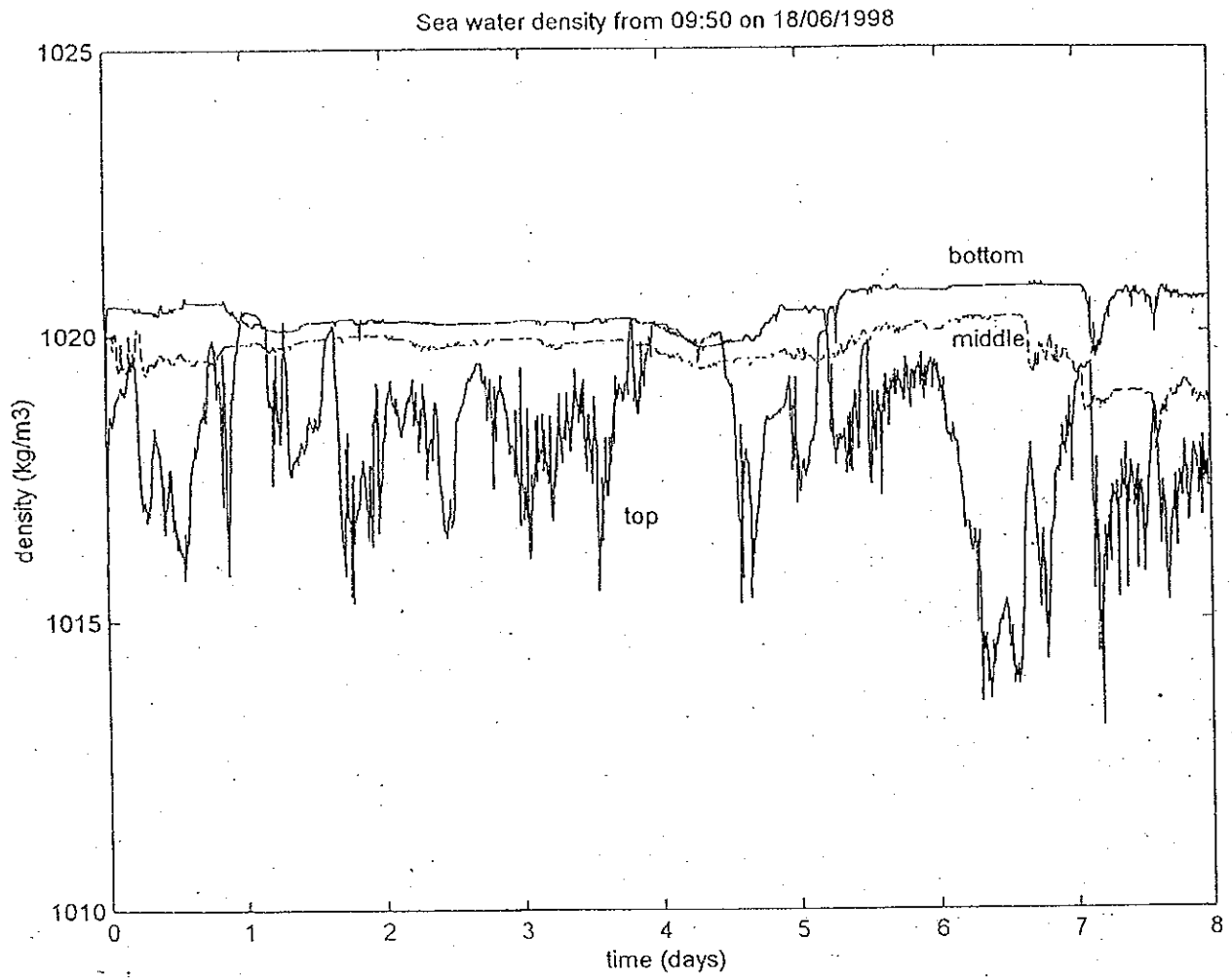
**Figure 4.4 Measured Density Variation - First Deployment**



Sea water density from 13:30 on 20/04/1998



**Figure 4.5 Measured Density Variation - Second Deployment**



**Figure 4.6 Measured Density Variation - Third Deployment**

### 4.3 Summary of Simulations to be Performed

The requirement for this study was to carry out simulations that represented the variation of the ambient velocity and density over the year. The extent of this variation was obtained from the field data. The density structure can be obtained with a high degree of confidence as three deployments over three seasons, including a period of heavy river flow were done. However, the estimate of velocity outside the north-east monsoon remain somewhat speculative as no measurements were made. Based on the analysis of this data and other information, six cases are selected, one each for the north-east and inter-monsoonal periods and four for the south-west monsoon. The representative velocity and density are summarised in Table 4.2 .

Flow Case	Monsoon	Velocity (cm/s)	Stratification	Ambient Density (kg/m <sup>3</sup> )	Top Layer Thickness (m)	Discharge Density (kg/m <sup>3</sup> )
NE	North-east	1.5	no	1019.86	-	1016.12
IM	Inter-monsoon	5	no	1019.86	-	1016.12
SW1	South-west	10	no	1019.86	-	1016.12
SW2	South-west	5	medium	bottom - 1019.86 top - 1017.84	2	1016.12
SW3	South-west	5	high	bottom - 1019.86 top - 1016.32	3	1016.12
SW4	South-west	10	medium	bottom - 1019.86 top - 1017.84	2	1016.12

**Table 4.2 Representative Ambient Velocities and Density Structures**

The first three cases have a uniform density and three different velocities. As discussed above, the same ambient density is as the specified temperature increase will make sure that the density difference is correct. The next three cases are stratified, with a two layer density being specified. Here too the bottom layer density is set to the same value used in the first three cases to facilitate the comparison of the results. The fourth and sixth cases are based on the field data while the fifth case is an estimate for very high river flows. As the intake is situated in the bottom layer, the discharge density will be the same for all cases (assuming a temperature increase of 10 degrees).

These flow cases will be used to simulate the discharge conditions of Cases A.

## 5. RESULTS OF THE SIMULATIONS

The results of the simulations outlined in the preceding chapter will be presented in this chapter. The results will be presented as contour plots of excess surface temperature, with a contour interval of 1 degrees. When the flow is stratified, the surface may be somewhat warmer than the bottom. However, the analysis of field data shows that the principal cause of stratification is a reduction of surface salinity caused by the river discharge. Therefore, a uniform density is assumed for the purpose of presenting the results.

The contour plots are presented within the required boundaries, i.e., 1500 m off shore and 2500 m downstream. Some irregularities in the contours are due to the sudden transition between various modules of CORMIX3. Another important feature of the discharge plume, in addition to its spread, is the depth of the plume. According to the past investigation results for the dispersion of warm water, it can be only reached to the depth below 1 m and not over 2m in depth in case of 5m<sup>3</sup>/sec as out put volume size, though horizontally it will dispersed wider area. Therefore, the expectation is that the plume will be on the surface and not mix down to the level of the intake.

The excess temperature contours for the six flow cases for discharge Case A are presented in Figures 5.1 to 5.6. The three unstratified cases are in Figures 5.1, 5.2 and 5.3, where the velocities are 1.5, 5 and 10 cm/s, respectively. In Figure 5.1, with the lowest velocity, the flow is initially a weakly deflected jet, a region which extends about 400m offshore.

In Figures 5.2 and 5.3 the cross-flow is increased. The result is a shortening of the jet region and quicker attachment to the shore. In Figure 5.3, the discharge does not extend more than 1000 m from the shore.

When the ambient sea water is stratified, the flow patterns are quite different. In Figures 5.4 and 5.5, which have the same cross-flow as Figure 5.2, the jet region is longer in extent. This is because the surface layer is lighter than in the unstratified case, so that the dissipation of momentum is slower. The stronger jet results in the 1 degree contour being a little further from the shore than before. In flow case SW2, high stratification, in Figure 5.5, the model results are limited to about 200 m offshore. This is because the discharge density is only slightly lighter than the surface layer (see Table 4.2). After a little mixing the density of the discharge and surface become the same, the discharge is no longer buoyant and CORMIX3 is not applicable.

The results of Figure 5.6 should be compared with those of Figure 5.3. The plume spread is much smaller than before and, as a result, the dilution is much slower.

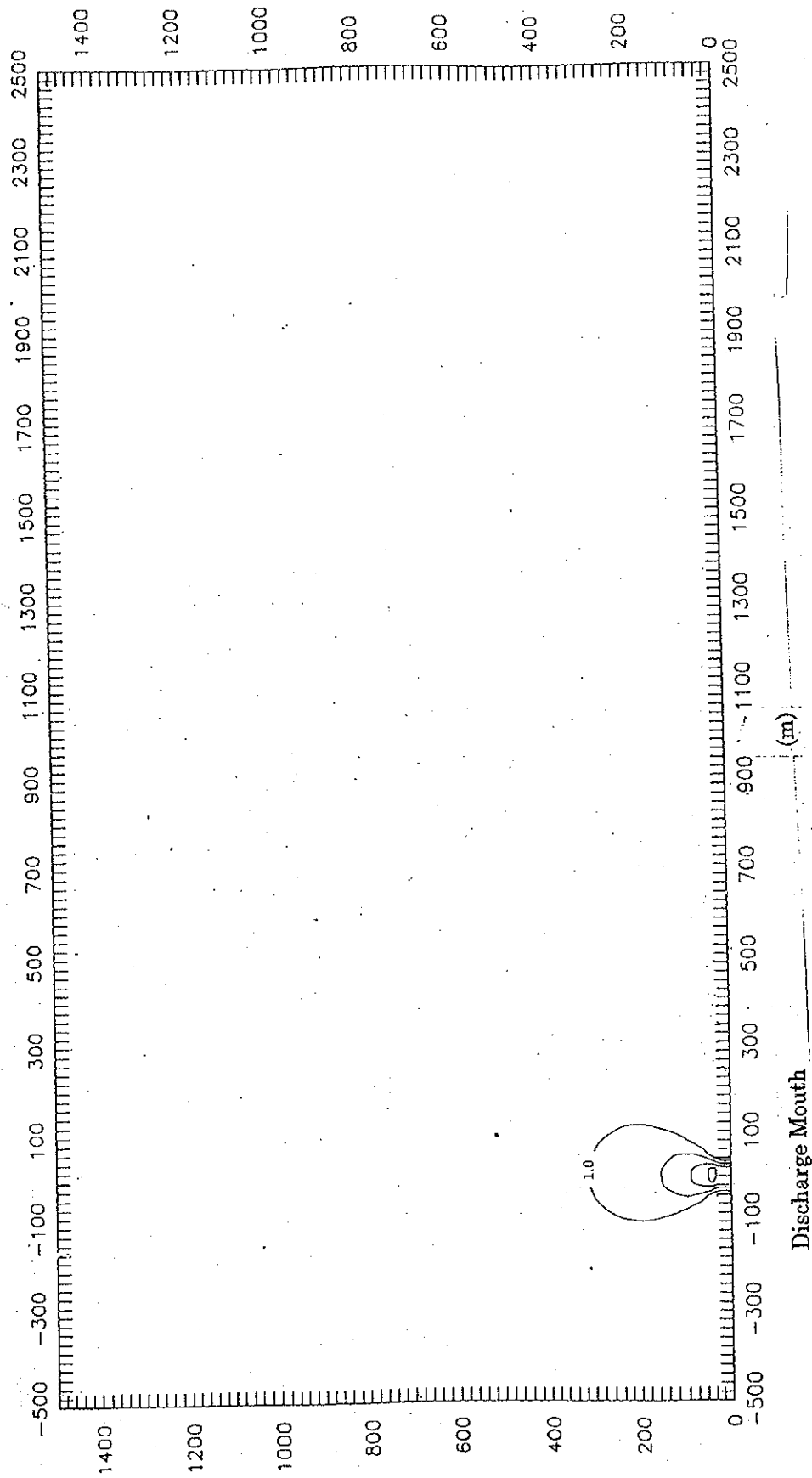


Figure 5.1 Temperature Contours for Case A - Flow Case NE

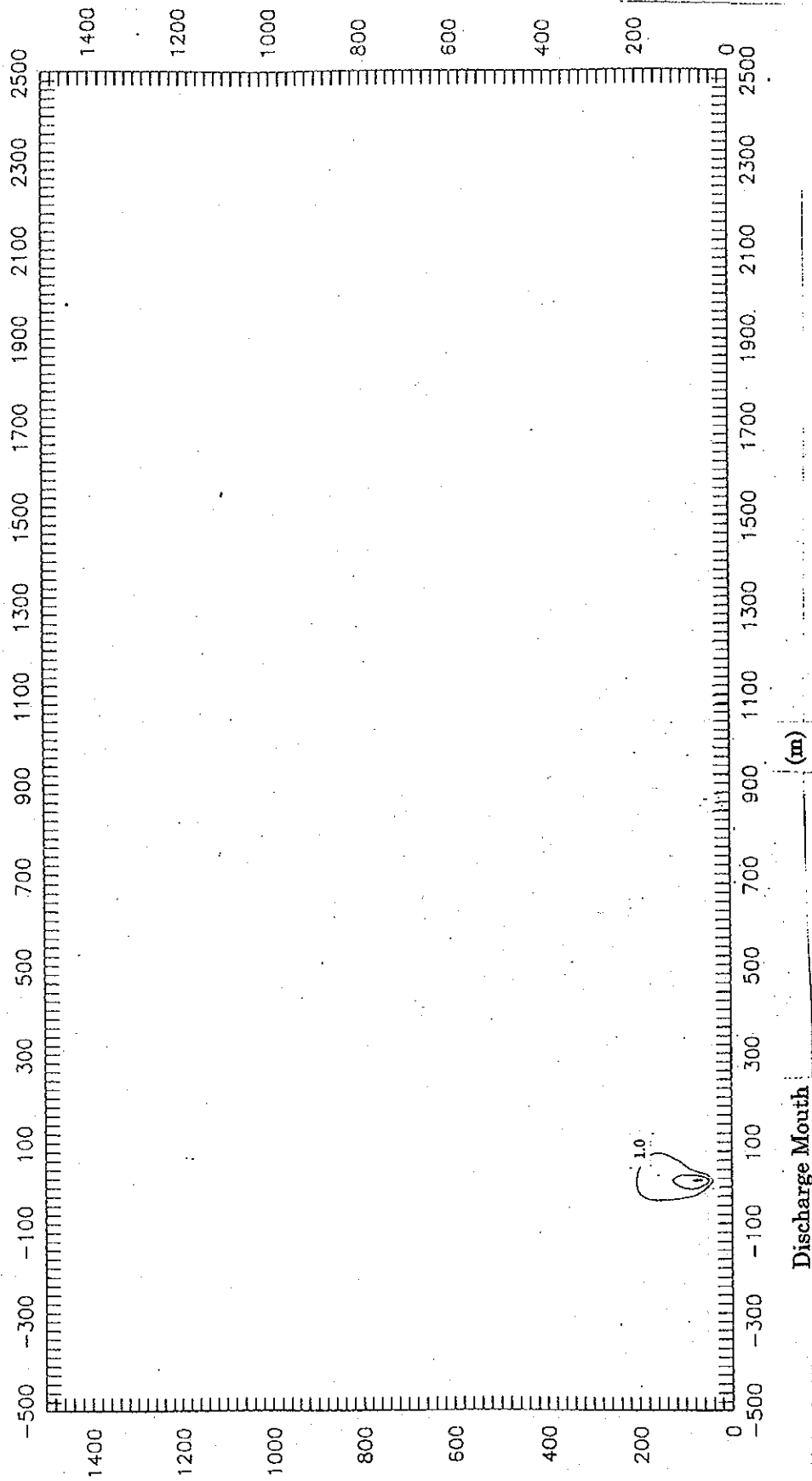


Figure 5.2 Temperature Contours for Case A - Flow Case IM

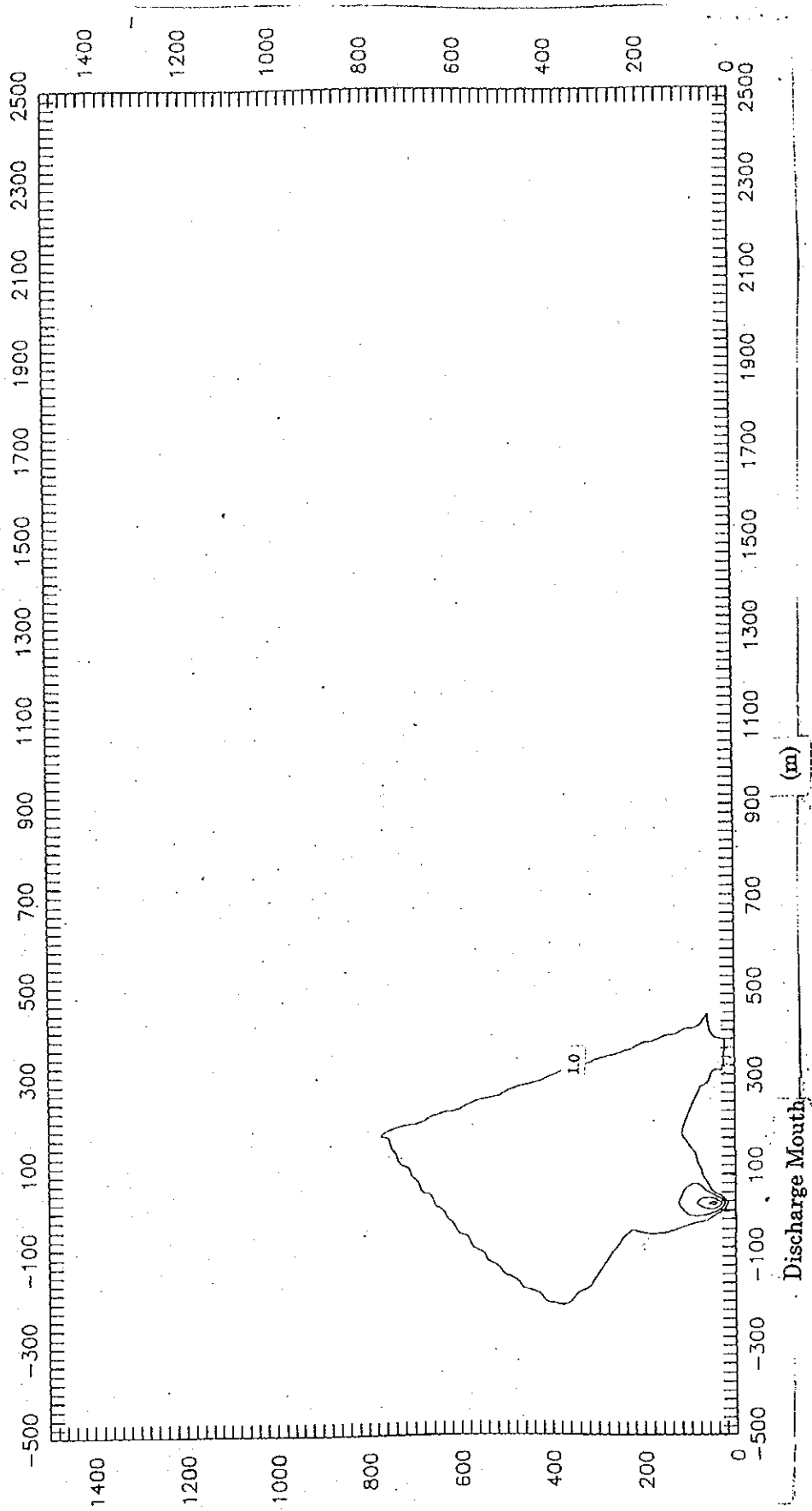


Figure 5.3 Temperature Contours for Case A - Flow Case SW1

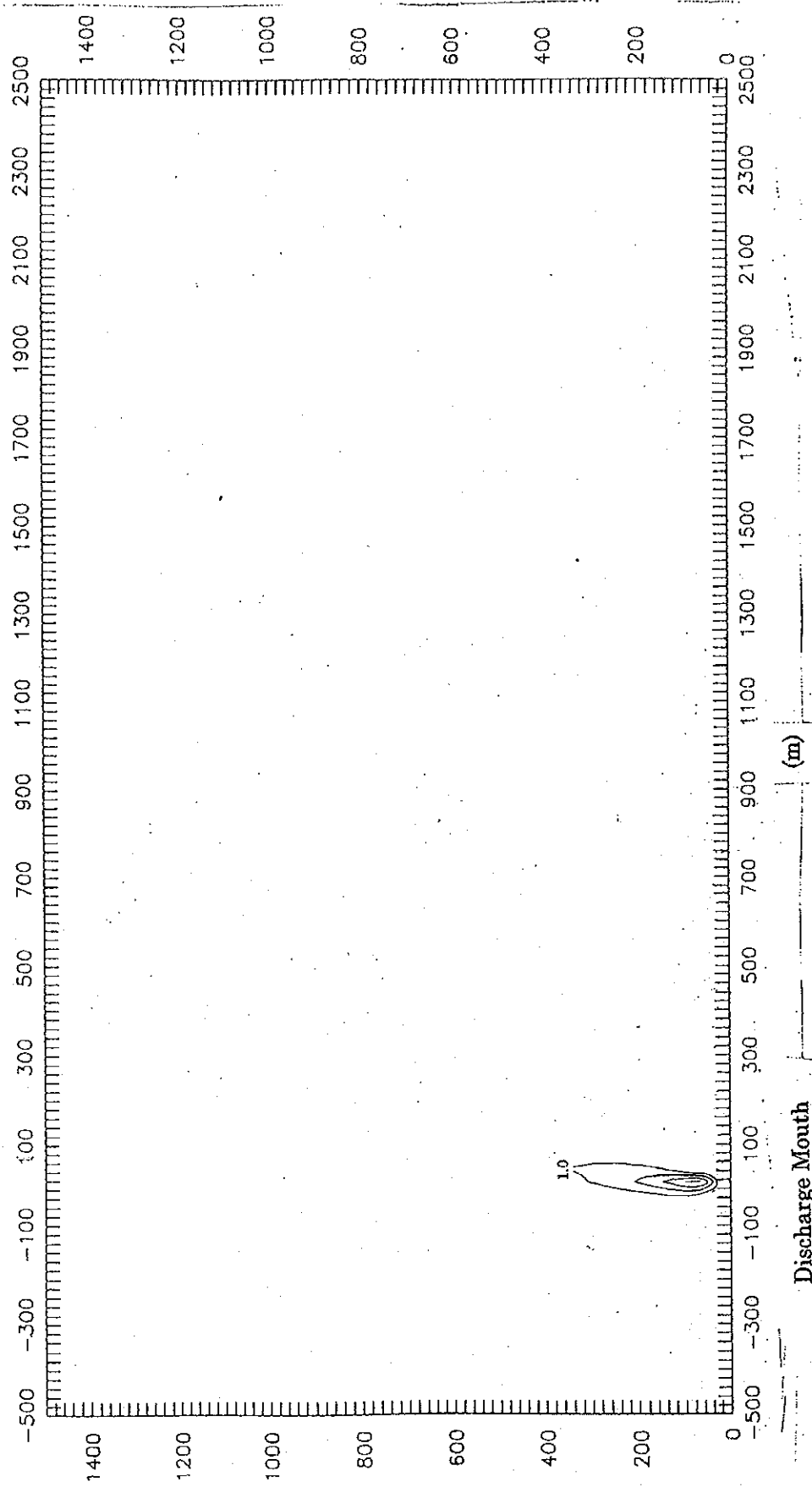


Figure 5.4 Temperature Contours for Case A - Flow Case SW2



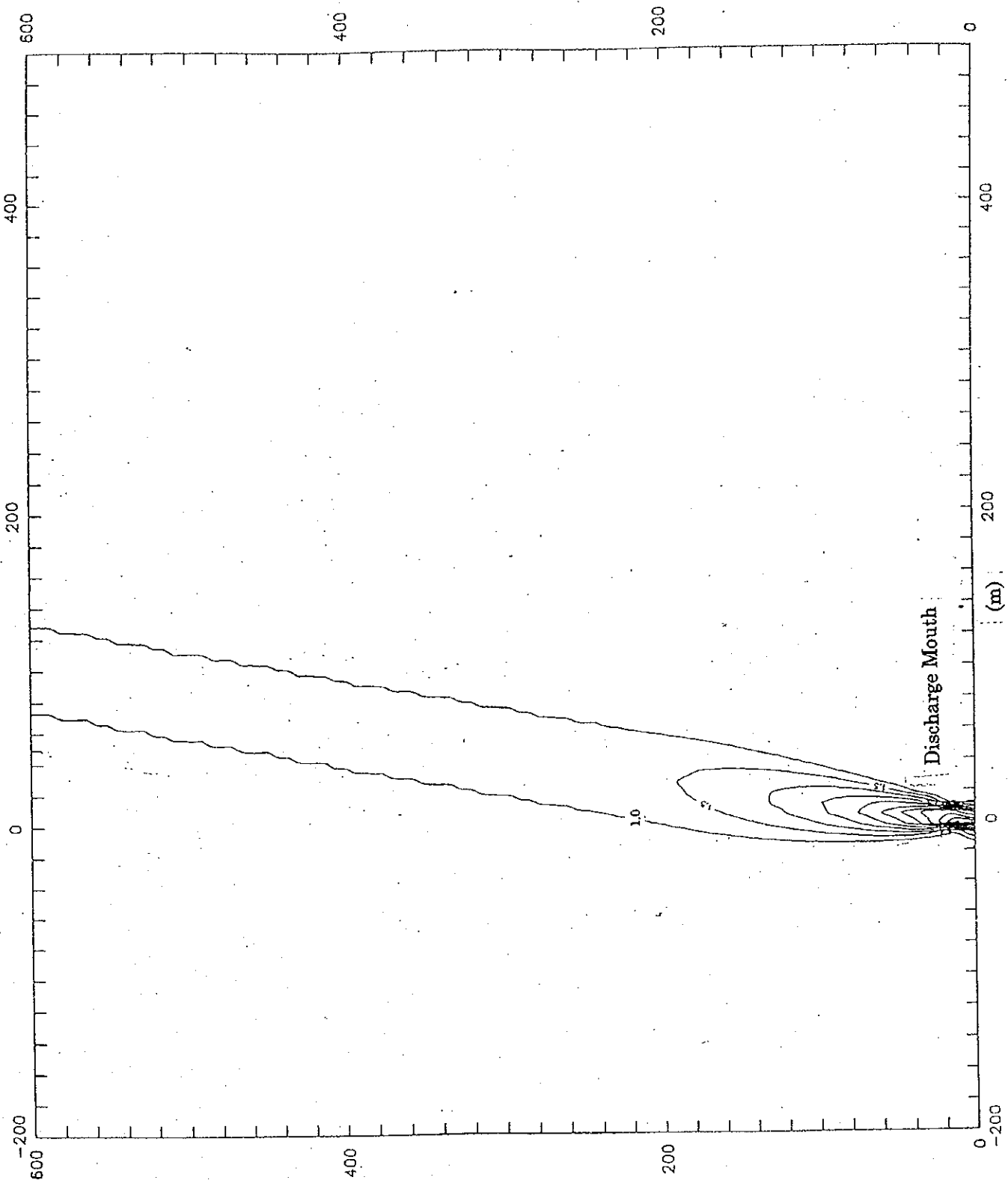


Figure 5.5 Temperature Contours for Case A - Flow Case SW3

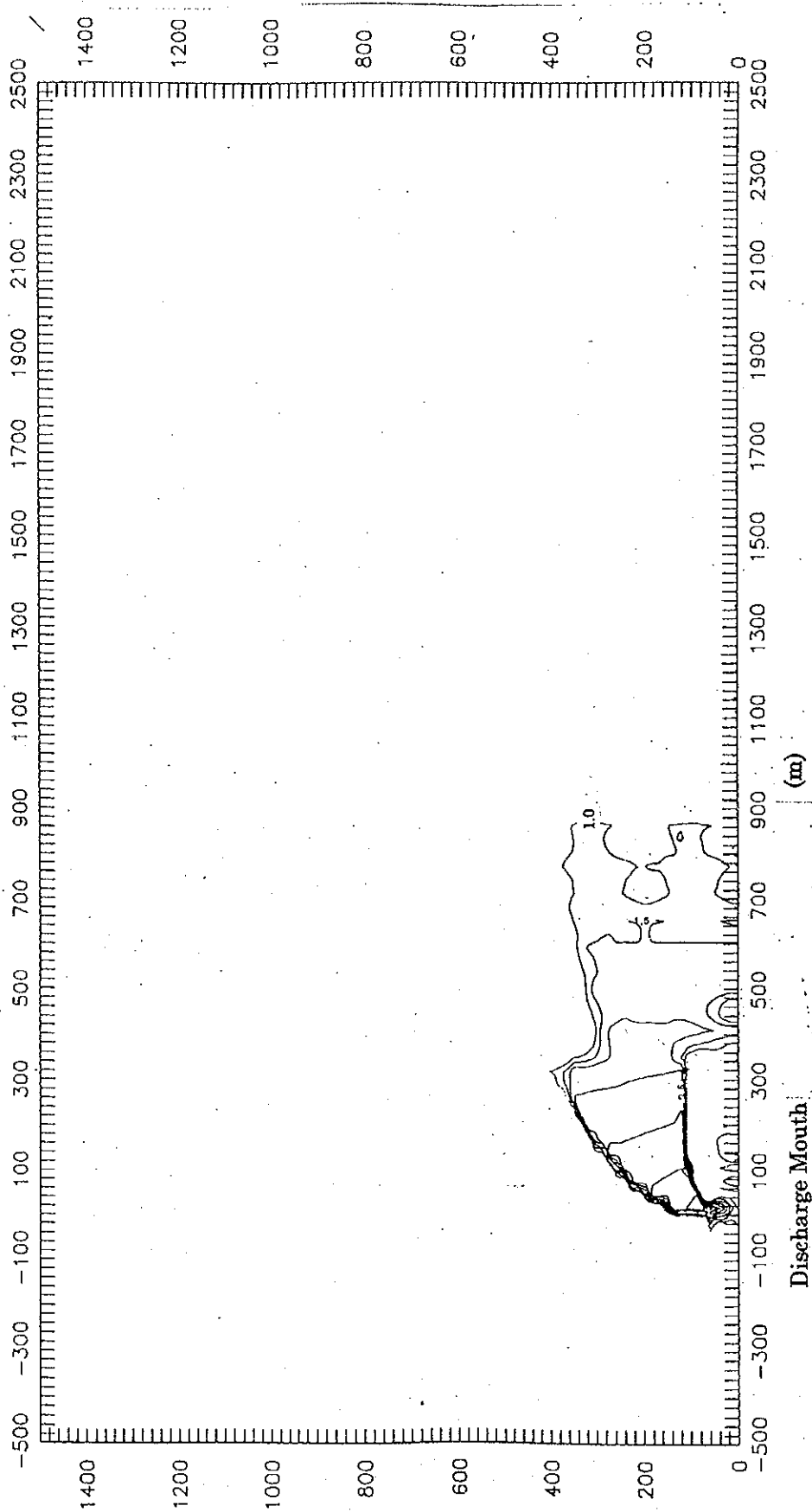


Figure 5.6 Temperature Contours for Case A - Flow Case SW4

As the steady state CORMIX3 model assumes that all the water entrained into the plume is at the ambient temperature the re-entrainment will cause the actual dilution to be less than that predicted by the model. The most recent version of CORMIX3 includes an enhancement that can be used to estimate the effects of tidal flow using a quasi-steady approach. Three examples will be given where the steady state results will be compared to the quasi-steady results.

Consider a case where the cross-flow is purely tidal, with a sinusoidal tidal variation of 24 hour period and a maximum amplitude of 10 cm/s. This type of variation is observed in the velocity data presented in Figure 4.3. The maximum will occur six hours before and after slack tide, i.e. the time when the velocity is zero. A cross-flow velocity of 5 cm/s will occur 2 hours before and after slack tide. The plume temperatures at these instances, when the cross-flow is 5 cm/s, can be compared to the result for a steady cross-flow of 5 cm/s given in Figure 5.7.

The temperature contours for the case of 2 hours after slack tide are shown in Figure 5.8. The contours are only given in the region 200 m offshore as the quasi-steady model is not applicable beyond this point. The plume is quite different from that shown in Figure 5.7, with the temperature at 200 m being about double the value for the steady flow case. This increase is the result of the unsteadiness of the flow and the re-entrainment of warm water discussed above. The results for 2 hours before slack tide are shown in Figure 5.9. The temperatures are not very different from the steady flow case, though they are slightly higher and the plume is broader. The region of validity of the solution now extends about 300 m offshore.

The differences between Figures 5.8 and 5.9 can be explained by considering the effect of the tidal cycle. Let us assume that the velocity is initially to the south, so that the plume forms to the south. The velocity reverses at slack tide, so that the pool of warm water formed south of the discharge is carried past the discharge to the north. At two hours after slack, the water that is carried past is what was discharged four hours before. As shown in Figure 5.8, the re-entrainment of this warm water causes significant differences from the steady case.

Eight hours later, i.e. two hours before the next slack period, the water that flows past the discharge is what was discharged twenty hours previously, i.e. eight hours before slack tide. This water has flowed north for ten hours and then moved back south for ten hours until it is once again at the discharge. During these twenty hours, the water has had time to mix with the ambient water and become fairly diluted. Therefore, as shown in Figure 5.9, the re-entrainment of this water does not result in significant differences from the steady state result.

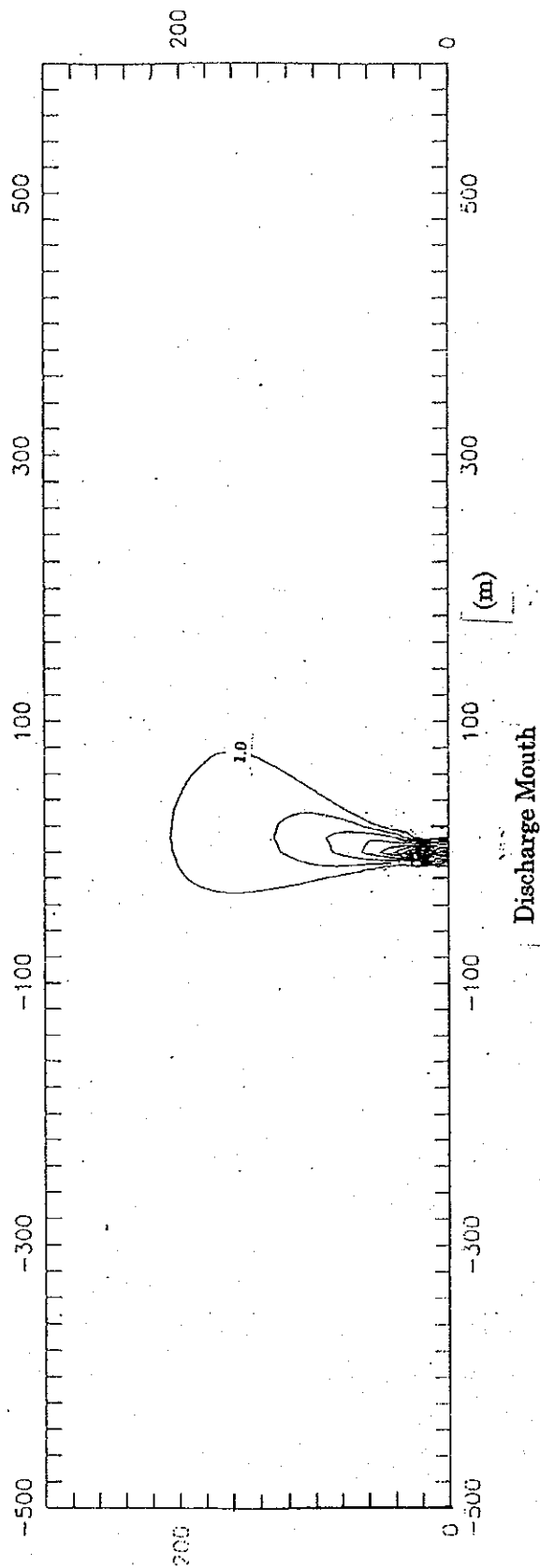


Figure 5.7 Temperature Contours for Case A - Flow Case IM (base case for tidal effect)

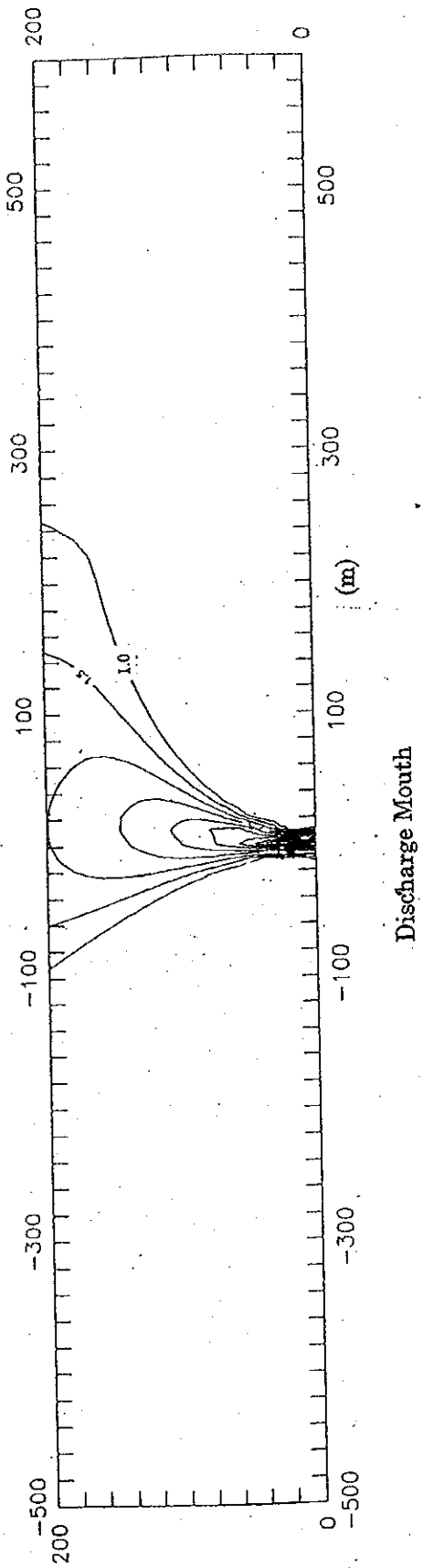


Figure 5.8 Temperature Contours for Case A - Tidal Flow 2 hours after slack

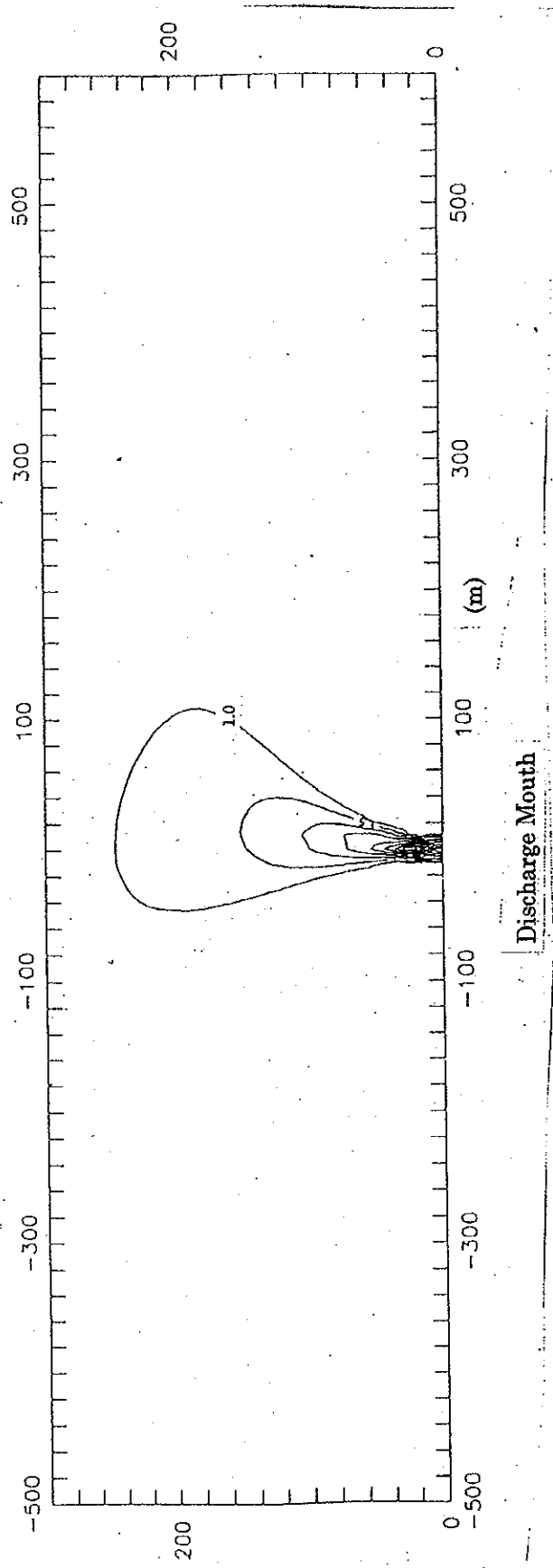


Figure 5.9 Temperature Contours for Case A - Tidal Flow 2 hours before slack

## 6. SUMMARY AND CONCLUSIONS

The objective of this study was to determine the dispersion of the cooling water discharge of the proposed combined-cycle power plant at Kerawalapitiya. The cooling water is to be discharged through a rectangular channel located at the shore-line, at velocities of 0.5 m/s.

The case study specifications required that four ambient conditions be simulated, based on the seasonal variation of the cross-flow and also the seasonal flow in the nearby Kelani Ganga, which may result in the stratification of the sea near the discharge. The important model parameters are the representation of the geometry, the ambient density structure and the ambient flow velocity. The model assumes that these parameters are the same throughout the model domain. The bathymetry was found to be quite uniform along the shore, i.e., in the direction of the cross-flow. The shore profile dropped off sharply to a depth of around 6 m to 8 m, so that the use of a representative rectangular cross-section by the model was justified. However, there was a sandstone reef about 900 m offshore, where the depth reduced abruptly to about 5 m before falling off to 10 m and more. This reef meant that the model results beyond 900 m from the shore are valid only if the plume is above the reef, i.e., the plume depth is less than 5 m, when it reaches the reef.

The temperature and salinity were measured at three depths. The measurement period included a period of high flow in the Kelani Ganga. Strong stratification was observed during this period. Based on this data three representative density profiles were developed, one unstratified (uniform) and two stratified (medium and high). Considering the data coverage it could be concluded that sufficient information was available to derive these profiles. On the other hand the velocity was only measured for two weeks during the north-east monsoon. Therefore velocities during other seasons were assumed based on experience with other projects in the same area.

The results of these simulations were presented as contour plots of surface temperature and the flow direction was assumed to be northward. Southward flows would merely produce a mirror image of the results. The results of Case A show that the discharge is diluted very rapidly, with an excess temperature of 1 degree being achieved within 500 m of the outfall.