

CHAPTER FIVE

5.0 CONCLUSIONS

5.1 GENERAL

This chapter summarizes the key results and comments of water quality analysis and recommendations to improve the water quality and recommendations for future researches.

5.2 KEY RESULTS AND COMMENTS

- Hydrodynamic and hydrological forcing drives much of the spatial and temporal water quality dynamics within the Negombo estuary.
- The highest COD values were recorded on day 3 and the lowest on day 4. This indicates that the organic pollutants, entrained with storm water are the major cause of the organic pollution. Once flushed with the higher rate of discharge after a period of heavy precipitation, on day 4, COD values have become minimal.
- Flushing has played a significant role in keeping nutrient concentrations down. Nitrate and phosphate concentrations are relatively lower within the estuary on day 4.
- Intense storm with the commencement of the intermonsoonal rain on day 3 delivered abundant ammoniacal N to the estuary.
- On day 4, concentrations of ammoniacal N through out the estuary are relatively high. It indicates that the microbial transformations of ammoniacal-N to nitrates have been minimal as a result of the least retention time on day 4.

- On day 4, abundant nitrate-N is delivered to the estuary from catchment runoff.
- The nitrate-N concentration of the marine water is around 0.04 mg/L and the fresh water inputs have higher nitrate-N concentrations indicating that the source of nitrate is fresh water inputs.
- Dandugam-Oya has brought the highest loads of DIN and TN irrespective of the climatic conditions.
- Dandugam-Oya has brought the highest loads of phosphate-P and TP on day 4. But Jaela has brought the highest load of phosphate-P on day 3.
- Higher concentrations of ammoniacal N, TN, phosphate and TP have been delivered to the estuary on day 3 and day 4 with the catchment runoff.
- When the fresh water discharge is high, results showed that there is a potential of P limitation of the primary production. When the fresh water discharge is low, there is a potential of N limitation. Though the studies of the estuaries in temperate zone have shown the potential of N limitation, this study shows that in Negombo estuary, which is in the tropical region, P has the limiting potential at many locations when the fresh water discharge is high. Limiting potential shifts from P to N when the fresh water discharge becomes low in the dry season.
- According the TN, TP and Chl *a* levels, location 1 (sea) is eutrophic both in dry and wet seasons.
- Chl *a* levels of locations 2 and 3 manifest that these two locations are eutrophicated.

- Chl *a* levels of the upstream of the Hamilton canal are higher than that of Dandugam-Oya and Ja-ela and manifest the waterbody is mesotrophic. Hamilton canal has faced the threat of eutrophication.
- Chl *a*, TN and TP levels in all the sampling locations at the middle part of the estuary, shows the waterbody is eutrophicated. Chl *a* levels of locations 6 and 7 on the wet season (05.01.2003) and location 7 on dry season (Day 6- 10.02.2003) has exceeded even the Eutrophic-hypertrophic boundary, which is 0.005 mg/L. This manifests that the location 7 is hypertrophic on both wet and dry seasons while the location 6 is hypertrophic on wet season.

5.3 RECOMMENDATIONS TO IMPROVE THE WATER QUALITY


- Discharges of nutrients to the estuary with the fresh water inflows should be strictly maintained below the permissive levels.
- Effluents of the wastewater treatment plants should be monitored to assure their proper functioning.
- As dredging reduces the flushing time and increases the water exchange, it would be the most preferred option to improve the water quality.
- As the most feasible dredging option is the alternative 6, it is recommended.
- To be able to effectively manage the nutrient over-enrichment, criteria of acceptable nutrient loads should be defined.
- As there is a tendency of P limitation of the primary production, limiting P is important in controlling the eutrophication.

- Keeping a riparian vegetated strip adjacent to the water course is reported to eliminate P leakage to the water course by sedimentation and deposition.

5.4 RECOMMENDATIONS FOR FUTURE RESEARCHES

- Maximum acceptable levels of nutrients in streams and rivers are not established so far. Therefore data analyses are needed to establish them.
- In this study, nutrient limitation was determined using the nutrient levels of the water column. It should be further investigated by bioassays.
- The dissolved oxygen (DO) profile of the estuary is very important as it is closely linked with the efficiency of nitrification-denitrification, release of phosphates from sediments, pH etc. In this study, due to the practical inabilities, it could not be done. In future researches it is better to study the variation of the DO profile with the other variables.
- To assess the health of the water body continuously, it is better to introduce a water quality index.

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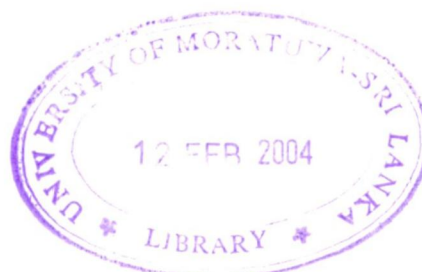
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ANNEXES



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A 1: PROPOSED AMBIENT WATER QUALITY STANDARDS FOR INLAND WATERS

Parameter	Unit, Type of limit	CLASS I Waters		CLASS II Waters (Sensitive waters)			Irrigation and agriculture	Class III Waters (general Waters)
		Nature Conservation	Drinking water With simple Treatment	Bathing	Fish and aquatic Life	Drinking water, With conventional Treatment		Minimum Quality (Other Uses)
		1	2	3	4	5	6	7
General								
1. Colour (after simple filtration)	Pt mg/l, max.	n	20	-	-	100	-	-
2. Total dissolved solids (TDS)	Mg/l, max.	n	-	-	-	-	500	-
3. Conductivity	dS/m, max.	n	-	-	-	-	0.7	-
4. Odour	-	n	unobj	unobj	-	unobj	-	-
5. Taste	-	n	unobj	-	-	unobj	-	-
6. Turbidity	NTU, max.	n	5	-	-	-	-	-
7. Sodium absorption ratio (SAR)	-	n	-	-	-	-	6-15	-
8. Residual sodium Carbonate (RSC)	Meq./l, max.	n	-	-	-	-	1.25	--
9. Total hardness	As CaCO ₃ mg/l, max.	n	250 des. 600 max	-	-	-	-	-
10. pH	-	n	6.0-8.5	6.0-9.0	6.0-8.5	6.0-9.0	6.0-8.5	5.5-9.0
11. Dissolved Oxygen at 25°C	Mg/l, min	n	6	5	3	4	3	3
12. BOD (5 days at 20°C or 3 days at 30°C)	Mg/l, max.	n	3	4	4	5	5	5
13. COD	Mg/l, max	n	15	20	15	30	-	40

Parameter	Unit, Type of limit	CLASS I Waters		CLASS II Waters (Sensitive waters)			Irrigation and agriculture	Class III Waters (general Waters)	
		Nature Conservation	Drinking water With simple Treatment	Bathing	Fish and aquatic Life	Drinking water, With conventional Treatment		Minimum Quality (Other Uses)	
		1	2	3	4	5	6	7	
Nutrients									
14. Nitrates (NO ₃ - N)	mg/l, max.	n	5	5	5	5	5	5	
15. Total ammonia (NH ₃ -N)	mg/l, max.								
- pH < 7.5		n	-	-	0.94	-	-	9.1	
- pH = 8.0		-	-	-	0.59	-	-	4.9	
- pH = 8.5		-	-	-	0.22	-	-	1.6	
16. Total phosphate (PO ₄ -P)	mg/l, max.	n	0.7	0.7	0.4	0.7	0.7	0.7	
Other Substances									
17. Chlorides (Cl)	mg/l, max.	n	200	-	-	200	100	-	
18. Cyanides (CN)	mg/l, max.	n	0.005	0.005	0.005	0.005	0.005	0.005	
19. Fluorides (F)	mg/l, max.	n	1.5	-	-	1.5	-	-	
20. Sulphates (SO ₄)	mg/l, max.	n	250	-	-	250	1000	--	
Metals									
21. Total cadmium (Cd)	µg/l, max.	n	5	-	H <60 60-120 120-180 >180	Cd 0.2 0.8 1.3 1.8	5	-	5
22. Total chromium (Cr)	µg/l, max.	n	50	-	2		50	-	50
23. Total copper (Cu)	µg/l, max.	n	-	-	H <60 60-120 120-180 >180	Cu 2 2 3 4	-	-	100

Parameter	Unit, Type of limit	CLASS I Waters		CLASS II Waters (Sensitive waters)			Irrigation and agriculture	Class III Waters (general Waters)
		Nature Conservation 1	Drinking water With simple Treatment 2	Bathing 3	Fish and aquatic Life 4	Drinking water, With conventional Treatment 5		Minimum Quality (Other Uses) 7
24. Iron (Fe)	µg/l, max.	n	300 des. 1000 max	-	300	200	-	-
25. Lead (Pb)	µg/l, max.	n	50	-	H <60 60-120 120-180 >180 Pb 1 2 4 7	50	-	50
26. Manganese (Mn)	µg/l, max.	n	1000	1000	1000	1000	1000	1000
27. Mercury (Hg)	µg/l, max.	n	1	1	0.1	1	1	2
28. Nickel (Ni)	µg/l, max.	n	100	100	H <60 60-120 120-180 >180 Ni 25 65 110 150	100	100	100
29. Selenium (Se)	µg/l, max.	n	10	10	1	10	-	-
30. Zinc (Zn)	µg/l, max.	n	1000	1000	30	1000	1000	1000
31. Boron (B)	µg/l, max.	n	-	-	-	-	500	--
32. Total arsenic (As)	µg/l, max.	n	10	50	50	10	50	50
33. Aluminium (Al)	µg/l, max.	n	200	-	-	200	5.0	-
Organic Micro Pollutants								
34. Phenol index	µg/l, max.	n	2	5	1	5	5	5
35. Oil and grease	µg/l, max.	n	100	200	10	100	-	300

Parameter	Unit, Type of limit	CLASS I Waters		CLASS II Waters (Sensitive waters)			Irrigation and agriculture	Class III Waters (general Waters) Minimum Quality (Other Uses)
		Nature Conservation 1	Drinking water With simple Treatment 2	Bathing 3	Fish and aquatic Life 4	Drinking water, With conventional Treatment 5		
36. Anionic surfactants (detergent) as MBAS	µg/l, max.	n	200	300	1000	200	1000	1000
37. Total pesticides	µg/l, max.	n	10	30	30	30	50	50
Micro Organisms								
38. Total coliform	MPN/100ml, (*P=95%)	n	5000	1000	20,000	5000	1000	-
39. Faecal coliform	MPN/100ml, (*P=95%)	n	250 des. 600 max	50	-	-	-	-

Abbreviations :

- n - Nature or baseline values
H - Hardness in terms of CaCO₃ in mg/l
des. - Desirable highest level
max. - Maximum permissible substances
MBAS - Methylene blue active substances
*P=95% - 95% of the samples give a value that is equal to or less than the indicated limit
1 - Mean – during longer period
2 - Min. dly – average of daily waters
3 - prevention of eutrophication, excessive weed growth, etc., may require lower, site specific, for stagnant waters

A 2 : COASTAL WATER QUALITY STANDARDS

Parameter	Unit	Value for different use classes			
		Nature conservation 1	Fishery of Shell Fish 2	Fishery of Fin Fish 3	Non Consumption 4
1. Floatable solids		n	n	n	NO
2. Floatable oil & grease		n	n	n	NO
3. Suspended solids		n	n	n	NO
4. Transparency ¹		n	<10%	<10%	<50%
5. Colour		n	NV	NV	NO
6. Odour		n	n	n	NO
7. Temperature	° C	<32	<32	<32	<32
8. Coliform (total)	MPN / ml	n	n	<10	<20
9. Coliform (faecal)	MPN / ml	n	n	<3	<6
10. pH		n	7.0-8.5	7.0-8.5	6.5-9.0
11. Salinity	g/l	n	29-35	<10%	<20%
12. Dissolved Oxygen	Saturation value	n	>80%	>70%	>60%
13. BOD ₅ at 20° C or BOD ₅ at 30° C	mg/l	n	<5	<5	<10
14. Phosphate (total) as N	mg/l	n	NA	NA	NA
15. Nitrogen (total) as N	mg/l	n	NA	NA	NA
16. Ammonia (free) as N	mg/l	n	<0.4	<0.4	<1.2
17. Cyanide (CN)	µg/l	n	<10	<10	<20
18. Sulphide (H ₂ S)	µg/l	n	<5	<5	<10
19. Fluoride (F)	µg/l	n	<1.5	<1.5	<3
20. Mercury (Hg)	µg/l	n	<0.1	<0.1	<0.2
21. Cadmium (Cd)	µg/l	n	<5	<5	<10
22. Chrome (hex.) (Cr ⁶⁺)	µg/l	n	<25	<25	<50
23. Lead (Pb)	µg/l	n	<25	<25	<50
24. Copper (Cu)	µg/l	n	<25	<25	<50
25. Manganese (Mn)	µg/l	n	<100	<100	<200
26. Zinc (Zn)	µg/l	n	<50	<50	<100
27. Iron (Fe)	µg/l	n	<300	<300	<600
28. Arsenic (As)	µg/l	n	<50	<50	<100
29. Phenols (C ₆ H ₅ OH)	µg/l	n	<30	<30	<60
30. PCB (total)	µg/l	n	<0.03	<0.03	<0.06
31. Pesticides (total)	µg/l	n	<0.05	<0.05	<0.1

¹ % = Change from natural condition

n = Natural condition

NO = Not Objectionable

NV = Not Visible

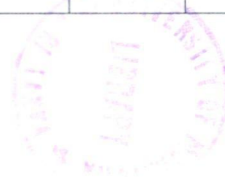
NA = Below level causing algae bloom (to be established)

A3: Project: Water Quality of Negombo Lagoon.

Sampling Date: 25, September, 2002 10.00 a.m.-12 .00 noon.

Sampling Point No.	Coordinates of each Point		Depth (m)	Time	pH		Temperature (°C)		Conductivity (ms/cm)		Salinity (ppt)	
	N	E			top	bottom	top	bottom	top	bottom	top	bottom
1	07° 12.644 ¹	079° 49.493 ¹	4.98	10.05a.m.	7.93		30.0		58.8		35.3	
1A	07° 12.492 ¹	079° 49.500 ¹		10.10a.m.	7.95		30.0		58.5		35.1	
2	07° 12.186 ¹	079° 49.832 ¹	3.45	10.12a.m.	7.97		30.0		57.7		34.6	
2A	07° 11.868 ¹	079° 49.776 ¹	1.5	10.20a.m.	7.95		30.0		58.4		35.0	
2B	07° 11.256 ¹	079° 49.818 ¹	1.85	10.25 a.m.	8.02		30.0		58.2		34.9	
3	07° 12.460 ¹	079° 50.224 ¹	1.02	10.17 a.m.	6.83		30.0		10.2		5.2	
4	07° 10.796 ¹	079° 49.910 ¹	1.63	10.30a.m.	8.01	7.95	30.0	30.0	58.4	60.1	35.0	36.2
5	07° 10.366 ¹	079° 50.247 ¹	1.29	10.45a.m.	7.98	7.91	30.0	30.0	59.4	60.5	35.7	36.5
6	07° 10.210 ¹	079° 50.592 ¹	1.57	11.02a.m.	7.94	7.52	30.0	30.5	59.2	58.3	35.6	34.6
6A	07° 8.838 ¹	079° 51.252 ¹	1.35	11.20a.m.	7.88	7.64	30.5	30.5	59.6	58.2	35.5	34.5
7	07° 08.383 ¹	079° 51.716 ¹	1.17	11.30a.m.	7.78	7.42	30.0	32.0	57.5	54.8	34.4	31.3
8A			1.25	12.00noon.	7.15		30.0		26.2		14.4	
8	07° 02.618 ¹	079° 51.772 ¹	1.27									
9A			0.73	11.55a.m	7.33		32.0		47.4		26.6	
9	07° 04.814 ¹	079° 53.444 ¹	2.21									
10A			1.92	11.40a.m	7.49		32.0		51.0		28.9	
10	07° 06.588 ¹	079° 52.964 ¹	4.98									

Sampling Point No.	Total Nitrogen (mg/l)		Nitrates - N (mg/l)		Ammonia - N (mg/l)		Phosphorous (mg/l)		Phosphate - P (mg/l)		COD (mg/l)		Total dissolved solids (mg/l)	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
1			0.499		0.041		0.80689		0.01127		163.78			
1A			0.065		0.054		0.74102		0.01041		155.16			
2	92.00						0.15232				181.02			
2A	35.7										163.78			
2B											77.58			
3	56.70						0.06484				103.44			
4			0.059	0.160	0.068	0.025	0.04405	0.12865	0.00086	0.06311	86.20	155.16		
5	45.1	46.2		0.258		0.034	0.07307	0.16364	0.01757	0.04214	163.78	241.36		
6	33.90	68.00	0.142	0.284	0.044	0.048	0.13585	0.16467	0.00431	0.02494	83.68	58.52	41440	41482
6A				0.404		0.072		0.06793		0.02577	200.64	58.58	42380	40696
7		95.50	0.150	0.218	0.036	0.017	0.21407	0.07822	0.01993	0.01068	92.05	75.31	36790	38980
8A			0.247		0.018		1.06213		0.00933		41.80			
8														
9A	58.8		0.246		0.033		0.10292		0.01075		83.68			
9														
10A	51.9		0.208		0.028		0.55989		0.00195		58.52			
10														



A 4: Project: Water Quality of Negombo Lagoon.

Sampling Date: 25 September, 2002 3.00 p.m.-7.00 p.m.

Sampling Point No.	Coordinates of each Point		Depth (m)	Time	pH		Temperature (°C)		Conductivity (ms/cm)		Salinity (ppt)			
	N	E			top	bottom	top	bottom	top	bottom	top	bottom		
1	07° 12.644 ¹	079° 49.493 ¹	4.98	3.00p.m.	8.02		30.0		61.6		37.2			
1A	07° 12.492 ¹	079° 49.500 ¹		3.02p.m.	7.99		30.0		61.2		36.9			
2	07° 12.186 ¹	079° 49.832 ¹	3.45	3.04p.m.	7.99		32.0		61.1		35.4			
2A	07° 11.868 ¹	079° 49.776 ¹	1.5	3.15p.m.	8.00		30.0		61.8		37.3			
2B	07° 11.256 ¹	079° 49.818 ¹	1.85	3.20p.m.	8.01		30.0		61.4		37.0			
3	07° 12.460 ¹	079° 50.224 ¹	1.02	3.10p.m.	7.14		30.0		24.9		13.6			
4	07° 10.796 ¹	079° 49.910 ¹	1.63	3.30p.m.	8.04		30.0		61.0		36.8			
5	07° 10.366 ¹	079° 50.247 ¹	1.29	3.40p.m.	7.78		30.5		60.5		36.1			
6	07° 10.210 ¹	079° 50.592 ¹	1.57	3.50p.m.	7.95		31.0		60.8		35.9			
6A	07° 8.838 ¹	079° 51.252 ¹	1.35	4.00p.m.	7.89		31.0		59.3		34.9			
7	07° 08.383 ¹	079° 51.716 ¹	1.17	4.10p.m.	7.81		32.0		54.5		31.1			
8A			1.25	4.43p.m.	7.56		32.0		26.5		14.0			
8	07° 02.618 ¹	079° 51.772 ¹	1.27	6.55p.m.	7.29		32.0		24.8		13.0			
9A			0.73	4.35p.m.	7.53		32.0		47.9		26.9			
9	07° 04.814 ¹	079° 53.444 ¹	2.21	6.30p.m.	6.78		32.0		22.2		11.5			
10A			1.92	4.20p.m.	7.65		32.0		50.5		28.6			
10	07° 06.588 ¹	079° 52.964 ¹	4.98	6.15p.m.	6.99		32.0		30.5		16.3			
Sampling Point No.	Total Nitrogen (mg/l)		Nitrates - N (mg/l)		Ammonia - N (mg/l)		Total Phosphorous (mg/l)		Phosphate - P (mg/l)		COD (mg/l)		Total dissolved solids (mg/l)	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
1			0.124		0.054		0.77808		0.00968		58.52			
1A	9.60		0.136		0.084		0.57223		0.02505		225.72			
2											71.06			
2A	96.00						0.17805		0.03406		117.04			
2B	60.50						0.15953				147.83			
3	111.1						0.17394				91.96			
4	17.70		0.152		0.087		0.71221		0.00579		58.58			
5	84.50						0.13071				86.96			
6			0.319		0.013						43.48			
6A	40.60						0.15335				121.74			
7			0.199		0.046		0.42631		0.00383		34.78			
8A	49.97		0.062		0.086		0.26348		0.03961		86.96			
8	41.9		0.422		0.123		0.54342		0.02575		78.26			
9A			0.223		0.048		0.75337				47.83			
9	37.50		0.249		0.237		0.34993		0.03158		78.26			
10A			0.215		0.023						4.34			
10			0.499		0.072		0.54342				121.74			

A 5: Project: Water Quality of Negombo Lagoon.

Sampling Date: 15, October, 2002 10.10 a.m.-12.10 p.m.

Sampling Point No.	Coordinates of each Point		Depth (m)	Time	pH		Temperature (°C)		Conductivity (ms/cm)		Salinity (ppt)	
	N	E			top	bottom	top	bottom	top	bottom	top	bottom
1	07° 12.644 ¹	079° 49.493 ¹	4.98	10.10a.m.	7.97		30.0		54.2		32.212	
1A	07° 12.492 ¹	079° 49.500 ¹		10.20a.m.	8.05		30.0		53.2		31.545	
2	07° 12.186 ¹	079° 49.832 ¹	3.45	10.30a.m.	8.10		30.0		52.1		30.815	
2A	07° 11.868 ¹	079° 49.776 ¹	1.5	10.45a.m.	8.06		30.0		51.0		30.087	
2B	07° 11.256 ¹	079° 49.818 ¹	1.85	10.55a.m.	8.05		30.0		45.3		26.357	
3	07° 12.460 ¹	079° 50.224 ¹	1.02	10.35 a.m.	6.94		30.0		23.2		12.61	
4	07° 10.796 ¹	079° 49.910 ¹	1.63	11.00a.m.	8.03		30.0	30	42.6	46.6	24.615	27.2
5	07° 10.366 ¹	079° 50.247 ¹	1.29	11.10a.m.	8.04		30.0	30	39.8	44.8	22.826	26
6	07° 10.210 ¹	079° 50.592 ¹	1.57	11.15a.m.	7.93		30.0	30	36.7	44.0	20.867	25.5
6A	07° 8.838 ¹	079° 51.252 ¹	1.35	11.30a.m.	7.91		30.0	30	35.9	42.4	20.365	24.5
7	07° 08.383 ¹	079° 50.716 ¹	1.17	11.40a.m.	7.79		30.0	30	35.3	38.6	19.989	22.1
8A			1.25	12.10p.m.	7.05		30.0		5.2		2.518	
8	07° 02.618 ¹	079° 51.772 ¹	1.27									
9A			0.73	12.00noon	8.42		30.0		18.1		9.622	
9	07° 04.814 ¹	079° 53.444 ¹	2.21									
10A			1.92	11.48a.m.	7.03		30.0		13.8		7.172	
10	07° 06.588 ¹	079° 52.964 ¹	4.98									

Sampling Point No.	Total Nitrogen (mg/l)		Nitrates - N (mg/l)		Ammonia - N (mg/l)		Total Phosphorous (mg/l)		Phosphate - P (mg/l)		COD (mg/l)		Total dissolved solids (mg/l)	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
1	9.4		0.072		0.034		0.4487		0.00385		88.8			
1A	9.5		0.061		0.000		0.3169		0.0515		58.5			
2	0.3										60.7			
2A	4.4										144.0			
2B	1.9										108.0			
3	5.8										22.5			
4	0.7		0.050		0.021		0.1894		0.0165		22.5			
5	0.3										153.0			
6	0.3		0.070		0.037		0.2964		0.00206		45.0			
6A	6.4										56.1			
7	5.1		0.130		0.067		0.4132		0.01440		130.0			
8A	7.7		0.047		0.276		0.0908		0.01132		74.8			
8														
9A	5.0		0.045		0.054		0.6838		0.0638		58.5			
9														
10A	3.8		0.056		0.056		0.011		0.01029		256.5			

A 6: Project: Water Quality of Negombo Lagoon.

Sampling Date: 15, October, 2002 2.45 p.m. a.m.-7.00 p.m.

Sampling Point No.	Coordinates of each Point		Depth (m)	Time	pH		Temperature (°C)		Conductivity (ms/cm)		Salinity (ppt)			
	N	E			top	bottom	top	bottom	top	bottom	top	bottom		
1	07° 12.644 ¹	079° 49.493 ¹	4.98	2.45p.m.	8.06		30.0		54.2		32.212			
1A	07° 12.492 ¹	079° 49.500 ¹		2.50p.m.	7.93		30.0		51.8		30.616			
2	07° 12.186 ¹	079° 49.832 ¹	3.45	2.55p.m.	8.02		30.0		51.8		30.616			
2A	07° 11.868 ¹	079° 49.776 ¹	1.5	3.15.m.	8.03		31.0		48.98		28.176			
2B	07° 11.256 ¹	079° 49.818 ¹	1.85	3.20p.m.	8.09		31.0		48.2		27.675			
3	07° 12.460 ¹	079° 50.224 ¹	1.02	3.05p.m.	6.96		31.0		36.7		20.447			
4	07° 10.796 ¹	079° 49.910 ¹	1.63	3.30p.m.	8.02		31.0		48.29		27.733			
5	07° 10.366 ¹	079° 50.247 ¹	1.29	3.40p.m.	7.95		31.0		43.7		24.812			
6	07° 10.210 ¹	079° 50.592 ¹	1.57	3.45p.m.	7.95		31.0		43.1		24.434			
6A	07° 8.838 ¹	079° 51.252 ¹	1.35	3.50p.m.	7.90		31.0		37.2		20.755			
7	07° 08.383 ¹	079° 50.716 ¹	1.17	4.00p.m.	7.81		31.0		40.1		22.554			
8A			1.25	4.35p.m.	6.99		31.0		6.9		3.337			
8	07° 02.618 ¹	079° 51.772 ¹	1.27	6.50p.m.	6.99		32.0		4.4		2.026			
9A			0.73	4.25p.m.	8.15		31.0		26.7		14.41			
9	07° 04.814 ¹	079° 53.444 ¹	2.21	6.25p.m.	6.61		32.0		6.7		3.171			
10A			1.92	4.10p.m.	7.95		31.0		16.7		8.641			
10	07° 06.588 ¹	079° 52.964 ¹	4.98	6.10p.m./	8.49		32.0		5.9		2.768			
Sampling Point No.	Total Nitrogen (mg/l)		Nitrates - N (mg/l)		Ammonia - N (mg/l)		Total Phosphorous (mg/l)		Phosphate - P (mg/l)		COD (mg/l)		Total dissolved solids (mg/l)	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
1	3.1		0.107		0.055		0.5393		0.00412		49.5			
1A	6.0		0.071		0.154		0.4282		0.0103		63.0			
2	5.7										79.4			
2A	6.5										500.0			
2B	0.7										228.8			
3	0.4										42.1			
4	5.0		0.045		0.149		0.424		0.00618		67.5			
5	5.0										526.8			
6	3.0		0.078		0.011		0.4652		0.00823		58.5			
6A	10.4										616.1			
7	5.0		0.076		0.030		0.3376		0.00		58.5			
8A	57.0		0.066		0.518		0.3582		0.03911		31.5			
8	21.0		0.054		0.737		0.5105		0.02676		37.4			
9A	5.0		0.079		0.056		0.3582		0.00823		400.5			
9	16.1		0.061		0.590		0.3376		0.0165		18.0			
10A	4.0		0.055		0.141		0.3541		0.00206		49.5			
10	12.8		0.054		0.120		0.3623		0.00823		13.5			

A 8 Project: Water Quality of Negombo Lagoon.
Sampling Date: 7 November, 2002 3.10 p.m.-7.00 p.m.

Sampling Point No.	Coordinates of each Point		Depth (m)	Time	pH		Temperature (°C)		Conductivity (ms/cm)		Salinity (ppt)			
	N	E			top	bottom	top	bottom	top	bottom	top	bottom		
1	07° 12.644 ¹	079° 49.493 ¹	4.98	3.10p.m.	8.44		31.0		30.1		16.435			
1A	07° 12.492 ¹	079° 49.500 ¹		3.15p.m.	8.49		31.0		31.9		17.519			
2	07° 12.186 ¹	079° 49.832 ¹	3.45	3.17p.m.	8.36		31.5		29.2		15.738			
2A	07° 11.868 ¹	079° 49.776 ¹	1.5	3.30.m.	7.57		31.0		28.0		15.181			
2B	07° 11.256 ¹	079° 49.818 ¹	1.85	3.35p.m.	8.37		31.0		21.3		11.258			
3	07° 12.460 ¹	079° 50.224 ¹	1.02	3.23p.m.	7.70		31.5		8.4		4.079			
4	07° 10.796 ¹	079° 49.910 ¹	1.63	3.40p.m.	8.40		31.0		20.3		10.683			
5	07° 10.366 ¹	079° 50.247 ¹	1.29	3.45p.m.	8.43		31.0		31.1		17.036			
6	07° 10.210 ¹	079° 50.592 ¹	1.57	3.50p.m.	8.34		31.5		15.1		7.671			
6A	07° 8.838 ¹	079° 51.252 ¹	1.35	3.55p.m.	8.29		31.0		13.9		7.084			
7	07° 08.383 ¹	079° 50.716 ¹	1.17	4.02p.m.	7.99		31.5		11.4		5.663			
8A			1.25	4.40p.m.	7.11		31.0		0.9		0.392			
8	07° 02.618 ¹	079° 51.772 ¹	1.27	7.00p.m.	7.04		30.0		2.1		0.966			
9A			0.73	4.25p.m.	6.86		29.0		0.2		0.091			
9	07° 04.814 ¹	079° 53.444 ¹	2.21	6.25p.m.	6.53		29.5		0.2		0.09			
10A			1.92	4.15p.m.	7.93		29.0		0.1		0.049			
10	07° 06.588 ¹	079° 52.964 ¹	4.98	6.15p.m.	6.26		28.5		0.2		0.092			
Sampling Point No.	Total Nitrogen (mg/l)		Nitrates - N (mg/l)		Ammonia - N (mg/l)		Total Phosphorous (mg/l)		Phosphate - P (mg/l)		COD (mg/l)		Total dissolved solids (mg/l)	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
1	4.80		0.042		0.085		0.422		0.0036		43.80			
1A	10.65		0.039		0.089		0.7204		0.0069		67.80			
2	9.56										152.54			
2A	12.10										67.80			
2B	9.95										84.75			
3	15.17										13.04			
4	2.20		0.050		0.111		0.0085		0.0043		99.82			
5	1.40										273.90			
6	0.42		0.082		0.081		0.571		0.00216		147.56			
6A	0.77										243.48			
7	0.85		0.034		0.095		0.3064		0.00391		78.26			
8A	1.40		0.145		0.128		0.3158		0.01276		21.90			
8	1.03		0.091		0.220		0.5466		0.04529		65.70			
9A	19.70		0.380		0.100		0.5137		0.08717		4.38			
9	11.15		0.166		0.133		0.4595		0.0071		4.38			
10A	18.25		0.282		0.148		0.5345		0.01441		4.35			
10	15.30		0.288		0.085		1.0276		0.01163		13.14			

A 9: Water quality of Negombo Lagoon (2nd January 2003)

Sampling Point No.		1	2	3	4	5	6	7	8	9	10
Coordinates of each point	N	07° 12.644 ¹	07° 12.186 ¹	07° 12.460 ¹	07° 10.796 ¹	07° 10.366 ¹	07° 10.210 ¹	07° 08.383 ¹	07° 02.618 ¹	07° 04.814 ¹	07° 06.588 ¹
	E	079° 49.493 ¹	079° 49.832 ¹	079° 50.224 ¹	079° 49.910 ¹	079° 50.247 ¹	079° 50.592 ¹	079° 50.716 ¹	079° 51.772 ¹	079° 53.444 ¹	079° 52.964 ¹
Depth (m)		4.98	3.45	1.02	1.63	1.29	1.57	1.17	1.22	1.95	4.94
Time		11.24 am	11.44 am	11.58 am	12.26 pm	12.36 pm	12.47 pm	1.07 pm	4.17 pm	3.43 pm	3.37 pm
pH	Top	8.46	8.38	8.20	8.41	8.30	8.36	8.32	7.13	6.42	6.86
	Bottom	8.20	8.28	8.27	8.32	8.36	8.29	8.53	7.07	6.41	6.81
Temperature (°C)	Top	26.8	27.1	28.3	28.1	28.0	28.5	28.9	29.5	28.6	29.1
	Bottom	28.3	27.2	28.2	27.5	27.7	27.9	27.9	29.8	28.8	27.9
Conductivity (mS/cm)	Top	58.6	52.0	58.2	43.1	35.8	34.2	14.4	6.4	0.2	0.4
	Bottom	58.6	55.4	58.8	58.8	54.2	56.6	23.4	6.4	0.2	0.5
Salinity (ppt)	Top	37.6	32.7	36.1	25.9	21.2	19.9	7.7	3.2	0.1	0.2
	Bottom	37.6	35.0	36.5	37.0	33.8	35.3	13.3	3.2	0.1	0.2
Total Nitrogen (mg/l)		0.98	0.15	0.95	0.18	0.30	0.43	2.00	5.02	0.30	0.40
Nitrates - N (mg/l)		0.04	0.04	0.04	0.04	0.04	0.06	0.09	0.12	0.26	0.28
Ammonia - N (mg/l)		0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.05
Total Phosphorous (mg/l)		0.06	0.05	0.05	0.06	0.08	0.08	0.10	0.10	0.06	0.06
Phosphate - P (mg/l)		0.01	0.01	0.01	0.02	0.02	0.02	0.04	0.02	0.01	0.02
COD (mg/l)		40	48	65	69	36	20	22	8	8	16
BOD ₅ (mg/l)		10	20	30	35	8	14	12	6	4	9
Total Coliforms In 100ml (MPN)		300	270	16000	17	50	11	17	340	16000	9000
Faecal Coliforms In 100ml (MPN)		80	70	170	2	4	2	4	90	220	170
Total dissolved solids (mg/l)		42950	40135	43735	42880	34430	27010	9695	2415	115	280



A 10 : Water quality of Negombo Lagoon (10th February 2003)

Sampling Point No.		1	2	3	4	5	6	7	8	9	10
Coordinates of each point	N	07° 12.644 ¹	07° 12.186 ¹	07° 12.460 ¹	07° 10.796 ¹	07° 10.366 ¹	07° 10.210 ¹	07° 08.383 ¹	07° 02.618 ¹	07° 04.814 ¹	07° 06.588 ¹
	E	079° 49.493 ¹	079° 49.832 ¹	079° 50.224 ¹	079° 49.910 ¹	079° 50.247 ¹	079° 50.592 ¹	079° 50.716 ¹	079° 51.772 ¹	079° 53.444 ¹	079° 52.964 ¹
Depth (m)		4.70	3.45	1.02	1.57	1.52	1.47	1.29	1.27	2.21	4.98
Time		11.37 am	11.48 am	12.01 pm	12.14 pm	12.26 pm	12.36 pm	12.53 pm	3.52 pm	3.16 pm	3.03 pm
pH	Top	8.30	7.46	8.28	8.24	8.20	8.19	7.97	6.96	6.60	6.71
	Bottom	8.22	8.76	8.20	8.09	8.03	8.12	7.80	7.39	6.59	6.71
Temperature (°C)	Top	29.7	29.5	29.3	29.2	29.2	29.5	30.3	31.6	30.6	29.8
	Bottom	29.6	29.4	29.7	29.5	29.7	30.1	29.6	32.0	31.3	30.0
Conductivity (mS/cm)	Top	58.7	35.3	51.3	42.2	31.9	27.7	7.6	9.0	0.1	0.1
	Bottom	58.7	57.9	51.5	46.3	42.6	33.4	16.3	9.6	0.1	0.1
Salinity (ppt)	Top	35.6	20.2	30.7	24.8	18.2	15.5	3.8	4.4	0.1	0.1
	Bottom	35.6	35.1	30.7	27.3	24.8	18.8	8.7	4.7	0.1	0.1
Total Nitrogen (mg/l)		3.50	0.56	0.59	0.23	0.18	0.26	0.28	0.36	0.22	0.86
Nitrates – N (mg/l)		0.09	0.04	0.06	0.06	0.04	0.04	0.08	0.07	0.19	0.10
Ammonia – N (mg/l)		0.00	0.49	0.00	0.01	0.00	0.00	0.00	0.15	0.00	0.00
Total Phosphorous (mg/l)		0.34	0.26	0.07	0.28	0.48	0.09	0.21	0.18	0.06	0.09
Phosphate – P (mg/l)		0.01	0.12	0.01	0.01	0.09	0.03	0.03	0.02	0.01	0.01
COD (mg/l)		47	32	48	60	27	39	24	31	35	35
BOD ₅ (mg/l)		15	15	36	28	16	21	15	16	20	25
Total Coliforms In 100ml (MPN)		500	9000	500	17	13	8	17	500	5000	2200
Faecal Coliforms In 100ml (MPN)		70	110	140	4	< 2	< 2	< 2	70	140	140
Total dissolved solids (mg/l)		34860	25620	26470	19990	19360	14360	5170	3710	100	470



A 11: Discharges of Hamilton Canal (8A), Ja-ela (9A) and Dandugam-Oya (10A) on Day 2 (25 September 2002, Day 3 (15 October 2002) and Day 4 (7 November 2002). These values have been extracted from MIKE 21 model of the CRMP project.

Time	Day 2			Day 3			Day 4		
	8A	9A	10A	8A	9A	10A	8A	9A	10A
0:00	-1.426	5.829	13.284	-1.065	7.93	30.545	-1.792	17.041	96.811
1:00	-1.177	2.189	4.438	-1.106	8.051	30.316	-1.354	13.816	91.118
2:00	-0.89	0.111	-6.769	-1.11	7.937	29.501	-0.843	11.123	84.55
3:00	-0.326	-0.068	-6.205	-1.048	7.457	27.866	0.287	6.582	76.529
4:00	0.709	-4.522	-6.022	-0.881	6.563	25.166	1.363	3.632	69.72
5:00	1.228	-5.117	-8.84	-0.684	5.946	23.867	1.736	3.454	65.544
6:00	1.445	-5.238	-9.062	-0.444	4.973	23.443	1.216	7.476	68.209
7:00	1.148	-2.528	0.459	-0.158	4.152	23.568	0.513	10.393	74.244
8:00	0.476	3.466	19.031	0.257	3.953	23.118	-0.704	12.65	80.511
9:00	-0.528	5.49	21.371	0.36	4.547	22.736	1.441	15.147	85.181
10:00	-1.074	7.101	19.312	0.52	5.892	23.527	-1.67	16.838	88.271
11:00	-1.245	6.972	17.311	0.019	8.828	27.983	-1.772	17.308	90.251
12:00	-1.3	6.408	14.943	-0.636	11.042	32.007	-1.791	17.056	90.879
13:00	-1.239	5.039	10.686	-0.995	12.803	34.332	-1.707	16.062	89.72
14:00	-0.864	1.161	-1.054	-1.165	14.169	34.842	-1.226	12.939	83.992
15:00	-0.41	0.311	-6.191	-1.244	15.244	34.881	-0.711	10.163	77.786
16:00	0.467	-2.867	-4.231	-1.327	16.297	35.233	-0.009	6.861	71.724
17:00	0.913	-3.916	-4.307	-1.409	17.26	35.949	0.561	6.75	69.077
18:00	0.913	-2.228	-1.232	-1.468	18.017	36.535	-0.287	10.061	73.03
19:00	0.059	3.301	13.725	-1.504	18.563	36.962	-1.057	12.43	77.575
20:00	-0.698	5.747	19.406	-1.519	18.872	37.382	-1.419	14.454	81.29
21:00	-1.117	6.801	17.881	-1.506	18.851	37.579	-1.62	15.708	84.366
22:00	-1.305	7.01	16.712	-1.423	18.35	37.172	-1.729	16.056	86.517
23:00	-1.4	6.846	15.604	-1.369	17.943	37.821	-1.77	15.846	87.498