Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 1 (C1780) RIVER NAME : Canal do Canto do rio

NO.OF SAMPLING			1	2	3	4	5	6
Genaral number of the laboratory								
DATE OF SAMPLING			19 MAR 906	AUG 90	20 AUG 90	11 APR 91	4 JUL 91	9 OCT 91
CODE	PARAMETER	UNITY						
	Time	H	8:50	9:30	9:05	9:50	8:35	8:05
02061F	Water temperature	° C	30.00	23.00	24.00	27.00	24.00	23.00
02062F	Air temperature	° C	31.00	23.00	26.50	28.00	23.00	22.00
96204F	Weather conditions		Cloudy	good	good	good	good	Cloudy
98101F	Rain in the last 24 hours		Nob	Nob	yes	No	No	yes
97251F	Sampling depth	m	0.10	0.10	0.10		0.15	0.10
97001F	Depth of water column	m						
96301F	OIL Presence		Nob	yes	yes	No	No	yes
96302F	Garbage Presence		yes	yes	yes	No	yes	yes
10301L	pH (Lab)		6.90	7.70	7.50	6.70	7.10	8.20
02041L	Conduct. (field)	uS/cm	420.00	420.00	330.00	490.00	480.00	500.00
02073L	Turbidity	UT						
10401L	Suspended Solids	mg/l	60.00	45.00	80.00	40.00	130.00	40.00
10104L	Total alcalinity	CaCO3 mg/l						
16302L	Dissolved sulphate	SO4 mg/l						
17204L	Dissolved Chloride	mg/l	40.00	40.00	30.00	50.00	50.00	50.00
08101L	DO	mg/l	2.00	3.60	5.20	2.40	3.20	3.40
08202L	BOD (total)	mg/l	22.00	20.00	14.00	28.00	40.00	16.00
08301L	COD (total)	mg/l	70.00	50.00	20.00	55.00	130.00	90.00
36101L	Total Coli x1000	MPN/100ml	1600<*	1600<*	1600<*	160<	24.00	160<
36111L	Fecal Coli x1000	MPN/100ml						
16404L	Dissolved Sulphide	mgS/l						
54752L	Total Alcalinity	CaCO3 mg/l						
10154L	Alcalinity to Phenolphtalein	mg/l						
07005L	Total kjeldahl Nitrogen	mg N/l	17.00	13.00	12.00	16.00	24.00	20.00
07556L	Ammonia Nitrogen	mg N/l	11.00	12.00	11.00	4.00	15.00	18.00
07306L	Nitrate Nitrogen	mg N/l	0.20	1.50	0.44	0.05	0.10	0.50
15408L	Total Phosphorus	mg P/l	1.00	0.90	0.80	1.00	2.00	0.65
15252L	Orthophoshate	mg P/l		0.10	0.30			
07206L	Nitrite Nitrogen	mg N/l						
16302L	Dissolved sulphide	SO4 mg/l						
09004L	Dissolved Fluoride	mg F/l						
06522L	Hexane Extractable	mg/l						
10701L	Surfactants							
06534L	Phenol	mg/l	<.003	<.001	0.001	0.03	0.008	0.004
06600L	Cyanide	mg CN/L	0.060	<.010	0.025	<.010	0.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l						
10474L	Humidity							
48004L	Cadmium	mg Cd/l	<.002	<.002	<.002	0.006	0.002	<.002
29005L	Copper	mg Cu/l	0.015	<.005	<.005	0.015	0.010	0.010
82004L	Lead	mg Pd/l	0.04	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01			
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.05	0.020	0.03	0.015	0.020	0.020
80013L	Mercury	ug Hg/l	0.10	0.15	<.10	<.10	<.10	2.00
26007L	Total iron (Fe2++Fe3+)	mg Fe/l						
25006L	Total Manganese	mg Mn/l						
50004L	Total Tin	mg Sn/l						
19102L	Total potassium	mg K/l						
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l						
25103L	Dissolved Manganese	mg Mn/l						
26101L	Dissolved iron	mg Fe/l	0.12	0.06	0.08	0.18	0.02	0.04
28002L	Dissolved Nickel	mg Ni/l						
29105L	Dissolved copper	mg Cu/l						
30103L	Zinc	mg Zn/l						
48005L	Dissolved chromium	mg Cr/l						
82005L	Dissolved Lead	mg Pb/l						

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 2 (BM760) RIVER NAME : Rio Bomba (1990~1991)

NO.OF SAMPLING			1	2	3	4	5	6	7
Genaral number of the laboratory									
DATE OF SAMPLING			19 MAR 906	AUG 90 20	AUG 9011	APR 914	JUL 91 21	AUG 919	OCT 91
CODE	PARAMETER	UNITY							
	Time	H	9:30	10:10	9:50	10:15	9:30	9:20	8:50
02061F	Water temperature	° C	30.00	21.00	24.00	26.50	27.00	21.00	21.00
02062F	Air temperature	° C	32.50	23.00	26.00	30.00	25.00	24.00	24.00
96204F	Weather conditions		good	good	good	good	Cloudy	good	Cloudy
98101F	Rain in the last 24 hours		Nob	No	yes	No	No	No	yes
97251F	Sampling depth	m	0.10	0.10	0.10		0.15		0.10
97001F	Depth of water column	m							
96301F	OfL Presence		Nob	No	No	No	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes	yes	yes	yes
10301L	pH (Lab)		6.90	7.20	7.10	6.90	6.80	6.80	8.00
02041L	Conduct. (field)	uS/cm	580.00	240.00	520.00	640.00	540.00	590.00	560.00
02073L	Turbidity	UT							
10401L	Suspended Solids	mg/l	90.00	900.00	100.00	140.00	110.00	150.00	50.00
10104L	Total alcalinity	CaCO3 mg/l							
16302L	Dissolved sulphate	SO4 mg/l							
17204L	Dissolved Chloride	mg/l	50.00	30.00	60.00	60.00	50.00	60.00	60.00
08101L	DO	mg/l	<.1	4.60	6.20	<.1	1.20	2.20	3.80
08202L	BOD (total)	mg/l	120.00	20.00	25.00	210.00	90.00	90.00	30.00
08301L	COD (total)	mg/l	220.00		50.00	290.00	240.00	250.00	80.00
36101L	Total Coli x1000	MPN/100ml							
36111L	Fecal Coli x1000	MPN/100ml	1600<*	1600<*	1600<*	160<	160<	160<	160<
16404L	Dissolved Sulphide	mgS/l							
54752L	Total Alcalinity	CaCO3 mg/l							
10154L	Alcalinity to Phenolphtalein	mg/l							
07005L	Total kjeldahl Nitrogen	mg N/l	40.00	11.00	26.00	27.00	29.00	30.00	25.00
07556L	Ammonia Nitrogen	mg N/l	30.00	4.00	18.00	3.40	20.00	17.00	23.00
07306L	Nitrate Nitrogen	mg N/l	0.30	0.40	0.02	0.02	0.02	0.09	0.80
15408L	Total Phosphorus	mg P/l	4.00	4.00	2.80	5.00	3.40	4.00	1.00
15252L	Orthophoshate	mg P/l		0.10	0.80				
07206L	Nitrite Nitrogen	mg N/l							
16302L	Dissolved sulphide	SO4 mg/l							
09004L	Dissolved Fluoride	mg F/l							
06522L	Hexane Extractable	mg/l							
10701L	Surfactants								
06534L	Phenol	mg/l	0.03	<.001	0.02	0.25	0.007	0.02	0.01
06600L	Cyanide	mg CN/L	*0.090*	*<.010*	*0.025*	*<.010*	*0.030*	*0.030*	*<.010*
07054L	Diss.Kjeldahl N.	mg N/l							
10474L	Humidity								
48004L	Cadmium	mg Cd/l	<.002	<.002	<.002	<.002	0.002	<.002	<.002
29005L	Copper	mg Cu/l	0.015	0.08	<.005	0.015	0.010	0.015	0.005
82004L	Lead	mg Pd/l	0.02	0.10	<.02	0.06	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	0.01	0.01	<.01				
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.07	0.32	0.03	0.04	0.04	0.07	0.015
80013L	Mercury	ug Hg/l	0.10	0.35	0.15	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l							
25006L	Total Manganese	mg Mn/l							
50004L	Total Tin	mg Sn/l							
19102L	Total potassium	mg K/l							
24101L	Chromuim VI	mg Cu/l	*<.01*	*<.01*	*<.01*	*<.01*	*<.01*	*<.01*	*<.01*
24051L	Dissolved Chromuim	mg Cr/l							
25103L	Dissolved Manganese	mg Mn/l							
26101L	Dissolved iron	mg Fe/l	0.65	0.90	0.20	1.90	0.18	0.30	0.30
28002L	Dissolved Nickel	mg Ni/l							
29105L	Dissolved copper	mg Cu/l							
30103L	Zinc	mg Zn/l							
48005L	Dissolved chromium	mg Cr/l							
82005L	Dissolved Lead	mg Pb/l							

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 4 (AN740) RIVER NAME : Rio Alcantara (1990~1991)

NO.OF SAMPLING			1	2	3	4	5	6	7
Genaral number of the laboratory									
DATE OF SAMPLING			19 MAR 90	6 AUG 90	20 AUG 90	11 APR 91	4 JUL 91	21 AUG 91	9 OCT 91
CODE	PARAMETER	UNITY							
	Time	H	10:00	10:40	10:15	10:40	9:30	9:20	8:50
02061F	Water temperature	° C	31.00	22.00	24.00	27.00	25.00	24.00	22.50
02062F	Air temperature	° C	35.50	24.00	28.00	31.00	25.00	26.00	24.50
96204F	Weather conditions		good	good	good	good	Cloudy	good	Cloudy
98101F	Rain in the last 24 hours		Nob	No	yes	No	No	No	yes
97251F	Sampling depth	m	0.10	0.10	0.10		0.15		0.10
97001F	Depth of water column	m							
96301F	OIL Presence		Nob	No	No	No	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes	yes	yes	yes
10301L	pH (Lab)		6.50	6.50	7.40	5.50	6.10	6.70	9.00
02041L	Conduct. (field)	uS/cm	530.00	460.00	430.00	900.00	450.00	720.00	430.00
02073L	Turbidity	UT							
10401L	Suspended Solids	mg/l	280.00	13.00	200.00	160.00	150.00	140.00	80.00
10104L	Total alcalinity	CaCO3 mg/l							
16302L	Dissolved sulphate	SO4 mg/l							
17204L	Dissolved Chloride	mg/l	40.00	50.00	60.00	120.00	60.00	65.00	40.00
08101L	DO	mg/l	2.20	4.80	2.00	2.80	5.40	5.20	4.40
08202L	BOD (total)	mg/l	100.00	40.00	50.00	500.00	20.00	80.00	-
08301L	COD (total)	mg/l	560.00		60.00	740.00	560.00	400.00	440.00
36101L	Total Coli x1000	MPN/100ml							
36111L	Fecal Coli x1000	MPN/100ml	1600<+	1600<+	500.00	160<	160<	160<	160<
16404L	Dissolved Sulphide	mgS/l							
54752L	Total Alcalinity	CaCO3 mg/l							
10154L	Alcalinity to Phenolphtaleinmg/l								
07005L	Total kjeldahl Nitrogen	mg N/l	30.00	16.00	10.00	25.00	21.00	20.00	14.00
07556L	Ammonia Nitrogen	mg N/l	13.00	3.00	7.00	1.00	10.00	6.00	8.00
07306L	Nitrate Nitrogen	mg N/l	0.20	<.01	0.90	0.06	0.03	9.00	8.00
15408L	Total Phosphorus	mg P/l	6.00	6.50	1.50	20.00	3.20	6.00	1.10
15252L	Orthophoshate	mg P/l		2.50	0.70				
07206L	Nitrite Nitrogen	mg N/l							
16302L	Dissolved sulphide	SO4 mg/l							
09004L	Dissolved Fluoride	mg F/l							
06522L	Hexane Extractable	mg/l							
10701L	Surfactants								
06534L	Phenol	mg/l	0.01	<.001	0.004	0.01	0.03	0.01	0.008
06600L	Cyanide	mg CN/L	0.025	<.010	0.035	0.035	0.050	0.050	<.010
07054L	Diss.Kjeldahl N.	mg N/l							
10474L	Humidity								
48004L	Cadmium	mg Cd/l	<.002	<.002	<.002	0.006	0.002	<.002	<.002
29005L	Copper	mg Cu/l	0.02	0.010	0.010	0.015	0.015	0.015	0.010
82004L	Lead	mg Pd/l	0.04	<.02	<.02	0.06	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01				
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.14	0.05	0.020	0.07	0.04	0.05	0.04
80013L	Mercury	ug Hg/l	0.10	0.25	0.40	<.10	<.10	0.15	0.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l							
25006L	Total Manganese	mg Mn/l							
50004L	Total Tin	mg Sn/l							
19102L	Total potassium	mg K/l							
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l							
25103L	Dissolved Manganese	mg Mn/l							
26101L	Dissolved iron	mg Fe/l	0.55	2.50	1.80	6.00	1.20	0.90	1.30
28002L	Dissolved Nickel	mg Ni/l							
29105L	Dissolved copper	mg Cu/l							
30103L	Zinc	mg Zn/l							
48005L	Dissolved chromium	mg Cr/l							
82005L	Dissolved Lead	mg Pb/l							

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO. OF STATION : 6 (GX720) RIVER NAME : Rio Guaxindiba (1990~1991)

NO. OF SAMPLING			1	2	3	4	5	6	7
Genaral number of the laboratory									
DATE OF SAMPLING			19 MAR 90	6 AUG 90	20 AUG 90	11 APR 91	4 JUL 91	21 AUG 91	9 OCT 91
CODE	PARAMETER	UNITY							
	Time	H	10:30	11:05	10:35	11:10	9:40	9:40	9:10
02061F	Water temperature	° C	29.00	22.00	24.50	27.50	24.00	24.00	20.00
02062F	Air temperature	° C	35.00	23.00	30.00	31.50	25.00	28.00	24.00
96204F	Weather conditions		good	good	good	good	Cloudy	good	Cloudy
98101F	Rain in the last 24 hours		Nob	No	yes	No	No	No	yes
97251F	Sampling depth	m	0.10	0.10	0.10		0.15		0.10
97001F	Depth of water column	m							
96301F	OIL Presence		Nob	Nob	No	No	yes	No	yes
96302F	Garbage Presence		yes	yes	yes	No	yes	yes	yes
10301L	pH (Lab)		6.90	8.20	7.20	6.60	6.90	6.90	7.70
02041L	Conduct. (field)	uS/cm	690.00	590.00	580.00	500.00	540.00	570.00	470.00
02073L	Turbidity	UT							
10401L	Suspended Solids	mg/l	20.00	15.00	12.00	18.00	70.00	16.00	50.00
10104L	Total alcalinity	CaCO3 mg/l							
16302L	Dissolved sulphate	SO4 mg/l							
17204L	Dissolved Chloride	mg/l	40.00	100.00	60.00	70.00	70.00	70.00	50.00
08101L	DO	mg/l	<.1	1.60	3.80	2.40	1.00	1.00	2.60
08202L	BOD (total)	mg/l	20.00	8.00	4.00	4.00	20.00	10.00	6.00
08301L	COD (total)	mg/l	40.00	30.00	40.00	30.00	40.00	40.00	40.00
36101L	Total Coli x1000	MPN/100ml							
36111L	Fecal Coli x1000	MPN/100ml	50.00	80.00	5.00	5.00	30.00	0.80	160.00
16404L	Dissolved Sulphide	mgS/l							
54752L	Total Alcalinity	CaCO3 mg/l							
10154L	Alcalinity to Phenolphtalein	mg/l							
07005L	Total kjeldahl Nitrogen	mg N/l	10.00	14.00	12.00	1.20	15.00	20.00	8.00
07556L	Ammonia Nitrogen	mg N/l	9.00	10.00	11.00	1.00	10.00	10.00	8.00
07306L	Nitrate Nitrogen	mg N/l	0.20	0.35	0.14	0.30	0.05	0.02	1.50
15408L	Total Phosphorus	mg P/l	1.00	0.50	1.00	0.50	0.70	2.40	0.70
15252L	Orthophoshate	mg P/l		0.08	0.20				
07206L	Nitrite Nitrogen	mg N/l							
16302L	Dissolved sulphide	SO4 mg/l							
09004L	Dissolved Fluoride	mg F/l							
06522L	Hexane Extractable	mg/l							
10701L	Surfactants								
06534L	Phenol	mg/l	0.001	<.001	<.001	0.003	<.001	0.005	0.001
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	<.010	<.010	0.020
07054L	Diss. Kjeldahl N.	mg N/l							
10474L	Humidity								
48004L	Cadmium	mg Cd/l	<.002		<.002	<.002	0.002	<.002	<.002
29005L	Copper	mg Cu/l	<.005	<.005	0.010	<.005	0.010	<.005	0.005
82004L	Lead	mg Pd/l	0.06	<.02	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01				
28104L	Total Nickel	mg Ni/l	0.01	<.01	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.005	0.010	0.005	0.07	0.08	0.010	0.015
80013L	Mercury	ug Hg/l	<.10	<.10	0.30	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l							
25006L	Total Manganese	mg Mn/l							
50004L	Total Tin	mg Sn/l							
19102L	Total potassium	mg K/l							
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l							
25103L	Dissolved Manganese	mg Mn/l							
26101L	Dissolved iron	mg Fe/l	0.10	0.08	0.12	0.06	0.02	0.04	0.06
28002L	Dissolved Nickel	mg Ni/l							
29105L	Dissolved copper	mg Cu/l							
30103L	Zinc	mg Zn/l							
48005L	Dissolved chromium	mg Cr/l							
82005L	Dissolved Lead	mg Pb/l							

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 7 (CC622) RIVER NAME : Rio Cacerebu (1990~1991)

NO.OF SAMPLING			1	2	3	4	5	6	7
Genaral number of the laboratory									
DATE OF SAMPLING			19 MAR 90	7 AUG 90	22 AUG 90	11 APR 91	4 JUL 91	21 AUG 91	9 OCT 91
CODE	PARAMETER	UNITY							
	Time	H	10:45	11:30	10:40	12:40	9:55	10:00	10:40
02061F	Water temperature	° C	31.00	23.00	22.00	26.00	21.50	21.00	21.00
02062F	Air temperature	° C	34.00	26.00	22.50	33.00	24.00	28.00	30.00
96204F	Weather conditions		good	good	rain	good	good	good	Cloudy
98101F	Rain in the last 24 hours		Nob	No	yes	No	No	No	yes
97251F	Sampling depth	m	0.10	0.10	0.10		0.15		0.10
97001F	Depth of water column	m							
96301F	OIL Presence		Nob	No	No	No	No	No	No
96302F	Garbage Presence		No	yes	No	No	yes	No	No
10301L	pH (Lab)		6.60	7.40	7.10	6.40	6.70	6.80	7.00
02041L	Conduct. (field)	uS/cm	*12100	500	*2300	216	290	360	165
02073L	Turbidity	UT							
10401L	Suspended Solids	mg/l	25	20	15	25	30	8	10
10104L	Total alcalinity	CaCO3 mg/l							
16302L	Dissolved sulphate	SO4 mg/l							
17204L	Dissolved Chloride	mg/l	120	100	520	30	50	60	20
08101L	DO	mg/l	1.80	3.80	3.80	1.20	3.00	2.60	2.80
08202L	BOD (total)	mg/l	8.00	4.00	14.00	10.00	4.00	10.00	8.00
08301L	COD (total)	mg/l	80.00	20.00	30.00	30.00	20.00	20.00	30.00
36101L	Total Coli x1000	MPN/100ml							
36111L	Fecal Coli x1000	MPN/100ml	0.08	0.11	2.30	1.30	5.00	0.30	8.00
16404L	Dissolved Sulphide	mgS/l							
54752L	Total Alcalinity	CaCO3 mg/l							
10154L	Alcalinity to Phenolphtalein	mg/l							
07005L	Total kjeldahl Nitrogen	mg N/l	4.00	1.40	1.80	1.00	3.00	1.20	1.00
07556L	Ammonia Nitrogen	mg N/l	2.00	0.60	0.30	0.45	0.20	0.15	0.07
07306L	Nitrate Nitrogen	mg N/l	0.20	0.90	2.00	0.04	0.60	1.10	0.40
15408L	Total Phosphorus	mg P/l	0.35	0.20	0.10	0.20	0.20	0.15	0.25
15252L	Orthophoshate	mg P/l		0.02	0.02				
07206L	Nitrite Nitrogen	mg N/l							
16302L	*Dissolved sulphide*	*SO4 mg/l*							
09004L	Dissolved Fluoride	mg F/l							
06522L	Hexane Extractable	mg/l							
10701L	Surfactants								
06534L	Phenol	mg/l	<.001	<.001	<.001	<.001	<.001	0.001	<.001
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	<.010	<.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l							
10474L	Humidity								
48004L	Cadmium	mg Cd/l	0.045	<.002	<.002	0.006	0.002	<.002	<.002
29005L	Copper	mg Cu/l	0.08	1.000	<.005	<.005	0.010	<.005	0.005
82004L	Lead	mg Pd/l	0.14	<.02	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	0.01	<.01	60.01				
28104L	Total Nickel	mg Ni/l	0.07	<.01	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.04	0.020	0.005	<.005	0.015	<.005	0.005
80013L	Mercury	ug Hg/l	<.10	<.10	<.10	<.10	<.10	<.10	0.60
26007L	Total iron (Fe2++Fe3+)	mg Fe/l							
25006L	Total Manganese	mg Mn/l							
50004L	Total Tin	mg Sn/l							
19102L	Total potassium	mg K/l							
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l							
25103L	Dissolved Manganese	mg Mn/l							
26101L	Dissolved iron	mg Fe/l	0.08	0.14	0.20	2.00	0.16	0.20	0.25
28002L	Dissolved Nickel	mg Ni/l							
29105L	Dissolved copper	mg Cu/l							
30103L	Zinc	mg Zn/l							
48005L	Dissolved chromium	mg Cr/l							
82005L	Dissolved Lead	mg Pb/l							

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 8 (GP600) RIVER NAME : Rio Guapi (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	7 AUG 90	22 AUG 90	10 APR 91	20 AUG 91
CODE	PARAMETER	UNITY					
	Time	H	11:40	11:00	11:15	12:55	11:15
02061F	Water temperature	° C	30.00	21.00	22.00	25.00	22.00
02062F	Air temperature	° C	32.00	24.00	22.50	33.00	26.00
96204F	Weather conditions		good	good	rain	good	good
98101F	Rain in the last 24 hours		No	No	yes	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.15
97001F	Depth of water column	m					
96301F	OIL Presence		No	No	No	No	No
96302F	Garbage Presence		No	No	No	No	No
10301L	pH (Lab)		7.20	7.40	7.50	6.50	6.80
02041L	Conduct. (field)	uS/cm	50.00	80.00	60.00	52.00	65.00
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	30.00	16.00	10.00	90.00	6.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	10.00	6.00	24.00	5.00	4.00
08101L	DO	mg/l	5.60	6.00	5.00	5.00	5.20
08202L	BOD (total)	mg/l	<2.0	2.40	<2.0	2.40	2.40
08301L	COD (total)	mg/l		10.00	10.00	20.00	10.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	13.00	8.00	50.00		0.80
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	0.20	1.20	1.20	1.00	0.80
07556L	Ammonia Nitrogen	mg N/l	0.04	0.09	0.10	0.08	0.06
07306L	Nitrate Nitrogen	mg N/l	0.20	0.20	0.30	0.20	0.20
15408L	Total Phosphorus	mg P/l	0.10	0.10	0.08	0.10	0.06
15252L	Orthophoshate	mg P/l	0.06	0.01	0.02		
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	<.001	0.002	<.001	<.001	0.001
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	<.002	0.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	<.005	<.005	<.005	<.005	<.005
82004L	Lead	mg Pd/l	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01		
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	<.005	<.005	<.005	<.005	<.005
80013L	Mercury	ug Hg/l	<.10	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.50	0.08	0.50	0.90	1.80
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO. OF STATION : 9 (MC967) RIVER NAME : Rio Macacu (1990~1991)

NO. OF SAMPLING			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Genaral number of the laboratory																	
DATE OF SAMPLING			20 MAR 90	19 APR 90	28 MAY 90	17 JUL 90	7 AUG 90	20 AGU 90	18 MAR 91	11 APR 91	4 JUL 91	11 JUL 91	18 JUL 91	21 AUG 91	10 SEP 91	9 OCT 91	6 NOV 91
CODE	PARAMETER	UNITY															
	Time	H	12:00	11:00	10:30	10:15	12:40	11:35	10:45	11:55	10:35	9:15	9:00	11:10	11:00	9:55	9:00
02061F	Water temperature	° C	28.00	23.00	20.00	20.00	20.00	23.00	24.00	23.00	24.00	22.00	19.00	20.00	23.00	19.00	21.00
02062F	Air temperature	° C	27.00	25.00	25.00	27.00	28.00	30.00	28.00	23.00	26.50	18.00	23.00	28.00	27.00	30.50	25.50
96204F	Weather conditions		Nob	rain	good	good	good	good	good	good	good	good	good	good	good	Cloudy	Cloudy
98101F	Rain in the last 24 hours		yes	yes	No	No	No	yes	No	Nob	yes	No	No	No	No	yes	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.15		0.15	0.10	0.10
97001F	Depth of water column	m															
96301F	OIL Presence		No	No	No	No	No	No	No	yes	yes	No	No	No	No	No	No
96302F	Garbage Presence		No	No	No	No	No	yes	No	yes	yes	No	No	No	No	No	No
10301L	pH (Lab)		7.40	6.70	7.30	7.10	7.60	7.60	6.60	7.70	7.50	7.10	6.60	6.60	7.80	7.20	7.00
02041L	Conduct. (field)	uS/cm	50.00	30.00	49.00	40.00	40.00	40.00	37.00	420.00	330.00	40.00	40.00	50.00	40.00	30.00	80.00
02073L	Turbidity	UT				8.00											
1d401L	Suspended Solids	mg/l	20.00	700.00	22.00	14.00	10.00	20.00	16.00	45.00	80.00	16.00	10.00	3.00	10.00	50.00	20.00
10104L	Total alcalinity	CaCO3 mg/l															
16302L	Dissolved sulphate	SO4 mg/l															
17204L	Dissolved Chloride	mg/l	3.00	7.00	4.00	3.00	2.00	2.00	5.00	40.00	30.00	4.00	5.00	4.00	*18400	3.00	15.00
08101L	DO	mg/l	7.20	7.20	8.40	8.80	9.60	8.60	8.40	3.60	5.20	8.80	8.60	9.00	7.80	8.40	8.00
08202L	BOD (total)	mg/l	4.00	4.80	<2.0	<2.0	<2.0	<2.0	<2.0	20.00	14.00	<2.0	<2.0	2.20	6.40	<2.0	<2.0
08301L	COD (total)	mg/l		130.00	<10	<10	<10	<10	<10	50.00	20.00	10.00	<10	<10	10.00	15.00	10.00
36101L	Total Coli x1000	MPN/100ml								1,600.00	1,600.00						
36111L	Fecal Coli x1000	MPN/100ml	13.00	30.00	30.00	8.00		50.60	8.00	50.00	24.00	50.00	24.00	17.00	5.00	24.00	24.00
16404L	Dissolved Sulphide	mgS/l															
54752L	Total Alcalinity	CaCO3 mg/l															
10154L	Alcalinity to Phenolphtalein	mg/l															
07005L	Total kjeldahl Nitrogen	mg N/l	1.00	3.00	1.00	0.40	0.80	1.20	0.45	13.00	12.00	0.80	0.20	1.00	0.45	0.60	0.50
07556L	Ammonia Nitrogen	mg N/l	0.07	0.05	0.10	0.08	0.07	0.15	0.04	12.00	11.00	0.08	0.07	0.40	0.09	0.09	<.01
07306L	Nitrate Nitrogen	mg N/l	0.20	0.24		0.20	0.20	0.20	0.20	1.50	0.44	0.25	0.20	0.20	0.30	0.30	0.20
15408L	Total Phosphorus	mg P/l	0.06	1.00	0.06	0.06	0.08	0.07	0.05	0.90	0.80	0.10	0.09	0.10	0.07	0.19	0.06
15252L	Orthophoshate	mg P/l	<.01	0.02	<.01	0.01	<.01	0.03		0.10	0.30						
07206L	Nitrite Nitrogen	mg N/l				0.003							0.004				
16302L	Dissolved sulphide	SO4 mg/l															
09004L	Dissolved Fluoride	mg F/l															
06522L	Hexane Extractable	mg/l															
10701L	Surfactants																
06534L	Phenol	mg/l	<.001	<.001	<.001	<.001	0.002	<.001	0.003	0.003	0.002	<.001	0.005	<.001	0.002	<.001	<.001
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010	<.010
07054L	Diss. Kjeldahl N.	mg N/l															
10474L	Humidity																
48004L	Cadmium	mg Cd/l	<.002	<.002	<.002	<.002	0.002	<.002	<.002	<.002	0.002	<.002	<.002	<.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	0.005	0.020	<.005	<.005	<.005	<.005	<.005	<.005	<.005	<.005	0.005	<.005	<.005	<.005	<.005
82004L	Lead	mg Pd/l	<.02	0.05	0.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01	<.01	<.01	<.01									
28104L	Total Nickel	mg Ni/l	0.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	0.01
30003L	Total Zinc	mg Zn/l	0.010	0.08	0.005	0.010	0.005	0.005	0.015	<.005	0.005	0.015	<.005	0.005	<.005	<.005	<.005
80013L	Mercury	ug Hg/l	<.10	0.10	<.10	0.10	0.25	<.10	<.10	<.10	<.10	<.10	<.10	<.10	<.10	<.10	1.00
26007L	Total iron (Fe2+ + Fe3+)	mg Fe/l															
25006L	Total Manganese	mg Mn/l			<.01												
50004L	Total Tin	mg Sn/l															
19102L	Total potassium	mg K/l															
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l															
25103L	Dissolved Manganese	mg Mn/l															
26101L	Dissolved iron	mg Fe/l	0.25	0.30	0.25	0.12	0.10	0.20	0.08	0.14	0.16	0.12	0.10	0.12	0.12	0.10	0.10
28002L	Dissolved Nickel	mg Ni/l															
29105L	Dissolved copper	mg Cu/l															
30103L	Zinc	mg Zn/l															
48005L	Dissolved chromium	mg Cr/l															
82005L	Dissolved Lead	mg Pb/l															

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 10 (SB998) RIVER NAME : Rio Soberbo (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			20 MAR 90	7 AUG 90	20 AUG 90	10 APR 91	20 AUG 91
CODE	PARAMETER	UNITY					
	Time	H	9:40	13:15	12:05	11:30	10:00
02061F	Water temperature	° C	25.00	22.50	24.50	25.00	21.00
02062F	Air temperature	° C	28.00	26.00	28.50	32.00	26.00
96204F	Weather conditions		Nob	good	good	good	good
98101F	Rain in the last 24 hours		yes	No	yes	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.15
97001F	Depth of water column	m					
96301F	OIL Presence		No	yes	yes	No	yes
96302F	Garbage Presence		No	yes	yes	No	yes
10301L	pH (Lab)		7.20	7.50	6.00	6.80	7.00
02041L	Conduct.(field)	uS/cm	40.00	100.00	90.00	72.00	150.00
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	20.00	40.00	30.00	90.00	12.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	3.00	8.00	6.00	7.00	12.00
08101L	DO	mg/l	6.80	3.60	1.60	6.80	2.80
08202L	BOD (total)	mg/l	10.00	18.00	24.00	16.00	130.00
08301L	COD (total)	mg/l		100.00	40.00	30.00	320.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	24.00	8.00	13.00	>160	3.00
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	1.00	1.20	2.00	2.00	2.40
07556L	Ammonia Nitrogen	mg N/l	<.01	0.40	0.07	0.20	0.45
07306L	Nitrate Nitrogen	mg N/l	0.20	0.60	0.20	0.20	0.10
15408L	Total Phosphorus	mg P/l	0.70	0.20	0.15	0.20	0.30
15252L	Orthophoshate	mg P/l	<.01	0.02	0.03		
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	<.001	0.002	0.005	<.001	0.01
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	0.020
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	<.002	<.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	0.010	0.005	<.005	0.010	0.010
82004L	Lead	mg Pd/l	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01		
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.03	0.020	0.010	0.015	0.06
80013L	Mercury	ug Hg/l	<.10	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.30	1.80	2.50	0.50	0.35
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 11 (MG580) RIVER NAME : Canal de Mage (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	7 AUG 90	22 AUG 90	10 APR 91	20 AUG 91
CODE	PARAMETER	UNITY					
	Time	H	11:15	10:55	11:03	13:10	11:00
02061F	Water temperature	° C	32.00	22.00	23.00	26.00	23.00
02062F	Air temperature	° C	32.00	24.00	22.00	32.00	27.00
96204F	Weather conditions		good	good	rain	good	good
98101F	Rain in the last 24 hours		No	No	yes	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.15
97001F	Depth of water column	m					
96301F	OIL Presence		yes	yes	yes	No	yes
96302F	Garbage Presence		yes	yes	yes	No	yes
10301L	pH (Lab)		7.80	8.50	8.20	7.00	6.80
02041L	Conduct. (field)	uS/cm	50.00	*1900	*2300	818.00	*1100
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	20.00	35.00	35.00	20.00	60.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	*1900	430.00	510.00	160.00	160.00
08101L	DO	mg/l	<.1	1.20	<.1	0.40	1.00
08202L	BOD (total)	mg/l	20.00	40.00	40.00	8.00	70.00
08301L	COD (total)	mg/l				50.00	240.00
36101L	Total Coli x1000	MPN/100ml			160.00		
36111L	Fecal Coli x1000	MPN/100ml	>160	>160		>160	>160
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	*Alcalinity to Phenolphtalein*	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	14.00	17.00	24.00	9.00	20.00
07556L	Ammonia Nitrogen	mg N/l	11.00	15.00	17.00	3.40	8.00
07306L	Nitrate Nitrogen	mg N/l		0.03	18.00	0.02	<.01
15408L	Total Phosphorus	mg P/l	1.00	2.00	5.00	0.75	3.00
15252L	Orthophoshate	mg P/l	0.60	1.60	1.80		
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.005	0.01	0.004	0.003	0.01
06600L	Cyanide	mg CN/L	<.010	0.010	0.010	<.010	0.020
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.025	<.002	<.002	0.004	<.002
29005L	Copper	mg Cu/l	0.04	0.010	0.015	<.005	0.005
82004L	Lead	mg Pd/l	0.10	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01		
28104L	Total Nickel	mg Ni/l	0.08	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.020	0.015	0.010	<.005	0.015
80013L	Mercury	ug Hg/l	<.10	0.25	0.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.20	0.20	0.35	0.10	0.45
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 12 (RN560) RIVER NAME : Rio Roncador (1990~1991)

NO. OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	7 AUG 90	22 AUG 90	10 APR 91	20 AUG 91
CODE	PARAMETER	UNITY					
	Time	H	11:10	10:45	10:45	12:15	10:45
02061F	Water temperature	° C	31.00	19.00	22.00	25.00	20.50
02062F	Air temperature	° C	32.00	22.00	21.50	32.00	26.00
96204F	Weather conditions		good	good	rain	good	good
98101F	Rain in the last 24 hours		No	No	yes	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.15
97001F	Depth of water column	m					
96301F	OIL Presence		No	yes	yes	No	yes
96302F	Garbage Presence		yes	yes	yes	No	yes
10301L	pH (Lab)		7.00	7.70	6.90	6.60	7.10
02041L	Conduct. (field)	uS/cm	190.00	90.00	110.00	52.00	80.00
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	30.00	10.00	16.00	10.00	9.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	50.00	8.00	8.00	5.00	15.00
08101L	DO	mg/l	6.00	7.20	5.00	7.40	7.40
08202L	BOD (total)	mg/l	4.00	2.80	<2.0	<2.0	<2.0
08301L	COD (total)	mg/l		10.00	20.00	<10	10.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	8.00	17.00	13.00	17.00	90.00
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	0.25	0.60	1.40	1.00	0.80
07556L	Ammonia Nitrogen	mg N/l	0.10	0.30	0.40	0.10	0.20
07306L	Nitrate Nitrogen	mg N/l		0.40	1.20	0.30	0.40
15408L	Total Phosphorus	mg P/l	0.10	0.10	0.20	0.06	0.08
15252L	Orthophoshate	mg P/l	0.02	0.02	0.06		
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	<.001	0.002	0.005	<.001	0.002
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	<.002	<.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	<.005	<.005	<.005	<.005	<.005
82004L	Lead	mg Pd/l	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01		
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.015	0.020	<.005	<.005	0.005
80013L	Mercury	ug Hg/l	<.10	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.4	0.12	1.40	<.02	0.40
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO. OF STATION : 15 (ES400) RIVER NAME : Rio Estrela (1990~1991)

NO. OF SAMPLING			1	2	3	4
Genaral number of the laboratory						
DATE OF SAMPLING			8 MAR 90	7 AUG 90	10 APR 91	20 AUG 91
CODE	PARAMETER	UNITY				
	Time	H	10:00	9:30	10:05	8:45
02061F	Water temperature	° C	31.00	21.00	25.00	22.00
02062F	Air temperature	° C	30.50	22.00	32.00	26.00
96204F	Weather conditions		good	good	good	good
98101F	Rain in the last 24 hours		No	No	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.15
97001F	Depth of water column	m				
96301F	OIL Presence		yes	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes
10301L	pH (Lab)		7.20	7.10	6.40	6.90
02041L	Conduct. (field)	uS/cm	*17700	*1800	120.00	*1700
02073L	Turbidity	UT				
10401L	Suspended Solids	mg/l	20.00	25.00	20.00	9.00
10104L	Total alcalinity	CaCO3 mg/l				
16302L	Dissolved sulphate	SO4 mg/l				
17204L	Dissolved Chloride	mg/l		470.00	17.00	440.00
08101L	DO	mg/l	0.60	2.00	4.20	2.20
08202L	BOD (total)	mg/l	12.00	8.00	5.60	10.00
08301L	COD (total)	mg/l		30.00	20.00	30.00
36101L	Total Coli x1000	MPN/100ml				
36111L	Fecal Coli x1000	MPN/100ml	24.00	17.00	160.00	90.00
16404L	Dissolved Sulphide	mgS/l				
54752L	Total Alcalinity	CaCO3 mg/l				
10154L	Alcalinity to Phenolphtalein	mg/l				
07005L	Total kjeldahl Nitrogen	mg N/l	5.00	3.00	2.40	3.60
07556L	Ammonia Nitrogen	mg N/l	5.00	0.70	0.40	2.00
07306L	Nitrate Nitrogen	mg N/l		0.10	0.40	0.30
15408L	Total Phosphorus	mg P/l	0.50	0.30	0.10	0.30
15252L	Orthophoshate	mg P/l	0.30	0.04		
07206L	Nitrite Nitrogen	mg N/l				
16302L	Dissolved sulphide	SO4 mg/l				
09004L	Dissolved Fluoride	mg F/l				
06522L	Hexane Extractable	mg/l				
10701L	Surfactants					
06534L	Phenol	mg/l	0.003	<.001	<.001	0.001
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010
07054L	Diss. Kjeldahl N.	mg N/l				
10474L	Humidity					
48004L	Cadmium	mg Cd/l	0.065	0.002	<.002	<.002
29005L	Copper	mg Cu/l	0.12	0.015	<.005	0.015
82004L	Lead	mg Pd/l	0.30	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	0.02	<.01		
28104L	Total Nickel	mg Ni/l	0.25	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.04	0.010	0.015	<.005
80013L	Mercury	ug Hg/l	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2+ + Fe3+)	mg Fe/l				
25006L	Total Manganese	mg Mn/l				
50004L	Total Tin	mg Sn/l				
19102L	Total potassium	mg K/l				
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l				
25103L	Dissolved Manganese	mg Mn/l				
26101L	Dissolved iron	mg Fe/l	0.12	0.04	0.65	0.04
28002L	Dissolved Nickel	mg Ni/l				
29105L	Dissolved copper	mg Cu/l				
30103L	Zinc	mg Zn/l				
48005L	Dissolved chromium	mg Cr/l				
82005L	Dissolved Lead	mg Pb/l				
18021L	op' DDE	ug/l		<.001		<.001
18001L	pp' DDT	ug/l		<.001		<.001
18011L	op' DDD	ug/l				
18012L	mp' DDD	ug/l				
18013L	pp' DDD	ug/l		<.001		<.001
18020L	op' DDE	ug/l		<.001		<.001
18021L	op' DDE	ug/l		<.001		<.001
18030L	Methoxi-Chlor	ug/l				
18040L	Heprachlor	ug/l				
18045L	Heptachlor epoxi	ug/l				
18050L	Endosulfan (Thiodan)	ug/l				
18060L	α -Chlordane	ug/l				
18061L	γ -Chlordane	ug/l				
18070L	Lindane	ug/l				<.001
18075L	α -BHC	ug/l				<.001
18080L	β -BHC	ug/l				<.001

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 16 (1N460) RIVER NAME : Rio Inhomirim (1990~1991)

NO. OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	7 AUG 90	22 AUG 90	10 APR 91	20 AUG 91
CODE	PARAMETER	UNITY					
	Time	H	10:55	10:20	10:30	11:05	9:35
02061F	Water temperature	° C	29.00	19.00	21.00	24.00	19.00
02062F	Air temperature	° C	32.50	22.00	21.50	31.00	24.00
96204F	Weather conditions		good	good	rain	good	good
98101F	Rain in the last 24 hours		No	No	yes	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.15
97001F	Depth of water column	m					
96301F	OIL Presence		No	No	No	No	No
96302F	Garbage Presence		No	yes	yes	No	yes
10301L	pH (Lab)		7.00	7.80	7.30	6.50	6.80
02041L	Conduct. (field)	uS/cm	90.00	130.00	140.00	62.00	80.00
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	50.00	14.00	14.00	60.00	6.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	20.00	8.00	12.00	5.00	20.00
08101L	DO	mg/l	2.00	4.20	2.80	7.00	4.20
08202L	BOD (total)	mg/l	4.00	7.20	8.00	2.00	<2.0
08301L	COD (total)	mg/l		20.00	20.00	10.00	10.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	90.00	30.00	160.00	90.00	>160
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	1.60	0.60	1.80	1.00	1.00
07556L	Ammonia Nitrogen	mg N/l	0.40	0.30	0.20	0.05	0.40
07306L	Nitrate Nitrogen	mg N/l	<.1	0.70	0.10	0.70	0.50
15408L	Total Phosphorus	mg P/l	0.50	0.10	0.20	0.10	0.10
15252L	Orthophoshate	mg P/l	0.02	0.02	0.03		
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	<.001	<.001	<.001	<.001	0.002
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	<.002	<.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	<.005	<.005	<.005	<.005	<.005
82004L	Lead	mg Pd/l	<.02	0.04	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01		
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.015	0.005	0.010	0.010	<.005
80013L	Mercury	ug Hg/l	<.10	0.25	0.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.10	0.40	0.50	0.50	0.20
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 17 (SC420) RIVER NAME : Rio Sracuruna (1990~1991)

NO. OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	7 AUG 90	22 AUG 90	10 APR 91	20 AUG 91
CODE	PARAMETER	UNITY					
	Time	H	10:40	10:10	10:20	10:50	9:20
02061F	Water temperature	° C	29.00	21.00	21.00	24.00	20.00
02062F	Air temperature	° C	33.00	22.00	21.00	31.00	25.00
96204F	Weather conditions		good	good	rain	good	good
98101F	Rain in the last 24 hours		No	No	yes	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.15
97001F	Depth of water column	m					
96301F	OIL Presence		No	yes	yes	No	yes
96302F	Garbage Presence		yes	No	yes	No	yes
10301L	pH (Lab)		7.20	7.20	6.50	6.50	6.90
02041L	Conduct. (field)	uS/cm	160.00	190.00	130.00	77.00	310.00
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	10.00	10.00	10.00	60.00	9.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	80.00	14.00	14.00	5.00	20.00
08101L	DO	mg/l	3.00	4.00	4.60	7.60	2.80
08202L	BOD (total)	mg/l	4.00	3.20	10.00	2.40	14.00
08301L	COD (total)	mg/l		10.00	20.00	80.00	15.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	30.00	8.00	13.00	300.00	90.00
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total Kjeldahl Nitrogen	mg N/l	1.00	1.40	2.00	1.00	1.80
07556L	Ammonia Nitrogen	mg N/l	0.50	0.80	0.90	0.10	0.60
07306L	Nitrate Nitrogen	mg N/l		0.40	0.20	0.50	0.60
15408L	Total Phosphorus	mg P/l	0.05	0.10	0.09	0.10	0.05
15252L	Orthophoshate	mg P/l	0.02	<.01	<.02		
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.003	<.001	0.002	<.001	0.009
06600L	Cyanide	mg CN/L	<.010	<.010	<.010	<.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.002	<.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	0.04	<.005	<.005	<.005	<.005
82004L	Lead	mg Pd/l	0.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01	<.01		
28104L	Total Nickel	mg Ni/l	0.02	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.015	0.010	0.005	0.010	<.005
80013L	Mercury	ug Hg/l	<.10	0.15	<.10	<.10	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.75	<.02	0.30	0.50	0.35
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO. OF STATION : 19 (SP300) RIVER NAME : Canal do Sarapui (1990~1991)

NO. OF SAMPLING			1	2	3	4	5	6
Genaral number of the laboratory								
DATE OF SAMPLING			13 MAR 90	28 MAY 90	10 JUL 90	2 JUL 91	26 AUG 91	17 OCT 91
CODE	PARAMETER	UNITY						
	Time	H	10:20	13:55	10:10	9:25	9:30	10:15
02061F	Water temperature	° C	31.50	26.00	23.00	22.00	24.00	28.50
02062F	Air temperature	° C	31.00	29.00	23.50	25.00	26.00	34.00
96204F	Weather conditions		good	good	Cloudy	Cloudy	good	good
98101F	Rain in the last 24 hours		No	No	Nob	No	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.10	0.15	0.10
97001F	Depth of water column	m						
96301F	OIL Presence		No	yes	yes	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes	yes	yes
10301L	pH (Lab)		7.30	7.20	6.90	7.20	6.80	7.10
02041L	*Conduct. (field)*	*uS/cm*	990.00	625.00	680.00	590.00	940.00	900.00
02073L	Turbidity	UT						
10401L	Suspended Solids	mg/l	5.00	22.00	50.00	70.00	25.00	25.00
10104L	Total alcalinity	CaCO3 mg/l						
16302L	Dissolved sulphate	SO4 mg/l						
17204L	Dissolved Chloride	mg/l	160.00	80.00	100.00	90.00	190.00	220.00
08101L	DO	mg/l	<.01	<.01	0.80	<.01	<.01	<.01
08202L	BOD (total)	mg/l	40.00	24.00	40.00	20.00	40.00	40.00
08301L	COD (total)	mg/l	100.00		80.00	70.00	130.00	110.00
36101L	*Total Coli x1000*	*MPN/100ml*						
36111L	Fecal Coli x1000	MPN/100ml	500.00	160<	1600<*	160<	160<	160<
16404L	Dissolved Sulphide	mgS/l						
54752L	Total Alcalinity	CaCO3 mg/l						
10154L	Alcalinity to Phenolphtalein	mg/l						
07005L	Total kjeldahl Nitrogen	mg N/l	19.00	17.00	16.00	10.00	21.00	17.00
07556L	Ammonia Nitrogen	mg N/l	16.00	14.00	13.00	10.00	15.00	14.00
07306L	Nitrate Nitrogen	mg N/l	0.02		0.01	0.02	0.02	<.01
15408L	Total Phosphorus	mg P/l	4.00	3.00	3.00	2.00	3.40	3.00
15252L	Orthophoshate	mg P/l	*2.00*	*0.20*	*2.00*			
07206L	Nitrite Nitrogen	mg N/l						
16302L	Dissolved sulphide	SO4 mg/l						
09004L	Dissolved Fluoride	mg F/l						
06522L	Hexane Extractable	mg/l						
10701L	Surfactants							
06534L	Phenol	mg/l	0.02	0.03	0.009	0.006	0.02	0.03
06600L	Cyanide	mg CN/L	0.050	0.050	<.001	0.010	0.010	0.030
07054L	Diss. Kjeldahl N.	mg N/l						
10474L	Humidity							
48004L	Cadmium	mg Cd/l	0.006	<.002	<.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	0.015	<.005	0.010	0.015	<.005	<.005
82004L	Lead	mg Pd/l	0.04	<.02	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	0.02	<.01	<.01			
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.03	0.010	0.020	0.015	0.005	0.015
80013L	Mercury	ug Hg/l	<.01	<.10	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2+ + Fe3+)	mg Fe/l						
25006L	Total Manganese	mg Mn/l		<.01				
50004L	Total Tin	mg Sn/l						
19102L	Total potassium	mg K/l						
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01	<.01
24051L	*Dissolved Chromuim*	*mg Cr/l*						
25103L	Dissolved Manganese	mg Mn/l						
26101L	Dissolved iron	mg Fe/l	0.10	2.00	0.40	0.04	0.04	0.20
28002L	Dissolved Nickel	mg Ni/l						
29105L	Dissolved copper	mg Cu/l						
30103L	Zinc	mg Zn/l						
48005L	Dissolved chromium	mg Cr/l						
82005L	Dissolved Lead	mg Pb/l						
18000L	op' DDT	ug/l						
18001L	*pp' DDT*	ug/l		<.001	<.001	0.013	<.001	<.001
18011L	op' DDD	ug/l						
18012L	pp' DDD	ug/l						
18013L	pp' DDD	ug/l		<.001	<.001	0.019	<.001	<.001
18020L	op' DDE	ug/l		<.001	<.001	<.001	<.001	<.001
18021L	op' DDE	ug/l		<.001	<.001	0.003	<.001	<.001
18030L	Methoxi-Chlor	ug/l						
18040L	Heprachlor	ug/l						
18045L	Heptachlor epoxi	ug/l						
18050L	*Endosulfan (Thiodan)*	ug/l						
18060L	α-Chlordane	ug/l						
18061L	γ-Chlordane	ug/l						
18070L	Lindane	ug/l		0.03				
18075L	α-BHC	ug/l		0.02				
18080L	β-BHC	ug/l		<.001				

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 20 (SJ220) RIVER NAME : Rio Sao Joao de Meriti (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			10 JUL 90	2 JUL 91	26 AUG 91	17 OCT 91	
CODE	PARAMETER	UNITY					
	Time	H	10:00	9:10	9:15	10:05	
02061F	Water temperature	° C	23.00	22.50	24.50	29.00	
02062F	Air temperature	° C	23.50	25.50	26.50	34.50	
96204F	Weather conditions		Cloudy	good	good	good	
98101F	Rain in the last 24 hours		Nob	No	No	No	
97251F	Sampling depth	m	0.10	0.10	0.15	0.10	
97001F	Depth of water column	m					
96301F	OIL Presence		yes	yes	yes	yes	
96302F	Garbage Presence		yes	yes	yes	yes	
10301L	pH (Lab)		6.90	7.10	6.90	7.00	
02041L	Conduct. (field)	uS/cm	*6900	*7300	*6200	*2600	
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	40.00	25.00	45.00	20.00	
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	*1900	*2150	*1800	690	
08101L	DO	mg/l	<.1	<.1	<.1	<.1	
08202L	BOD (total)	mg/l	10.00	30.00	50.00	50.00	
08301L	COD (total)	mg/l	120.00	115.00		170.00	
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	1600<*	160<	160<	160<	
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	15.00	14.00	15.00	17.00	
07556L	Ammonia Nitrogen	mg N/l	11.00	13.00	10.00	15.00	
07306L	Nitrate Nitrogen	mg N/l	0.02	0.02	0.03	<.01	
15408L	Total Phosphorus	mg P/l	2.00	2.00	2.70	1.80	
15252L	Orthophoshate	mg P/l	1.60				
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.04	0.07	0.03	0.06	
06600L	Cyanide	mg CN/L	<.010	0.010	0.20	0.020	
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.004	<.002	<.002	<.002	
29005L	Copper	mg Cu/l	0.015	0.04	0.010	0.015	
82004L	Lead	mg Pd/l	<.02	<.02	<.02	<.02	
24002L	Chromium	mg Cr/l	0.01				
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	
30003L	Total Zinc	mg Zn/l	0.03	0.020	0.020	0.06	
80013L	Mercury	ug Hg/l	0.60	<.10	<.10	0.35	
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.10	0.35	0.06	0.14	
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					
18000L	op'DDT	ug/l					
18001L	pp'DDT	ug/l	<.001	<.001	<.001	<.001	
18011L	op'DDD	ug/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 22 (IJ200) RIVER NAME : Rio Iraja (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	10 JUL 90	2 JUL 91	26 AUG 91	17 OCT 91
CODE	PARAMETER	UNITY					
	Time	H	9:15	9:50	9:00	9:05	9:05
02061F	Water temperature	° C	29.50	23.00	23.00	24.00	25.00
02062F	Air temperature	° C	29.00	24.00	25.00	26.50	33.00
96204F	Weather conditions		good	Cloudy	good	good	good
98101F	Rain in the last 24 hours		No	Nob	No	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.15	0.10
97001F	Depth of water column	m					
96301F	OIL Presence		yes	Nob	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes	yes
10301L	pH (Lab)		7.10	7.10	7.00	7.00	6.90
02041L	Conduct. (field)	uS/cm	*4650	*2800	*6500	750.00	*4000
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	40.00	60.00	20.00	230.00	30.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	*1400	720.00	*1900	150.00	*1150
08101L	DO	mg/l	<.1	<.1	<.1	<.1	<.1
08202L	BOD (total)	mg/l	30.00	10.00	20.00	110.00	40.00
08301L	COD (total)	mg/l		110.00	75.00	255.00	200.00
36101L	Total Coli x1000	MPN/100ml	160<	160<*	160<	160<	160<
36111L	Fecal Coli x1000	MPN/100ml					
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	11.00	15.00	10.00	18.00	19.00
07556L	Ammonia Nitrogen	mg N/l	8.00	12.00	9.00	9.00	10.00
07306L	Nitrate Nitrogen	mg N/l		0.10	0.05	0.04	0.02
15408L	Total Phosphorus	mg P/l	1.00	2.00	1.50	3.50	0.90
15252L	Orthophoshate	mg P/l	0.03	1.00			
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.01	0.01	<.001	0.02	0.02
06600L	Cyanide	mg CN/L	<.010	<.010	0.010	0.020	0.010
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.016	<.002	<.002	0.004	<.002
29005L	Copper	mg Cu/l	0.04	0.010	0.04	<.005	0.005
82004L	Lead	mg Pd/l	0.10	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01			
28104L	Total Nickel	mg Ni/l	0.06	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.03	0.020	0.010	0.04	0.015
80013L	Mercury	ug Hg/l	<.10	0.50	<.10	0.25	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.40	0.35	0.30	0.30	0.30
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					
18000L	op'DDT	ug/l					
18001L	pp'DDT	ug/l		<.001	<.001		
18011L	op'DDD	ug/l					
18012L	pp'DDD	ug/l					
18013L	pp'DDD	ug/l		<.001	<.001		
18020L	op'DDE	ug/l		<.001	<.001		
18021L	op'DDE	ug/l		<.001	<.001		
18030L	Methoxi-Chlor	ug/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 24 (CN100) RIVER NAME : Canal do Cunha (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	10 JUL 90	2 JUL 91	26 AUG 91	17 OCT 91
CODE	PARAMETER	UNITY					
	Time	H	8:55	9:10	8:45	8:45	8:55
02061F	Water temperature	° C	29.00	22.50	23.00	23.00	25.00
02062F	Air temperature	° C	27.00	23.00	25.00	25.00	31.00
96204F	Weather conditions		good	Cloudy	good	good	good
98101F	Rain in the last 24 hours		No	Nob	No	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.15	0.10
97001F	Depth of water column	m					
96301F	OIL Presence		yes	Nob	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes	yes
10301L	pH (Lab)		7.00	6.80	6.90	6.80	6.90
02041L	Conduct.(field)	uS/cm	410.00	400.00	*1550	415.00	500.00
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	40.00	150.00	90.00	120.00	40.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	55.00	40.00	380.00	70.00	60.00
08101L	DO	mg/l	<.1	1.00	<.1	<.1	<.1
08202L	BOD (total)	mg/l	50.00	60.00	70.00	100.00	60.00
08301L	COD (total)	mg/l		170.00	180.00	140.00	150.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	160<	1600<*	160<	160<	160<
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	11.00	15.00	16.00	14.00	13.00
07556L	Ammonia Nitrogen	mg N/l	7.50	9.00	13.00	9.00	12.00
07306L	Nitrate Nitrogen	mg N/l		2.00	0.02	0.02	<.01
15408L	Total Phosphorus	mg P/l	0.80	2.00	2.50	2.50	1.00
15252L	Orthophoshate	mg P/l	0.07	0.70			
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.02	0.006	0.04	0.03	0.04
06600L	Cyanide	mg CN/L	0.030	0.020	0.030	0.020	0.020
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	<.002	0.002	0.002	0.002	<.002
29005L	Copper	mg Cu/l	0.01	0.07	0.05	0.25	0.14
82004L	Lead	mg Pd/l	<.02	0.04	0.06	0.12	<.02
24002L	Chromium	mg Cr/l	<.01	0.01			
28104L	Total Nickel	mg Ni/l	<.01	0.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.015	0.06	0.10	0.40	0.03
80013L	Mercury	ug Hg/l	<.10	<.10	<.10	0.70	<.10
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.60	0.40	0.40	0.60	0.45
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : 25 (MN000) RIVER NAME : Canal do Mangue (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			8 MAR 90	10 JUL 90	2 JUL 91	26 AUG 91	17 OCT 91
CODE	PARAMETER	UNITY					
	Time	H	8:40	8:55	8:30	8:30	8:40
02061F	Water temperature	° C	29.00	22.00	23.00	23.00	21.00
02062F	Air temperature	° C	27.00	23.00	25.00	25.00	29.00
96204F	Weather conditions		good	Cloudy	good	good	good
98101F	Rain in the last 24 hours		No	No	yes	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.15	0.10
97001F	Depth of water column	m					
96301F	OIL Presence		yes	Nob	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes	yes
10301L	pH (Lab)		7.00	6.70	6.80	6.90	6.60
02041L	Conduct. (field)	uS/cm	*1850	*1500	*1800	*4800	900.00
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	50.00	50.00	30.00	35.00	60.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	340.00	360.00	440.00	*1300	190.00
08101L	DO	mg/l	<.1	<.1	<.1	<.1	<.1
08202L	BOD (total)	mg/l	90.00	40.00	40.00	50.00	60.00
08301L	COD (total)	mg/l		120.00	120.00		150.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	160<	1600<*	160<	160<	160<
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	17.00	28.00	12.00	13.00	17.00
07556L	Ammonia Nitrogen	mg N/l	13.00	14.00	11.00	8.00	7.00
07306L	Nitrate Nitrogen	mg N/l		0.04	0.03	0.03	<.01
15408L	Total Phosphorus	mg P/l	1.00	2.00	2.00	1.70	0.90
15252L	Orthophoshate	mg P/l	0.90	1.00			
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.02	0.01	0.03	0.01	0.02
06600L	Cyanide	mg CN/L	0.05	<.010	0.020	<.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.006	<.002	0.002	<.002	<.002
29005L	Copper	mg Cu/l	0.04	0.005	0.015	0.010	<.005
82004L	Lead	mg Pd/l	0.06	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01			
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.07	0.09	0.020	0.020	0.020
80013L	Mercury	ug Hg/l	<.10	0.20	<.10	<.10	0.15
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l					
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.40	0.30	0.50	0.40	0.55
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : (1A261) RIVER NAME : Iguacu (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			28 MAY 90	10 JUL 90	2 JUL 91	26 AUG 91	17 OCT 91
CODE	PARAMETER	UNITY					
	Time	H	14:00	11:20	10:00	10:30	10:50
02061F	Water temperature	° C	25.00	23.00	22.00	24.00	30.00
02062F	Air temperature	° C	28.50	24.00	24.00	27.00	34.00
96204F	Weather conditions		good	Cloudy	good	good	good
98101F	Rain in the last 24 hours		No	Nob	No	No	No
97251F	Sampling depth	m	0.10	0.10	0.10	0.15	0.10
97001F	Depth of water column	m					
96301F	OIL Presence		yes	yes	yes	yes	yes
96302F	Garbage Presence		yes	yes	yes	yes	yes
10301L	pH (Lab)		6.80	6.90	6.90	7.10	6.90
02041L	Conduct.(field)	uS/cm	*2800	*6000	*6300	*16000	*7100
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	19.00	20.00	50.00	20.00	20.00
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	730	*1700	*1900	*5200	*2900
08101L	DO	mg/l	<.1	0.60	1.40	<.1	<.1
08202L	BOD (total)	mg/l	12.00	12.00	25.00	10.00	10.00
08301L	COD (total)	mg/l	40.00	60.00	70.00		240.00
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml	160<	*1600	24.00	160<	160<
16404L	Dissolved Sulphide	mgS/l					
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	7.00	6.00	3.00	9.00	7.00
07556L	Ammonia Nitrogen	mg N/l	59.00	5.00	2.00	5.00	7.00
07306L	Nitrate Nitrogen	mg N/l		0.02	0.40	0.03	<.01
15408L	Total Phosphorus	mg P/l	0.90	0.60	0.35	1.00	0.90
15252L	Orthophoshate	mg P/l	0.06	0.20			
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.04	0.06	<.001	0.04	0.02
06600L	Cyanide	mg CN/L	0.010	<.010	<.010	<.010	<.010
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.004	<.002	<.002	<.002	<.002
29005L	Copper	mg Cu/l	0.010	0.005	0.04	0.03	0.005
82004L	Lead	mg Pd/l	0.04	<.02	<.02	<.02	<.02
24002L	Chromium	mg Cr/l	<.01	<.01			
28104L	Total Nickel	mg Ni/l	<.01	<.01	<.01	<.01	<.01
30003L	Total Zinc	mg Zn/l	0.015	<.005	0.04	0.015	<.005
80013L	Mercury	ug Hg/l	<.10	<.10	<.10	<.10	<.10
26007L	Total iron (Fe2+ + Fe3+)	mg Fe/l					
25006L	Total Manganese	mg Mn/l	<.10				
50004L	Total Tin	mg Sn/l					
19102L	Total potassium	mg K/l					
24101L	Chromuim VI	mg Cu/l	<.01	<.01	<.01	<.01	<.01
24051L	Dissolved Chromuim	mg Cr/l					
25103L	Dissolved Manganese	mg Mn/l					
26101L	Dissolved iron	mg Fe/l	0.35	0.18	<.02	0.60	0.06
28002L	Dissolved Nickel	mg Ni/l					
29105L	Dissolved copper	mg Cu/l					
30103L	Zinc	mg Zn/l					
48005L	Dissolved chromium	mg Cr/l					
82005L	Dissolved Lead	mg Pb/l					
18000L	op'DDT	ug/l					
18001L	pp'DDT	ug/l	<.001	<.001			
18011L	op'DDD	ug/l					
18012L	mp'DDD	ug/l					
18013L	pp'DDD	ug/l	<.001	<.001			
18020L	op'DDE	ug/l	<.001	<.001			
18021L	op'DDE	ug/l	<.001	<.001			
18030L	Methoxi-Chlor	ug/l					
18040L	Heprachlor	ug/l					
18045L	Heptachlor epoxi	ug/l					
18050L	Endosulfan (Thiodan)	ug/l					
18060L	α-Chlordane	ug/l					
18061L	γ-Chlordane	ug/l					
18070L	Lindane	ug/l	0.01				
18075L	α-BHC	ug/l	0.01				
18080L	β-BHC	ug/l	<.001				

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO. OF STATION : (CC626) RIVER NAME : Fover (1990~1991)

NO. OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING							
CODE	PARAMETER	UNITY					
	Time	H	11:45				
02061F	Water temperature	° C	31.00				
02062F	Air temperature	° C	36.00				
96204F	Weather conditions		Cloudy				
98101F	Rain in the last 24 hours		Nob				
97251F	Sampling depth	m	0.10				
97001F	Depth of water column	m					
96301F	OIL Presence		Nob				
96302F	Garbage Presence		yes				
10301L	pH (Lab)		7.00				
02041L	Conduct. (field)	uS/cm	140.00				
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	20.00				
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	14.00				
08101L	DO	mg/l	8.00				
08202L	BOD (total)	mg/l	5.80				
08301L	COD (total)	mg/l	20.00				
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml					
16404L	Dissolved Sulphide	mgS/l	<.5				
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	3.50				
07556L	Ammonia Nitrogen	mg N/l	3.00				
07306L	Nitrate Nitrogen	mg N/l	1.00				
15408L	Total Phosphorus	mg P/l	0.30				
15252L	Orthophoshate	mg P/l					
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	<.001				
06600L	Cyanide	mg CN/L					
07054L	Diss. Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.014				
29005L	Copper	mg Cu/l	0.03				
82004L	Lead	mg Pd/l	0.08				
24002L	Chromium	mg Cr/l	<.01				
28104L	Total Nickel	mg Ni/l	0.03				
30003L	Total Zinc	mg Zn/l	0.03				
80013L	Mercury	ug Hg/l					

Table APP. 8-3 Results of River Water Quality Analysis by FEEMA (1990-1991)

NO.OF STATION : (CC627) RIVER NAME : Fover Enviaradescricao (1990~1991)

NO.OF SAMPLING			1	2	3	4	5
Genaral number of the laboratory							
DATE OF SAMPLING			19 MAR 90				
CODE	PARAMETER	UNITY					
	Time	H	11:45				
02061F	Water temperature	° C	30.00				
02062F	Air temperature	° C	36.00				
96204F	Weather conditions		good				
98101F	Rain in the last 24 hours		Nob				
97251F	Sampling depth	m	0.10				
97001F	Depth of water column	m					
96301F	OIL Presence		Nob				
96302F	Garbage Presence		yes				
10301L	pH (Lab)		7.00				
02041L	Conduct.(field)	uS/cm	350.00				
02073L	Turbidity	UT					
10401L	Suspended Solids	mg/l	30.00				
10104L	Total alcalinity	CaCO3 mg/l					
16302L	Dissolved sulphate	SO4 mg/l					
17204L	Dissolved Chloride	mg/l	50.00				
08101L	DO	mg/l	5.40				
08202L	BOD (total)	mg/l	14.00				
08301L	COD (total)	mg/l	50.00				
36101L	Total Coli x1000	MPN/100ml					
36111L	Fecal Coli x1000	MPN/100ml					
16404L	Dissolved Sulphide	mgS/l	<.5				
54752L	Total Alcalinity	CaCO3 mg/l					
10154L	Alcalinity to Phenolphtalein	mg/l					
07005L	Total kjeldahl Nitrogen	mg N/l	10.00				
07556L	Ammonia Nitrogen	mg N/l	6.50				
07306L	Nitrate Nitrogen	mg N/l	0.30				
15408L	Total Phosphorus	mg P/l	0.60				
15252L	Orthophoshate	mg P/l					
07206L	Nitrite Nitrogen	mg N/l					
16302L	Dissolved sulphide	SO4 mg/l					
09004L	Dissolved Fluoride	mg F/l					
06522L	Hexane Extractable	mg/l					
10701L	Surfactants						
06534L	Phenol	mg/l	0.002				
06600L	Cyanide	mg CN/L					
07054L	Diss.Kjeldahl N.	mg N/l					
10474L	Humidity						
48004L	Cadmium	mg Cd/l	0.014				
29005L	Copper	mg Cu/l	0.03				
82004L	Lead	mg Pd/l	0.08				
24002L	Chromium	mg Cr/l	0.01				
28104L	Total Nickel	mg Ni/l	0.03				
30003L	Total Zinc	mg Zn/l	0.03				
80013L	Mercury	ug Hg/l					
26007L	Total iron (Fe2++Fe3+)	mg Fe/l					

APPENDIX 9

ESTIMATION RESULTS OF RUNOFF LOAD FROM EACH SUB-BASIN

Table APP. 9-1 Estimation Results of Runoff Load from Each Sub-Basin (1991)

Basin No.		Name	Covered Basin Area (Km2)	NO.	Basin Area (Km2)	Population (persons)	Population Density (10^3/km2)	Land use Type	Rainy Season Discharge (m3/s)	BOD Load (t/d)	CODcm Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Dry Season Discharge (m3/s)	BOD Load (t/d)	CODcm Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Mean Value Discharge (m3/s)	BOD Load (t/d)	CODcm Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)
Eastern Basin	1	R. -CHARITAS	9.40	1	9.40	53.310	5.67	Urban	1.40	2.74	2.16	0.92	0.12	21.16	0.93	1.96	1.61	0.66	0.18	7.38	1.17	2.35	1.89	0.79	0.15	14.52
	2	CANAL CANTO DO RIO	7.40	2	7.40	41.745	5.64	Urb/S.T	1.10	2.15	1.70	0.73	0.10	16.60	0.73	1.54	1.27	0.52	0.14	6.19	0.92	1.84	1.49	0.62	0.12	11.40
	3	R. -CATEDRAR	7.80	3	7.80	37.458	4.80	Urban	1.03	1.92	1.53	0.66	0.09	15.05	0.68	1.38	1.14	0.47	0.13	5.62	0.86	1.65	1.33	0.56	0.11	10.33
	4	R. -NORTE CENTRO	7.90	4	7.90	43.607	5.52	Urban	1.15	2.24	1.77	0.76	0.10	17.36	0.77	1.61	1.33	0.55	0.15	6.47	0.96	1.92	1.55	0.65	0.12	11.91
	5	RIO BOMBA	26.20	5	26.20	183.099	6.99	Urban	4.52	9.34	7.25	3.06	0.42	71.39	2.99	6.67	5.40	2.23	0.60	28.42	3.75	8.00	6.33	2.65	0.51	48.90
	6	RIO IMBOASSU	30.80	6	30.80	138.638	4.50	Urban	3.80	7.05	5.58	2.36	0.31	55.43	2.48	4.99	4.04	1.65	0.44	20.61	3.14	6.02	4.81	2.00	0.38	38.02
Northeastern Basin	7	R. -ITACCA	6.40	7	6.40	31.925	4.99	Urban	0.87	1.64	1.31	0.56	0.08	12.81	0.58	1.18	0.98	0.40	0.11	4.78	0.73	1.41	1.14	0.48	0.09	8.80
	8	RIO ALCANTARA	144.60	8	144.60	670.420	3.25	Urban	14.01	23.66	18.91	7.91	1.00	191.63	8.94	16.49	13.10	5.29	1.40	71.33	11.48	20.07	16.01	6.60	1.20	131.48
	9	RIO CACHERENG	846.70	9	846.70	336.193	0.40	N/A	34.45	17.91	22.38	10.12	0.73	249.25	20.89	11.70	12.19	4.03	0.86	100.89	27.67	14.80	17.28	7.08	0.80	174.97
	10	RIO GUAPIMIRIM	1253.10	10	1253.10	69.853	0.06	N/A	40.93	5.93	17.94	8.65	0.31	218.43	23.79	3.41	8.01	1.90	0.21	93.71	32.36	4.67	12.97	5.28	0.25	156.07
	11	CANAL DE MAGE	18.30	11	18.30	8.458	0.46	N/A	0.82	0.46	0.55	0.26	0.02	5.91	0.52	0.31	0.32	0.11	0.02	2.41	0.67	0.38	0.44	0.18	0.02	4.16
	12	RIO MONCADOR	111.40	12	111.40	36.770	0.33	N/A	4.51	2.00	2.74	1.28	0.09	30.27	2.79	1.31	1.49	0.48	0.10	12.45	3.65	1.66	2.11	0.88	0.09	21.36
	13	RIO IRIRI	27.80	13	27.80	10.584	0.38	N/A	1.18	0.58	0.75	0.36	0.03	8.18	0.75	0.39	0.42	0.14	0.03	3.36	0.97	0.49	0.59	0.25	0.03	5.77
	14	RIO SURUI	68.80	14	68.80	12.910	0.19	N/A	2.59	0.77	1.38	0.66	0.03	15.33	1.60	0.50	0.69	0.20	0.04	6.48	2.09	0.63	1.02	0.43	0.04	10.90
Northwestern Basin	15	R. -MAIA	28.90	15	28.90	8.541	0.30	N/A	1.18	0.48	0.69	0.33	0.02	7.58	0.74	0.32	0.37	0.12	0.02	3.15	0.96	0.40	0.53	0.22	0.02	5.36
	16	RIO ESTRELA	342.50	16	342.50	392.495	0.88	N/A	17.40	15.43	15.05	6.55	0.63	160.29	10.79	10.40	9.14	3.37	0.22	82.38	14.10	12.92	12.09	4.96	0.72	111.33
	17-1	RIO IGUACU	562.80	17-1	562.80	758.010	1.35	N/A	33.34	38.08	33.82	14.35	1.54	355.57	20.68	25.86	21.34	8.17	2.05	135.49	27.01	31.97	27.58	11.26	1.80	245.53
	17-6	RIO SARAPUI	165.50	17-6	165.50	1.012.275	6.12	Urban	25.06	50.96	39.24	16.28	2.20	392.22	16.15	35.84	28.19	11.60	3.12	144.44	20.61	43.40	33.72	13.94	2.66	268.33
	18	R. -CABO DO BRITO	27.00	18	27.00	132.091	4.89	Urban	3.54	8.73	5.30	2.24	0.30	52.54	2.32	4.77	3.87	1.59	0.43	19.52	2.93	5.75	4.58	1.91	0.36	35.03
Western Basin	19	RIO S.J. DE MERITI	184.50	19	184.50	1.492.458	9.07	Urban	34.28	75.35	57.33	23.77	2.30	568.72	22.26	53.31	42.02	17.41	4.71	208.69	28.27	64.33	49.68	20.59	4.01	388.70
	20	RIO IRAJA	35.70	20	35.70	500.276	14.01	Urban	11.09	25.64	19.60	8.26	1.18	190.74	7.41	18.43	15.00	6.25	1.71	70.24	9.25	22.04	17.30	7.26	1.44	130.49
	21	CANAL DO CUMBA	63.60	21	63.60	815.389	12.82	Urban	18.10	41.58	31.67	13.27	1.88	310.05	11.98	29.75	23.93	9.97	2.72	113.98	15.04	35.66	27.80	11.62	2.30	212.01
	22	R. -S.CRISTOVAO	6.60	22	6.60	60.011	9.09	Urban	1.44	3.10	2.42	1.03	0.15	23.40	0.97	2.24	1.86	0.77	0.21	8.68	1.21	2.67	2.14	0.90	0.18	16.04
	23	CANAL DO MANGUE	42.80	23	42.80	500.876	11.70	Urb/S.T	11.30	25.59	19.57	8.23	1.16	191.36	7.50	18.33	14.82	6.17	1.68	70.46	9.40	21.96	17.20	7.20	1.42	130.91
	24	R. -BOTAFOGO	26.00	24	26.00	358.622	13.79	Urban	8.00	18.42	14.12	5.97	0.85	137.09	5.36	13.27	10.85	4.52	1.24	50.54	6.68	15.84	12.48	5.24	1.04	93.81
Island	25	I. DO GOVERNADOR	38.20	25	38.20	153.903	4.02	Urban	4.35	7.81	6.21	2.62	0.34	61.99	2.83	5.51	4.45	1.82	0.48	21.08	3.59	6.66	5.33	2.22	0.41	42.54
	26	I. DO FUNDAO	5.40	26	5.40	5.277	0.98	N/A	0.30	0.28	0.27	0.12	0.01	2.77	0.20	0.19	0.18	0.07	0.02	1.09	0.25	0.23	0.22	0.09	0.01	1.93
	27	I. DE PAQUETA	1.70	27	1.70	3.254	1.91	N/A	0.13	0.17	0.15	0.07	0.01	1.47	0.09	0.12	0.10	0.04	0.01	0.56	0.11	0.14	0.13	0.05	0.01	1.02
	28	I. DO ENGENHO	1.30	28	1.30	11.034	8.49	Urban	0.27	0.58	0.46	0.20	0.03	4.37	0.19	0.42	0.36	0.15	0.04	1.63	0.23	0.50	0.41	0.17	0.03	3.00
	29	I. DE S. CRUZ	1.40	29	1.40	4.851	3.47	Urban	0.15	0.25	0.21	0.09	0.01	2.03	0.10	0.18	0.15	0.06	0.02	0.77	0.13	0.22	0.18	0.08	0.01	1.40
		Total			4080.50	7,594,031			282.31	338.81	332.04	141.64	17.06	3391.03	178.01	272.36	228.53	90.72	23.67	1283.10	230.16	230.59	280.34	116.18	20.37	2337.07

Table APP. 9-1 Estimation Results of Runoff Load from Each Sub-Basin (2000)

Basin No.		Name	Covered Basin Area (Km2)	NO.	Basin Area (Km2)	Population (persons)	Population Density (persons X10^3/km2)	Land use Type	Rainy Season						Dry Season						Mean Value					
									Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)
Eastern Basin	1	R. -CHARITAS	9.40	1	9.40	57,042	6.07	Urban	1.47	2.93	2.31	0.98	0.13	28.89	0.98	2.10	1.73	0.71	0.19	8.39	1.23	2.51	2.02	0.85	0.16	18.64
	2	CANAL CANTO DO RIO	7.40	2	7.40	44,667	6.04	Urb/S.T	1.16	2.30	1.81	0.77	0.11	17.70	0.77	1.65	1.36	0.56	0.15	6.59	0.97	1.97	1.59	0.67	0.13	12.14
	3	R. -CATEDRAL	7.80	3	7.80	40,080	5.14	Urban	1.08	2.06	1.63	0.70	0.09	20.54	0.72	1.47	1.22	0.50	0.13	5.98	0.90	1.77	1.43	0.60	0.11	13.26
	4	R. -NORTE CENTRO	7.90	4	7.90	46,659	5.91	Urban	1.22	2.40	1.89	0.81	0.11	23.69	0.81	1.72	1.42	0.59	0.16	6.89	1.01	2.06	1.66	0.70	0.13	15.29
	5	RIO BOMBA	2.40	5	26.20	227,043	8.67	Urban	5.39	11.61	8.96	2.78	0.53	87.77	2.57	8.31	6.74	2.80	0.76	32.42	4.48	9.96	7.85	2.29	0.64	60.10
	6	RIO MEDAGRI	11.60	6	30.80	180,227	5.85	Urban	4.61	9.18	7.17	3.02	0.41	70.82	3.03	6.52	5.27	2.17	0.58	25.21	3.82	7.85	6.22	2.60	0.50	48.53
Northeastern Basin	7	R. -ITAOCA	6.40	7	6.40	41,503	6.48	Urban	1.06	2.14	1.68	0.72	0.10	20.98	0.71	1.54	1.23	0.53	0.14	6.10	0.89	1.84	1.48	0.62	0.12	13.54
	8	RIO ALCANTARA	58.50	8	144.60	592,729	4.10	Urban	16.35	29.81	23.45	9.78	1.27	236.35	10.48	20.86	16.50	6.72	1.79	87.57	13.41	25.33	19.98	8.25	1.53	161.96
	9	RIO CACERENGU	752.40	9	848.70	450,499	0.53	N/A	36.72	23.44	26.37	11.72	0.05	283.48	22.37	15.48	14.90	5.15	1.16	115.20	29.54	19.46	20.64	8.43	1.05	202.34
	10	RIO GUAPIRINIM	1202.70	10	1253.10	83,824	0.07	N/A	41.37	6.80	18.45	8.88	0.34	223.37	24.14	3.35	8.34	2.03	0.24	85.60	32.76	5.22	12.40	5.46	0.29	159.48
	11	CANAL DE MACE	4.60	11	18.30	10,150	0.55	N/A	0.85	0.54	0.61	0.28	0.02	5.52	0.54	0.37	0.37	0.13	0.03	2.63	0.70	0.45	0.49	0.21	0.03	4.57
	12	RIO RONCADOR	107.00	12	111.40	43,644	0.39	N/A	4.66	2.36	3.00	1.39	0.10	32.86	2.89	1.56	1.87	0.55	0.12	13.40	3.78	1.96	2.43	0.97	0.11	23.13
	13	RIO IRIRI	8.40	13	27.80	12,821	0.46	N/A	1.23	0.69	0.83	0.35	0.03	8.94	0.78	0.46	0.48	0.18	0.04	3.54	1.00	0.58	0.66	0.28	0.03	6.29
	14	RIO SUNUI	53.20	14	66.80	15,492	0.23	N/A	2.65	0.90	1.45	0.70	0.04	16.25	1.64	0.58	0.75	0.23	0.04	6.81	2.15	0.74	1.10	0.46	0.04	11.53
Northwestern Basin	15	R. -BAHIA	28.90	15	28.90	10,249	0.35	N/A	1.21	0.56	0.75	0.36	0.02	10.79	0.76	0.38	0.42	0.14	0.03	3.39	0.99	0.47	0.59	0.25	0.03	7.09
	16	RIO ESTRELA	342.50	16	342.50	362,994	1.06	N/A	18.56	18.40	17.20	7.42	0.75	181.85	11.54	12.47	10.66	4.01	0.99	70.15	15.05	15.44	12.93	5.71	0.87	126.00
	17.1~5	RIO IGUACU	544.20	17-1~5	562.80	909,612	1.62	N/A	36.20	45.55	36.22	16.51	1.85	409.67	22.51	31.05	25.18	9.77	2.49	154.98	29.35	38.30	32.20	13.14	2.17	282.33
	17.6	RIO SARAPUI	159.80	17-6	165.50	1,153,994	6.97	Urban	27.79	58.14	44.56	18.48	2.52	444.30	17.95	40.98	32.24	13.29	3.58	162.36	22.87	49.56	38.40	15.88	3.05	303.83
	18	R. -CABO DO SRITO	27.00	18	27.00	158,509	5.87	Urban	4.06	8.08	6.31	2.66	0.36	79.96	2.67	5.75	4.65	1.92	0.52	23.11	3.37	6.91	5.48	2.29	0.44	51.53
	19	RIO S. J. DE MERITI	163.50	19	164.50	3,611,855	9.80	Urban	36.59	81.43	61.85	25.65	3.58	812.74	23.90	57.68	45.50	18.87	5.12	224.74	30.19	69.56	53.68	22.26	4.35	473.74
Western Basin	20	RIO IRAJA	27.30	20	35.70	535,295	14.99	Urban	11.79	27.45	20.98	8.84	1.27	293.89	7.88	19.76	15.10	6.72	1.84	75.08	9.83	23.61	18.54	7.78	1.55	184.48
	21	CANAL DO CUNHA	60.50	21	63.60	872,466	13.72	Urban	19.23	44.52	33.89	14.20	2.02	331.36	12.75	31.88	25.68	10.78	2.92	121.79	15.98	38.20	29.79	12.45	2.47	226.57
	22	R. -S. CRISTOVAO	6.60	22	6.60	64,212	9.73	Urban	1.53	3.32	2.58	1.10	0.16	21.89	1.03	2.40	2.00	0.83	0.23	9.27	1.28	2.86	2.29	0.97	0.19	20.58
	23	CANAL DO MANGUE	42.80	23	42.80	535,937	12.52	Urb/S.T	12.00	27.40	20.94	8.80	1.25	204.47	7.97	19.65	15.90	6.62	1.81	75.27	9.99	23.52	18.42	7.71	1.53	139.87
	24	R. -BOTAFOGO	26.00	24	26.00	383,726	14.76	Urban	8.50	19.72	15.11	6.39	0.91	187.09	5.70	14.22	11.64	4.86	1.35	54.02	7.10	16.97	13.38	5.62	1.12	120.56
Island	25	I. DO GAVIARADOR	32.20	25	32.20	164,676	4.31	Urban	4.56	8.36	5.62	2.79	0.37	84.33	2.97	5.90	4.77	1.95	0.52	24.53	3.78	7.13	5.69	2.37	0.44	54.63
	26	I. DO FUNDAO	5.40	26	5.40	5,648	1.05	N/A	0.31	0.29	0.25	0.13	0.01	3.77	0.20	0.20	0.19	0.07	0.02	1.14	0.26	0.25	0.23	0.10	0.02	2.48
	27	I. DE PAQUETA	1.70	27	1.70	3,482	2.05	N/A	0.13	0.18	0.16	0.07	0.01	2.00	0.09	0.13	0.11	0.04	0.01	0.60	0.11	0.15	0.13	0.06	0.01	1.20
	28	I. DO ENGENHO	1.30	28	1.30	11,806	9.08	Urban	0.29	0.62	0.49	0.21	0.03	5.94	0.20	0.45	0.39	0.16	0.04	1.74	0.25	0.53	0.44	0.19	0.04	2.84
	29	I. DE S. CRUZ	1.40	29	1.40	5,191	3.71	Urban	0.16	0.27	0.22	0.10	0.01	2.76	0.11	0.19	0.17	0.07	0.02	0.81	0.13	0.23	0.19	0.08	0.02	1.79
		Total			4080.50	8,638,028			302.73	441.24	370.31	157.64	19.36	3881.47	191.59	309.55	257.61	102.85	25.99	1421.44	247.16	375.40	314.21	130.24	23.17	2651.46

Table APP. 9-1 Estimation Results of Runoff Load from Each Sub-Basin (2010-1)

Basin No.		Name	Covered Basin Area (Km2)	NO.	Basin Area (Km2)	Population (persons)	Population Density (10^3/km2)	Land use Type	Rainy Season Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Dry Season Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Mean Value Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)
Eastern Basin	1	B. -CHARITAS	9.40	1	9.40	58.641	6.24	Urban	1.51	3.01	2.37	1.01	0.14	29.65	1.00	2.16	1.78	0.73	0.20	8.61	1.25	2.59	2.07	0.87	0.17	19.13
	2	CANAL CANTO DO RIO	7.40	2	7.40	45.926	6.21	Urb/S.T	1.18	2.36	1.86	0.79	0.11	18.17	0.79	1.70	1.40	0.58	0.16	6.76	0.99	2.03	1.63	0.69	0.13	12.47
	3	B. -CATEDRAR	7.30	3	7.30	41.204	5.28	Urban	1.10	2.12	1.68	0.72	0.10	21.07	0.74	1.52	1.25	0.52	0.14	6.13	0.92	1.82	1.47	0.62	0.12	13.60
	4	B. -NORTE CENTRO	7.90	4	7.90	47.968	6.07	Urban	1.24	2.47	1.94	0.83	0.11	24.31	0.83	1.77	1.46	0.60	0.15	7.07	1.04	2.12	1.70	0.72	0.14	15.69
	5	RIO BOMBA	3.40	5	26.20	256.339	9.78	Urban	5.97	13.12	10.10	4.26	0.60	98.72	3.97	8.40	7.65	3.18	0.86	38.44	4.97	11.26	8.87	3.72	0.73	67.58
	6	RIO IRAJA	11.60	6	30.80	209.340	6.80	Urban	5.19	10.67	8.28	3.49	0.45	81.63	3.42	7.60	6.14	2.54	0.69	30.20	4.30	9.13	7.21	3.01	0.58	55.91
Northeastern Basin	7	B. -ITAOCA	6.40	7	6.40	48.207	7.53	Urban	1.20	2.49	1.95	0.83	0.12	24.19	0.81	1.79	1.49	0.62	0.17	7.03	1.00	2.14	1.72	0.72	0.14	15.61
	8	RIO ALCANTARA	58.50	8	144.60	672.701	4.65	Urban	17.88	33.85	26.43	11.00	1.45	285.55	11.48	23.73	18.74	7.66	2.05	98.17	14.68	28.79	22.58	9.33	1.75	191.86
	9	RIO CACERIBU	738.40	9	845.70	534.547	0.63	N/A	38.36	27.53	29.31	12.89	1.11	319.12	23.43	18.28	16.91	5.98	1.38	125.88	30.89	22.90	23.11	9.43	1.25	222.50
	10	RIO GUAPIRIRIM	1233.70	10	1253.10	102.684	0.08	N/A	41.93	7.49	19.14	9.19	0.37	230.00	24.57	4.45	8.77	2.28	0.28	98.12	33.25	5.97	13.96	5.73	0.33	164.06
	11	CANAL DE MAGE	4.60	11	18.30	12.349	0.67	N/A	0.90	0.55	0.69	0.32	0.03	7.31	0.57	0.44	0.42	0.15	0.04	2.92	0.73	0.55	0.56	0.24	0.03	5.12
	12	RIO RONCADOR	107.00	12	111.40	53.100	0.48	N/A	4.86	2.82	3.34	1.53	0.12	35.23	3.02	1.88	1.90	0.65	0.15	14.62	3.94	2.35	2.62	1.09	0.13	25.43
	13	RIO IRIRI	8.40	13	27.80	15.599	0.56	N/A	1.29	0.83	0.93	0.43	0.04	9.94	0.82	0.56	0.55	0.19	0.04	4.00	1.05	0.69	0.74	0.31	0.04	6.97
	14	RIO SURUI	53.20	14	68.80	18.849	0.27	N/A	2.73	1.06	1.57	0.75	0.05	17.44	1.69	0.70	0.84	0.26	0.05	7.25	2.21	0.88	1.20	0.51	0.05	12.35
Northwestern Basin	15	B. -BACA	28.90	15	28.90	12.470	0.43	N/A	1.26	0.67	0.83	0.39	0.03	11.82	0.79	0.45	0.48	0.16	0.04	3.67	1.03	0.56	0.66	0.28	0.03	7.74
	16	RIO ESTRELA	342.50	16	342.50	423.493	1.24	N/A	19.72	21.39	19.36	8.29	0.87	203.44	12.29	14.54	12.20	4.64	1.16	77.95	16.00	17.96	15.78	6.47	1.02	140.70
	17.1~5	RIO IGUACU	544.20	17-1~5	562.80	1.023.314	1.82	N/A	38.34	51.16	43.28	18.14	2.08	450.31	23.88	34.96	28.08	10.98	2.81	169.63	31.11	43.06	35.68	14.56	2.45	309.97
	17.6	RIO SARAPUI	159.80	17-6	165.50	1.255.221	7.58	Urban	29.73	63.28	48.37	20.05	2.76	481.49	19.24	44.65	35.14	14.52	3.92	176.90	24.49	53.97	41.76	17.28	3.34	329.20
	18	B. -CABO DO BRITO	27.00	18	27.00	178.323	6.60	Urban	4.45	9.09	7.08	2.99	0.41	89.35	2.94	6.48	5.25	2.17	0.58	25.89	3.69	7.79	6.16	2.58	0.50	57.57
Western Basin	19	RIO S. J. DE MERITI	163.50	19	184.50	1.571.553	10.16	Urban	37.74	84.48	64.12	26.50	3.72	634.78	24.57	59.87	47.25	19.61	5.22	222.79	31.15	72.17	55.69	23.10	4.52	433.78
	20	RIO IRAJA	27.30	20	35.70	550.304	15.41	Urban	12.09	28.23	21.57	9.09	1.30	209.53	8.09	20.33	15.57	6.92	1.89	77.15	10.09	24.28	19.07	8.01	1.60	143.34
	21	CANAL DO CUNHA	60.50	21	63.60	898.928	14.10	Urban	19.71	45.78	34.84	14.60	2.08	340.50	13.07	32.80	26.43	11.02	3.01	125.14	16.39	39.29	30.64	12.81	2.54	232.82
	22	B. -S. CRISTOVAO	6.60	22	6.60	66.012	10.00	Urban	1.56	3.41	2.66	1.13	0.16	32.76	1.06	2.47	2.06	0.85	0.23	9.52	1.31	2.94	2.36	0.99	0.20	21.14
	23	CANAL DO MANGUE	42.80	23	42.80	550.964	12.87	Urb/S.T	12.29	28.17	21.53	9.05	1.29	210.09	8.18	20.21	16.37	6.82	1.86	77.34	10.24	24.19	18.95	7.94	1.57	143.71
	24	B. -BOTAFOGO	26.00	24	26.00	394.484	15.17	Urban	8.71	20.28	15.53	6.57	0.94	192.24	5.85	14.63	11.99	5.00	1.37	55.51	7.28	17.45	13.76	5.79	1.16	123.88
Inland	25	L. DO GAVIANDOR	38.20	25	38.20	169.293	4.43	Urban	4.65	8.60	6.79	2.87	0.38	87.00	3.03	6.07	4.90	2.00	0.54	25.15	3.84	7.33	5.85	2.43	0.46	56.08
	26	L. DO FUNDAO	5.40	26	5.40	5.805	1.07	N/A	0.31	0.30	0.29	0.13	0.01	3.85	0.20	0.21	0.19	0.07	0.02	1.16	0.26	0.26	0.24	0.10	0.02	2.50
	27	L. DE PAQUETA	1.70	27	1.70	3.579	2.11	N/A	0.14	0.19	0.16	0.07	0.01	2.05	0.09	0.13	0.11	0.05	0.01	0.61	0.11	0.16	0.14	0.06	0.01	1.33
	28	L. DO ENGENHO	1.30	28	1.30	12.137	9.34	Urban	0.30	0.63	0.50	0.22	0.03	8.10	0.20	0.45	0.40	0.16	0.05	1.79	0.25	0.55	0.45	0.19	0.04	3.94
	29	L. DE S. CRUZ	1.40	29	1.40	5.338	3.81	Urban	0.16	0.28	0.23	0.10	0.01	2.83	0.11	0.20	0.17	0.07	0.02	0.83	0.14	0.24	0.20	0.08	0.02	1.83
		Total			4080.50	9.336.661			316.48	476.40	396.76	168.32	20.90	4141.47	200.72	334.44	276.89	110.91	29.18	1514.16	258.60	405.42	338.33	139.62	25.04	2827.82

Table APP. 9-1 Estimation Results of Runoff Load from Each Sub-Basin (2010-2)

Basin No.		Name	Covered Basin Area (Km2)	NO.	Basin Area (Km2)	Population (persons)	Population Density (10^3/km2)	Land use Type	Rainy Season Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Dry Season Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)	Mean Value Discharge (m3/s)	BOD Load (t/d)	CODmn Load (t/d)	TN Load (t/d)	TP Load (t/d)	SS Load (t/d)
Eastern Basin	1	R.-CHARITAS	9.40	1	9.40	59.707	6.35	Urban	1.53	3.07	2.41	1.03	0.14	30.16	1.02	2.20	1.81	0.75	0.20	8.76	1.27	2.63	2.11	0.89	0.17	19.46
	2	CANAL CANTO DO RIO	7.40	2	7.40	48.754	6.32	Urb/S.T	1.20	2.41	1.89	0.81	0.11	18.48	0.80	1.73	1.43	0.59	0.16	6.88	1.00	2.07	1.66	0.70	0.14	12.68
	3	R.-CATUMBAR	7.80	3	7.80	41.953	5.38	Urban	1.12	2.16	1.71	0.73	0.10	21.43	0.75	1.54	1.28	0.53	0.14	6.24	0.93	1.85	1.49	0.63	0.12	13.83
	4	R.-NOCTE CENTRO	7.90	4	7.90	48.840	6.18	Urban	1.26	2.51	1.98	0.84	0.12	24.73	0.84	1.80	1.49	0.61	0.17	7.19	1.05	2.16	1.73	0.73	0.14	15.96
	5	RIO BONSA	3.40	5	26.20	258.170	9.85	Urban	6.09	13.21	10.17	4.29	0.60	99.41	3.99	8.47	7.70	3.20	0.87	35.69	5.00	11.34	8.94	3.75	0.74	68.05
	6	RIO IMBOASSU	11.60	6	30.50	299.340	6.80	Urban	5.19	10.57	8.25	3.49	0.48	81.63	3.42	7.60	6.14	2.54	0.69	30.20	4.30	9.13	7.21	3.01	0.58	55.91
Northeastern Basin	7	R.-ITAOCA	6.40	7	6.40	48.207	7.53	Urban	1.20	2.49	1.95	0.83	0.12	24.19	0.81	1.79	1.49	0.62	0.17	7.03	1.00	2.14	1.72	0.72	0.14	15.91
	8	RIO ALCANTARA	58.50	8	144.60	677.405	4.68	Urban	17.97	34.09	26.61	11.07	1.46	257.27	11.54	23.90	18.87	7.71	2.06	98.80	14.75	28.99	22.74	9.39	1.76	183.03
	9	RIO CACERIBU	758.40	9	845.70	534.547	0.63	N/A	28.36	27.53	29.31	12.99	1.11	319.12	23.43	18.28	16.91	5.98	1.38	125.88	30.89	22.90	23.11	9.43	1.25	222.50
	10	RIO GUAPINIRIM	1233.70	10	1253.10	102.884	0.08	N/A	41.93	7.49	19.14	9.19	0.37	230.00	24.57	6.45	8.77	2.20	0.28	98.12	33.25	5.97	13.96	5.70	0.33	164.06
	11	CANAL DE MAGE	4.60	11	18.30	12.349	0.67	N/A	0.90	0.65	0.69	0.32	0.03	7.31	0.57	0.44	0.42	0.15	0.04	2.92	0.73	0.55	0.56	0.24	0.03	5.12
	12	RIO SONCADOR	107.00	12	111.40	53.100	0.48	N/A	4.86	2.82	3.34	1.53	0.12	36.23	3.02	1.88	1.90	0.85	0.15	14.62	3.94	2.35	2.62	1.09	0.13	25.43
	13	RIO IGUAI	8.40	13	27.80	15.599	0.56	N/A	1.29	0.83	0.93	0.43	0.04	9.94	0.82	0.58	0.55	0.19	0.04	4.00	1.05	0.69	0.74	0.31	0.04	6.97
	14	RIO SURUI	53.20	14	68.80	18.849	0.27	N/A	2.73	1.06	1.57	0.75	0.05	17.44	1.69	0.70	0.84	0.26	0.05	7.25	2.21	0.88	1.20	0.51	0.05	12.35
Northwester Basin	15	R.-BAIA	28.90	15	28.90	12.470	0.42	N/A	1.26	0.67	0.83	0.39	0.03	11.82	0.79	0.45	0.48	0.16	0.04	3.67	1.03	0.56	0.66	0.28	0.03	7.74
	16	RIO ESTRELA	342.50	16	342.50	435.593	1.27	N/A	19.95	21.98	19.79	8.46	0.99	207.77	12.43	14.98	12.50	4.77	1.19	79.51	16.19	18.47	16.15	6.62	1.35	143.64
	17.1~5	RIO IGUACU	544.20	17-1~5	562.80	1.076.374	1.91	N/A	39.33	53.79	45.18	18.90	2.19	469.30	24.52	36.79	29.44	11.55	2.97	176.48	31.93	45.29	37.31	15.23	2.58	322.89
	17.6	RIO SARAPUI	159.80	17-6	165.50	1.305.835	7.89	Urban	30.71	65.85	50.25	20.84	2.87	500.10	19.89	45.50	36.60	15.13	4.09	183.68	25.30	56.17	43.44	17.99	3.48	341.89
	18	R.-CABO DO BRITO	27.00	18	27.00	187.569	6.95	Urban	4.63	9.57	7.43	3.14	0.43	93.73	3.06	6.82	5.53	2.28	0.62	27.06	3.85	8.20	6.48	2.71	0.52	60.40
Western Basin	19	RIO S. J. DE MERITI	163.50	19	164.50	1.716.327	10.43	Urban	28.61	56.78	65.22	27.30	2.82	651.51	25.15	61.51	48.56	20.16	5.47	220.82	31.88	74.14	57.19	23.73	4.65	445.06
	20	RIO IRAJA	27.38	20	28.70	560.309	15.65	Urban	12.28	28.75	21.96	9.26	1.33	213.29	8.22	20.71	16.35	7.05	1.53	78.54	10.25	24.73	19.42	8.16	1.83	145.91
	21	CANAL DO CUNHA	60.50	21	62.60	913.226	14.36	Urban	20.03	46.82	35.48	14.87	2.12	346.59	13.29	33.41	26.94	11.23	3.07	127.38	16.66	40.02	31.21	13.05	2.59	236.99
	22	R.-S.CRISTOVAO	5.80	22	6.60	67.212	10.18	Urban	1.59	2.47	2.79	1.16	0.16	33.34	1.07	2.51	2.05	0.87	0.24	9.59	1.33	2.99	2.40	1.01	0.20	21.51
	23	CANAL DO MANGUE	42.80	23	42.80	560.981	13.11	Urb/S.T	12.49	26.63	21.92	9.22	1.31	213.84	8.31	20.59	16.68	6.95	1.90	78.71	10.48	24.64	19.30	8.08	1.60	146.28
	24	R.-BOTAFOGO	25.90	24	28.00	401.657	15.45	Urban	8.88	20.65	15.82	6.69	0.96	195.68	5.95	14.90	12.21	5.10	1.40	56.51	7.40	17.78	14.02	5.89	1.18	126.09
Island	25	I. DO GAVIAO	38.20	25	38.20	172.371	4.51	Urban	4.71	8.75	6.91	2.91	0.39	86.45	3.07	6.19	4.99	2.04	0.53	25.57	3.89	7.47	5.95	2.48	0.47	57.01
	26	I. DO FUNDAO	5.40	26	5.40	5.910	1.09	N/A	0.32	0.31	0.29	0.13	0.01	2.90	0.21	0.21	0.19	0.07	0.02	1.18	0.26	0.26	0.24	0.10	0.02	2.54
	27	I. DE PAQUETA	1.70	27	1.70	2.644	2.14	N/A	0.14	0.19	0.16	0.07	0.01	2.08	0.09	0.13	0.12	0.05	0.01	0.82	0.11	0.16	0.14	0.06	0.01	1.35
	28	I. DO ENGENHO	1.30	28	1.30	12.358	9.51	Urban	0.30	0.65	0.51	0.22	0.03	6.20	0.21	0.47	0.40	0.17	0.05	1.82	0.25	0.56	0.48	0.19	0.04	4.01
	29	I. DE S.CRUZ	1.40	29	1.40	5.433	3.88	Urban	0.18	0.28	0.23	0.10	0.01	2.88	0.11	0.20	0.17	0.07	0.02	0.85	0.14	0.24	0.20	0.09	0.02	1.80
		Total			4030.50	9.564.782			320.89	487.96	405.23	171.87	21.42	4227.61	203.64	342.99	283.41	113.64	29.93	1544.64	252.27	415.33	344.37	142.76	25.58	2886.12

Table APP. 9-2 Estimation Results of Runoff Load from Each Area (1991, 2000, 2010)

(SN1991)

	Basin No.	Basin Area	Population	Population Density	Land use Type	Whole basin Mean Value						Whole basin Mean Value					
						Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load	Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load
		(Km2)	(persons)	(10^3/km2)		(m3/s)	(t/d)	(t/d)	(t/d)	(t/d)	(t/d)	(%)	(%)	(%)	(%)	(%)	(%)
Eastern Basin	1 - 6	89.50	497.855	5.56	Urban	10.80	21.79	17.39	7.28	1.39	135.08	5	7	6	6	7	6
Northeastern Basin	7 - 14	2,477.10	976.813	0.39	N/U	79.60	44.11	51.56	21.18	2.53	513.50	35	13	18	18	12	22
Northwestern Basin	15 - 18	1,126.70	2,213.412	1.96	Urban	65.61	94.43	78.51	32.30	5.56	666.64	29	29	28	28	27	29
Western Basin	19 - 24	339.20	3,727.632	10.99	Urban	69.85	162.50	126.60	52.81	10.40	971.97	30	49	45	45	51	42
Island	25 - 29	48.00	178.319	3.71	Urban	4.31	7.75	6.27	2.62	0.49	49.88	2	2	2	2	2	2
Total		4,080.50	7,594.031			230.16	330.59	280.34	116.18	20.37	2,337.07	100	100	100	100	100	100

(SN2000)

	Basin No.	Basin Area	Population	Population Density	Land use Type	Whole basin Mean Value						Whole basin Mean Value					
						Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load	Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load
		(Km2)	(persons)	(10^3/km2)		(m3/s)	(t/d)	(t/d)	(t/d)	(t/d)	(t/d)	(%)	(%)	(%)	(%)	(%)	(%)
Eastern Basin	1 - 6	89.50	595.718	6.66	Urban	12.41	26.12	20.76	8.70	1.68	167.96	5	7	7	7	7	6
Northeastern Basin	7 - 14	2,477.10	1,250.660	18.67	N/U	84.22	55.59	60.07	24.68	3.20	582.85	34	15	19	19	14	22
Northwestern Basin	5 - 18	1,126.70	2,595.358	2.30	Urban	71.63	110.68	90.60	37.28	6.56	770.78	29	29	29	29	28	29
Western Basin	20 - 24	339.20	4,003.491	11.80	Urban	74.38	174.71	136.09	56.80	11.21	1,065.81	30	47	43	44	48	40
Island	25 - 29	48.00	190.801	3.98	Urban	4.51	8.30	6.69	2.79	0.52	64.06	2	2	2	2	2	2
Total		4,080.50	8,636.028			247.16	375.40	314.21	130.24	23.17	2,651.46	100	100	100	100	100	100

(SN2010-1)

	Basin No.	Basin Area	Population	Population Density	Land use Type	Whole basin Mean Value						Whole basin Mean Value					
						Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load	Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load
		(Km2)	(persons)	(10^3/km2)		(m3/s)	(t/d)	(t/d)	(t/d)	(t/d)	(t/d)	(%)	(%)	(%)	(%)	(%)	(%)
Eastern Basin	1 - 6	89.50	659.411	7.37	Urban	13.47	28.94	22.96	9.62	1.87	184.38	5	7	7	7	7	7
Northeastern Basin	7 - 14	2,477.10	1,458.034	0.59	N/U	87.76	64.27	66.50	27.33	3.71	633.90	34	16	20	20	15	22
Northwestern Basin	15 - 18	1,126.70	2,892.820	2.57	Urban	76.32	123.34	100.03	41.16	7.33	845.18	30	30	30	29	29	30
Western Basin	19 - 24	339.20	4,130.244	12.18	Urban	76.46	180.33	140.46	58.53	11.59	1,098.67	30	44	42	42	46	39
Island	25 - 29	48.00	196.151	4.09	Urban	4.60	8.54	6.87	2.87	0.54	65.68	2	2	2	2	2	2
Total		4,080.50	9,336.661			258.60	405.42	336.83	139.52	25.04	2,827.82	100	100	100	100	100	100

(SN2010-2)

	Basin No.	Basin Area	Population	Population Density	Land use Type	Whole basin Mean Value						Whole basin Mean Value					
						Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load	Discharge	BOD. Load	CODmn. Load	TN. Load	TP. Load	SS. Load
		(Km2)	(persons)	(10^3/km2)		(m3/s)	(t/d)	(t/d)	(t/d)	(t/d)	(t/d)	(%)	(%)	(%)	(%)	(%)	(%)
Eastern Basin	1 - 6	89.50	664.764	7.43	Urban	13.56	29.18	23.15	9.70	1.89	185.89	5	7	7	7	7	6
Northeastern Basin	7 - 14	2477.10	1,462.738	0.59	N/U	87.83	64.47	66.65	27.39	3.73	635.07	33	16	19	19	15	22
Northwestern Basin	15 - 18	1126.70	3,017.841	2.68	Urban	78.29	126.69	104.03	42.82	7.66	876.55	30	31	30	30	30	30
Western Basin	19 - 24	339.20	4,219.722	12.44	Urban	77.93	184.29	143.54	59.93	11.85	1,121.84	30	44	42	42	46	39
Island	25 - 29	48.00	199.717	4.16	Urban	4.66	8.69	6.99	2.92	0.55	66.77	2	2	2	2	2	2
Total		4,080.50	9,564.782			262.27	415.33	344.37	142.76	25.68	2,886.12	100	100	100	100	100	100

APPENDIX 10

ESTIMATION RESULTS OF RUNOFF LOAD WITH COUNTOUR MEASURES

Table APP.10-1 Estimation Results of Runoff Load with Countour Measures

IDB/OEEF Program(1991-2010)

Basin No.		Name	Basin Area (Km2)	NO.	Discharge (m3/s) (1991)	Discharge (m3/s) (2000)	Discharge (m3/s) (2010)	BOD Load (t/d) (1991)	BOD Load (t/d) (2000)	BOD Load (t/d) (2010)	TN Load (t/d) (1991)	TN Load (t/d) (2000)	TN Load (t/d) (2010)	TP Load (t/d) (1991)	TP Load (t/d) (2000)	TP Load (t/d) (2010)
	1	B.-CHARITAS	9.40	1	1.17	1.23	1.27	2.35	1.23	0.47	0.79	0.76	0.73	0.15	0.16	0.16
Eastern	2	CANAL CANTO DO RIO	7.40	2	0.92	0.97	1.00	1.84	0.97	0.37	0.62	0.60	0.57	0.12	0.12	0.12
Basin	3	B.-CATEDRAR	7.80	3	0.86	0.90	0.93	1.65	0.87	0.33	0.56	0.54	0.51	0.11	0.11	0.11
	4	B.-NORTE CENTRO	7.90	4	0.96	1.01	1.05	1.92	1.01	0.39	0.65	0.63	0.60	0.12	0.13	0.13
	5	RIO BOMBA	25.20	5	3.75	4.48	5.00	8.00	5.32	2.86	2.65	2.99	3.13	0.51	0.61	0.68
	6	RIO IMBOASSU	30.80	6	3.14	3.82	4.30	6.02	7.85	9.13	2.00	2.60	3.01	0.38	0.50	0.58
	7	B.-ITAOCA	6.40	7	0.73	0.89	1.00	1.41	1.84	2.14	0.48	0.62	0.72	0.09	0.12	0.14
Northeastern	8	RIO ALCANTARA	144.60	8	11.48	13.41	14.75	20.07	25.33	28.99	6.60	8.25	9.39	1.20	1.53	1.76
Basin	9	RIO CACEREBU	846.70	9	27.67	29.54	30.89	14.80	19.46	22.90	7.08	8.43	9.43	0.80	1.05	1.25
	10	RIO GUAPIMIRIM	1253.10	10	32.36	32.76	33.25	4.67	5.22	5.97	5.28	5.46	5.70	0.26	0.29	0.33
	11	CANAL DE MAGE	18.30	11	0.67	0.70	0.73	0.38	0.45	0.55	0.18	0.21	0.24	0.02	0.03	0.03
	12	RIO RONCADOR	111.40	12	3.65	3.78	3.94	1.66	1.96	2.35	0.88	0.97	1.09	0.09	0.11	0.13
	13	RIO IRIRI	27.80	13	0.97	1.00	1.05	0.49	0.58	0.69	0.25	0.28	0.31	0.03	0.03	0.04
	14	RIO SURUI	68.80	14	2.09	2.15	2.21	0.63	0.74	0.88	0.43	0.46	0.51	0.04	0.04	0.05
	15	B.-MAUA	28.90	15	0.96	0.99	1.03	0.40	0.47	0.56	0.22	0.25	0.28	0.02	0.03	0.03
Northwestern	16	RIO ESTRELA	342.50	16	14.10	15.05	16.19	12.92	15.44	18.47	4.96	5.71	6.62	0.72	0.87	1.05
Basin	17.1~5	RIO IGUACU	562.80	17-1~5	27.01	29.35	31.93	31.97	38.30	45.29	11.26	13.14	15.23	1.80	2.17	2.58
	17.6	RIO SARAPUI	165.50	17-6	20.61	22.87	25.30	43.40	42.87	43.98	13.94	15.46	17.13	2.66	3.01	3.40
	18	B.-CABO DO BRITO	27.00	18	2.93	3.37	3.85	5.75	5.82	6.11	1.91	2.22	2.56	0.36	0.43	0.51
	19	RIO S.J.DE MERITI	164.50	19	28.27	30.19	31.88	64.33	62.53	62.09	20.59	21.82	22.89	4.01	4.31	4.56
	20	RIO IRAJA	35.70	20	9.25	9.83	10.25	22.04	15.51	11.10	7.25	7.26	7.17	1.44	1.50	1.53
Western	21	CANAL DO CUNHA	63.60	21	15.04	15.99	16.66	35.66	22.67	13.86	11.62	11.45	11.18	2.30	2.37	2.41
Basin	22	B.-S.CRISTOVAO	6.60	22	1.21	1.28	1.33	2.67	1.69	1.02	0.90	0.89	0.87	0.18	0.18	0.19
	23	CANAL DO MANGUE	42.80	23	9.40	9.99	10.40	21.96	16.65	13.07	7.20	7.27	7.25	1.42	1.48	1.52
	24	B.-BOTAFOGO	26.06	24	6.66	7.10	7.40	15.84	15.04	14.52	5.24	5.50	5.66	1.04	1.11	1.15
	25	I. DO GAVANADOR	38.20	25	3.59	3.76	3.89	5.66	5.45	4.63	2.22	2.26	2.27	0.41	0.43	0.45
Island	26	I. DO FUNDAO	5.40	26	0.25	0.26	0.26	0.23	0.20	0.17	0.09	0.10	0.10	0.01	0.01	0.02
	27	I. DE PAQUETA	1.70	27	0.11	0.11	0.11	0.14	0.15	0.16	0.05	0.06	0.06	0.01	0.01	0.01
	28	I. DO ENGENHO	1.30	28	0.23	0.25	0.25	0.50	0.53	0.56	0.17	0.19	0.19	0.03	0.04	0.04
	29	I. DE S.CRUZ	1.40	29	0.13	0.13	0.14	0.22	0.23	0.24	0.08	0.08	0.09	0.01	0.02	0.02
		Total	4080.50		230.16	247.16	262.27	330.59	316.38	313.87	116.18	126.45	135.47	20.37	22.80	24.96

Table APP.10-1 Estimation Results of Runoff Load with Countour Measures

Ocean outfall(2010)

Basin No.	Name	Basin Area (Km2)	NO.	(2010) Discharge (m3/s)					(2010) BOD Load (t/d)				
				No Sewerage	Ocean outfall(1)	Ocean outfall(2)	Ocean outfall(3)	Ocean outfall(4)	No Sewerage	Ocean outfall(1)	Ocean outfall(2)	Ocean outfall(3)	Ocean outfall(4)
	1 B.-CHARITAS	9.40	1	1.27	0.12	0.12	0.12	0.12	2.63	0.07	0.06	0.06	0.06
Eastern	2 CANAL CANTO DO RIO	7.40	2	1.00	0.10	0.10	0.10	0.10	2.07	0.06	0.06	0.06	0.06
Basin	3 B.-CATEDRAL	7.80	3	0.93	0.09	0.09	0.09	0.84	1.85	0.05	0.05	0.05	9.91
	4 B.-NORTE CENTRO	7.90	4	1.05	0.10	0.10	0.10	0.95	2.16	0.06	0.06	0.06	1.06
	5 RIO BOMBA	26.20	5	5.00	4.77	4.77	4.54	4.54	11.34	6.07	6.07	6.07	6.07
	6 RIO IMBOASSU	30.80	6	4.30	4.30	4.30	4.30	4.30	9.13	9.13	9.13	9.13	9.13
	7 B.-ITAOCA	8.40	7	1.00	1.00	1.00	1.00	1.00	2.14	2.14	2.14	2.14	2.14
Northeastern	8 RIO ALCANTARA	144.60	8	14.75	14.75	14.75	14.75	14.75	28.99	28.99	28.99	28.99	28.99
Basin	9 RIO CACEREBU	846.70	9	30.89	30.89	30.89	30.89	30.89	22.90	22.90	22.90	22.90	22.90
	10 RIO GUAPIMIRIM	1253.10	10	33.25	33.25	33.25	33.25	33.25	5.97	5.97	5.97	5.97	5.97
	11 CANAL DE MAGE	18.30	11	0.73	0.73	0.73	0.73	0.73	0.55	0.55	0.55	0.55	0.55
	12 RIO ROCADOR	111.40	12	3.94	3.94	3.94	3.94	3.94	2.35	2.35	2.35	2.35	2.35
	13 RIO IRIRI	27.80	13	1.05	1.05	1.05	1.05	1.05	0.69	0.69	0.69	0.69	0.69
	14 RIO SURUI	68.80	14	2.21	2.21	2.21	2.21	2.21	0.88	0.88	0.88	0.88	0.88
	15 B.-MAUA	28.90	15	1.03	1.03	1.03	1.03	1.03	0.56	0.56	0.56	0.56	0.56
Northwestern	16 RIO ESTRELA	342.50	16	16.19	16.19	16.19	16.19	16.19	18.47	18.47	18.47	18.47	18.47
Basin	17.1~5 RIO IGUACU	562.80	17-1~5	31.93	31.93	31.93	31.93	31.93	45.29	45.29	45.29	45.29	45.29
	17.6 RIO SARAPUI	165.50	17-6	25.10	24.86	24.98	24.63	24.63	56.17	48.59	48.59	48.59	48.59
	18 B.-CABO DO BRITO	27.00	18	3.65	3.79	3.73	3.79	3.79	6.20	6.90	6.90	6.90	6.90
	19 RIO S.J.DE MERITI	164.50	19	21.88	26.16	21.56	21.25	21.25	74.14	58.87	66.64	66.64	66.64
	20 RIO IRAJA	35.70	20	10.25	8.02	8.02	9.57	9.57	24.73	8.59	8.59	16.25	16.25
Western	21 CANAL DO CUNHA	63.60	21	18.66	4.64	4.64	4.64	15.38	40.02	9.04	9.04	9.04	22.75
Basin	22 B.-S.CRISTOVAO	6.60	22	1.33	0.38	0.38	0.38	1.22	2.95	0.86	0.86	0.86	1.77
	23 CANAL DO MANGUE	42.80	23	10.40	5.01	5.01	5.01	9.81	24.66	10.94	10.94	10.94	17.45
	24 B.-BOTAFOGO	26.00	24	7.40	5.91	5.91	5.91	5.91	17.76	13.93	13.93	13.93	13.93
	25 I. DO GAVANADOR	38.20	25	3.89	3.80	3.80	3.71	3.71	7.47	5.70	5.70	5.70	5.70
Island	26 I. DO FUNDAO	5.40	26	0.26	0.16	0.16	0.16	0.25	0.26	0.16	0.16	0.16	0.21
	27 I. DE PAQUETA	1.70	27	0.11	0.11	0.11	0.11	0.11	0.16	0.16	0.16	0.16	0.16
	28 I. DO ENGENHO	1.30	28	0.25	0.25	0.25	0.25	0.25	0.56	0.56	0.56	0.56	0.56
	29 I. DE S.CRUZ	1.40	29	0.14	0.14	0.14	0.14	0.14	0.24	0.24	0.24	0.24	0.24
	Total	4089.50		262.27	225.76	231.18	235.70	253.15	415.33	309.58	316.36	324.02	346.23

Basin No.	Name	Basin Area (Km2)	NO.	(2010) TN Load (t/d)					(2010) TP Load (t/d)				
				No Sewerage	Ocean outfall(1)	Ocean outfall(2)	Ocean outfall(3)	Ocean outfall(4)	No Sewerage	Ocean outfall(1)	Ocean outfall(2)	Ocean outfall(3)	Ocean outfall(4)
	1 B.-CHARITAS	9.40	1	0.89	0.08	0.08	0.08	0.08	0.17	0.02	0.02	0.02	0.02
Eastern	2 CANAL CANTO DO RIO	7.40	2	0.70	0.07	0.07	0.07	0.07	0.14	0.01	0.01	0.01	0.01
Basin	3 B.-CATEDRAL	7.80	3	0.63	0.06	0.06	0.06	0.56	0.12	0.01	0.01	0.01	0.11
	4 B.-NORTE CENTRO	7.90	4	0.73	0.07	0.07	0.07	0.66	0.14	0.01	0.01	0.01	0.13
	5 RIO BOMBA	26.20	5	3.75	3.40	3.40	3.40	3.40	0.71	0.70	0.70	0.67	0.67
	6 RIO IMBOASSU	30.80	6	3.01	3.01	3.01	3.01	3.01	0.58	0.58	0.58	0.58	0.58
	7 B.-ITAOCA	8.40	7	0.72	0.72	0.72	0.72	0.72	0.14	0.14	0.14	0.14	0.14
Northeastern	8 RIO ALCANTARA	144.60	8	9.39	9.39	9.39	9.39	9.39	1.76	1.76	1.76	1.76	1.76
Basin	9 RIO CACEREBU	846.70	9	9.43	9.43	9.43	9.43	9.43	1.25	1.25	1.25	1.25	1.25
	10 RIO GUAPIMIRIM	1253.10	10	5.70	5.70	5.70	5.70	5.70	0.33	0.33	0.33	0.33	0.33
	11 CANAL DE MAGE	18.30	11	0.24	0.24	0.24	0.24	0.24	0.03	0.03	0.03	0.03	0.03
	12 RIO ROCADOR	111.40	12	1.09	1.09	1.09	1.09	1.09	0.13	0.13	0.13	0.13	0.13
	13 RIO IRIRI	27.80	13	0.31	0.31	0.31	0.31	0.31	0.04	0.04	0.04	0.04	0.04
	14 RIO SURUI	68.80	14	0.51	0.51	0.51	0.51	0.51	0.05	0.05	0.05	0.05	0.05
	15 B.-MAUA	28.90	15	0.28	0.28	0.28	0.28	0.28	0.03	0.03	0.03	0.03	0.03
Northwestern	16 RIO ESTRELA	342.50	16	6.62	6.62	6.62	6.62	6.62	1.05	1.05	1.05	1.05	1.05
Basin	17.1~5 RIO IGUACU	562.80	17-1~5	15.23	15.23	15.23	15.23	15.23	2.58	2.58	2.58	2.58	2.58
	17.6 RIO SARAPUI	165.50	17-6	17.59	17.51	17.51	17.51	17.51	3.48	3.43	3.43	3.43	3.39
	18 B.-CABO DO BRITO	27.00	18	2.71	2.63	2.63	2.63	2.63	0.52	0.52	0.52	0.51	0.51
	19 RIO S.J.DE MERITI	164.50	19	23.73	19.48	23.26	23.26	23.26	4.65	3.81	4.50	4.55	4.55
	20 RIO IRAJA	35.70	20	8.16	3.19	3.19	7.61	7.61	1.63	0.64	0.64	1.52	1.52
Western	21 CANAL DO CUNHA	63.60	21	13.05	3.64	3.64	3.64	12.01	2.59	0.72	0.72	0.72	2.39
Basin	22 B.-S.CRISTOVAO	6.60	22	1.01	0.28	0.28	0.28	0.93	0.20	0.05	0.05	0.05	0.18
	23 CANAL DO MANGUE	42.80	23	8.08	3.90	3.90	3.90	7.62	1.60	0.77	0.77	0.77	1.51
	24 B.-BOTAFOGO	26.00	24	5.89	4.70	4.70	4.70	4.70	1.18	0.94	0.94	0.94	0.94
	25 I. DO GAVANADOR	38.20	25	2.48	2.36	2.36	2.36	2.36	0.47	0.46	0.46	0.46	0.46
Island	26 I. DO FUNDAO	5.40	26	0.10	0.06	0.06	0.06	0.10	0.02	0.01	0.01	0.01	0.02
	27 I. DE PAQUETA	1.70	27	0.06	0.06	0.06	0.06	0.06	0.01	0.01	0.01	0.01	0.01
	28 I. DO ENGENHO	1.30	28	0.19	0.19	0.19	0.19	0.19	0.04	0.04	0.04	0.04	0.04
	29 I. DE S.CRUZ	1.40	29	0.09	0.09	0.09	0.09	0.09	0.02	0.02	0.02	0.02	0.02
	Total	4089.50		142.76	114.29	118.08	122.49	136.37	25.68	20.15	20.94	21.67	24.42

Table APP.10-1 Estimation Results of Runoff Load with Countour Measures

Retardation pond(1991)

Basin No.		Name	Basin Area (Km2)	NO.	(1991) BOD Load (t/d)	Retardation pond BOD Load (t/d)	(1991) TN Load (t/d)	Retardation pond TN Load (t/d)	Cutted Load by Retardation Pond(t/d) (A)	Capacity of Retardation Pond(*10^4 m3) (B)	Cutted Load/ha (t/d/ha) (C=A/B)
	1	B.-CHARITAS	9.40	1	2.35	2.28	0.79	0.79	0.07	8.12	0.009
Eastern	2	CANAL CANTO DO RIO	7.40	2	1.84	1.80	0.62	0.62	0.04	4.92	0.009
Basin	3	B.-CATEDRAR	7.80	3	1.65	1.60	0.56	0.56	0.05	5.92	0.009
	4	B.-NORTE CENTRO	7.90	4	1.92	1.86	0.65	0.65	0.06	6.61	0.009
	5	RIO BOMBA	26.20	5	8.00	7.76	2.65	2.64	0.25	27.22	0.009
	6	RIO IMBOASSU	30.80	6	6.02	5.83	2.00	2.00	0.19	23.16	0.008
	7	B.-ITAOCA	6.40	7	1.41	1.37	0.48	0.48	0.04	4.92	0.009
Northeastern	8	RIO ALCANTARA	144.60	8	20.07	19.41	6.60	6.59	0.66	90.55	0.007
Basin	9	RIO CACEREBU	846.70	9	14.80	14.26	7.08	7.07	0.54	244.17	0.002
	10	RIO GUAPIMIRIM	1253.10	10	4.67	4.49	5.28	5.28	0.18	327.37	0.001
	11	CANAL DE MAGE	18.30	11	0.38	0.37	0.18	0.18	0.01	4.92	0.003
	12	RIO RONCADOR	111.40	12	1.66	1.60	0.88	0.88	0.06	29.81	0.002
	13	RIO IRIRI	27.80	13	0.49	0.47	0.25	0.25	0.02	7.30	0.002
	14	RIO SURUI	68.80	14	0.63	0.61	0.43	0.43	0.02	17.28	0.001
	15	B.-MAUA	28.90	15	0.40	0.38	0.22	0.23	0.01	7.39	0.002
Northwestern	16	RIO ESTRELA	342.50	16	12.92	12.54	4.96	4.96	0.38	116.60	0.003
Basin	17.1~5	RIO IGUACU	562.80	17-1~5	31.97	30.86	11.26	11.24	1.11	226.71	0.005
	17.6	RIO SARAPUI	165.50	17-6	43.40	42.00	13.94	13.92	1.40	162.56	0.009
	18	B.-CABO DO BRITO	27.00	18	5.75	5.57	1.91	1.91	0.18	21.47	0.008
	19	RIO S.J.DE MERITI	164.50	19	64.33	62.29	20.59	20.56	2.04	220.84	0.009
	20	RIO IRAJA	35.70	20	22.04	21.51	7.26	7.25	0.53	52.14	0.010
Western	21	CANAL DO CUNHA	63.60	21	35.66	34.56	11.62	11.61	1.10	111.41	0.010
Basin	22	B.-S.CRISTOVAO	6.60	22	2.67	2.59	0.90	0.90	0.08	8.16	0.010
	23	CANAL DO MANGUE	42.80	23	21.96	21.28	7.20	7.19	0.67	68.69	0.010
	24	B.-BOTAFOGO	26.00	24	15.84	15.36	5.24	5.24	0.48	47.39	0.010
	25	I. DO GAVANADOR	38.20	25	6.66	6.45	2.22	2.22	0.21	26.74	0.008
Island	26	I. DO FUNDAO	5.40	26	0.23	0.23	0.09	0.09	0.01	1.68	0.005
	27	I. DE PAQUETA	1.70	27	0.14	0.14	0.05	0.05	0.00	0.69	0.007
	28	I. DO ENGENHO	1.30	28	0.50	0.48	0.17	0.17	0.01	1.43	0.010
	29	I. DE S.CRUZ	1.40	29	0.22	0.21	0.08	0.08	0.01	0.78	0.009
		Total	4080.50		330.59	320.16	116.18	116.07	10.43	1876.95	0.203

(Retardation pond area:9.38Km2 (Water depth:2.0m))

Table APP.10-1 Estimation Results of Runoff Load with Countour Measures

Secondary Treatment + Optional Treatment(2010)

Basin No.		Name	Basin Area (Km2)	NO.	Mean Value Discharge (m3/s)	BOD. Load (t/d)	TN. Load (t/d)	TP. Load (t/d)
	1	B.-CHARITAS	9.40	1	1.27	0.47	0.73	0.16
Eastern	2	CANAL CANTO DO RIO	7.40	2	1.00	0.37	0.57	0.12
Basin	3	B.-CATEDRAR	7.80	3	0.93	0.33	0.51	0.11
	4	B.-NORTE CENTRO	7.90	4	1.05	0.39	0.60	0.13
	5	RIO BOMBA	3.40	5	5.00	2.86	3.13	0.68
	6	RIO IMBOASSU	11.60	6	4.30	6.53	2.85	0.57
	7	B.-ITAOCA	6.40	7	1.00	2.14	0.72	0.14
Northeastern	8	RIO ALCANTARA	58.50	8	14.75	22.23	8.96	1.72
Basin	9	RIO CACEREBU	758.40	9	30.89	21.28	9.30	1.24
	10	RIO GUAPIMIRIM	1233.70	10	33.25	5.91	5.69	0.32
	11	CANAL DE MAGE	4.60	11	0.73	0.55	0.24	0.03
	12	RIO RONCADOR	107.00	12	3.94	2.35	1.09	0.13
	13	RIO IRIRI	8.40	13	1.05	0.69	0.31	0.04
	14	RIO SURUI	53.20	14	2.21	0.88	0.51	0.05
	15	B.-MAUA	28.90	15	1.03	0.56	0.28	0.03
Northwestern	16	RIO ESTRELA	342.50	16	16.19	16.57	6.48	1.04
Basin	17.1~5	RIO IGUACU	544.20	17-1~5	31.93	38.46	14.78	2.54
	17.6	RIO SARAPUI	159.80	17-6	25.30	35.62	16.60	3.35
	18	B.-CABO DO BRITO	27.00	18	3.85	5.69	2.53	0.51
	19	RIO S.J.DE MERITI	163.50	19	31.88	43.68	21.73	4.45
	20	RIO IRAJA	27.30	20	10.25	8.66	7.01	1.51
Western	21	CANAL DO CUNHA	60.50	21	16.66	13.86	11.18	2.41
Basin	22	B.-S.CRISTOVAO	6.60	22	1.33	0.95	0.86	0.19
	23	CANAL DO MANGUE	42.80	23	10.40	13.07	7.25	1.52
	24	B.-BOTAFOGO	26.00	24	7.40	11.00	5.43	1.13
	25	I. DO GAVANADOR	38.20	25	3.89	3.91	2.22	0.44
Island	26	I. DO FUNDAO	5.40	26	0.26	0.17	0.10	0.02
	27	I. DE PAQUETA	1.70	27	0.11	0.16	0.06	0.01
	28	I. DO ENGENHO	1.30	28	0.25	0.56	0.19	0.04
	29	I. DE S.CRUZ	1.40	29	0.14	0.24	0.09	0.02
Total					262.27	260.17	132.00	24.63

PART III

HYDRODYNAMIC CONDITIONS AND SEDIMENTATION IN THE BAY

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CHAPTER 1

TOPOGRAPHY

1.1 Coastal Line

The area of Guanabara Bay is about 346 km^2, including 59 km^2 of islands and islets, such as Ilha do Governador, Ilha do Fundao and Ilha de Paqueta.

The coastal line of the bay is about 131 km in length and partially covered with mangroves, especially in the northeast area.

Fig. 1.1-1 shows the change in the coastal line between 1930 's. A remarkable advancement in the coastal line is seen in the four areas, Ilha do Governador and Fundao area, Flamengo beach, Niteroi area and northeastern mangrove area.

1.2 Submarine Topography

The bay is characterized with a shallow water depth, 5.7 meters on average, and a narrow mouth of 1.6 km in width at the entrance of the bay. therefore, the bay is a typically enclosed coastal sea.

The seabed of the bay is uneaven and ancient river channels are currently partially filled with sediment deposited in recent times.

The maximum water depth at the mouth of the bay is 51 meters. A 20 m contour line indents until the Rio-Niteroi bridge and an area deeper than 20 meters is also seen in the eastern side of Ilha do Governador as shown in Fig. 1.2-1. A contour line of 10 meters penetrates far into the inner part from the mouth of the bay at about 2.5 km in width and reaches to the Ilha de Paqueta.

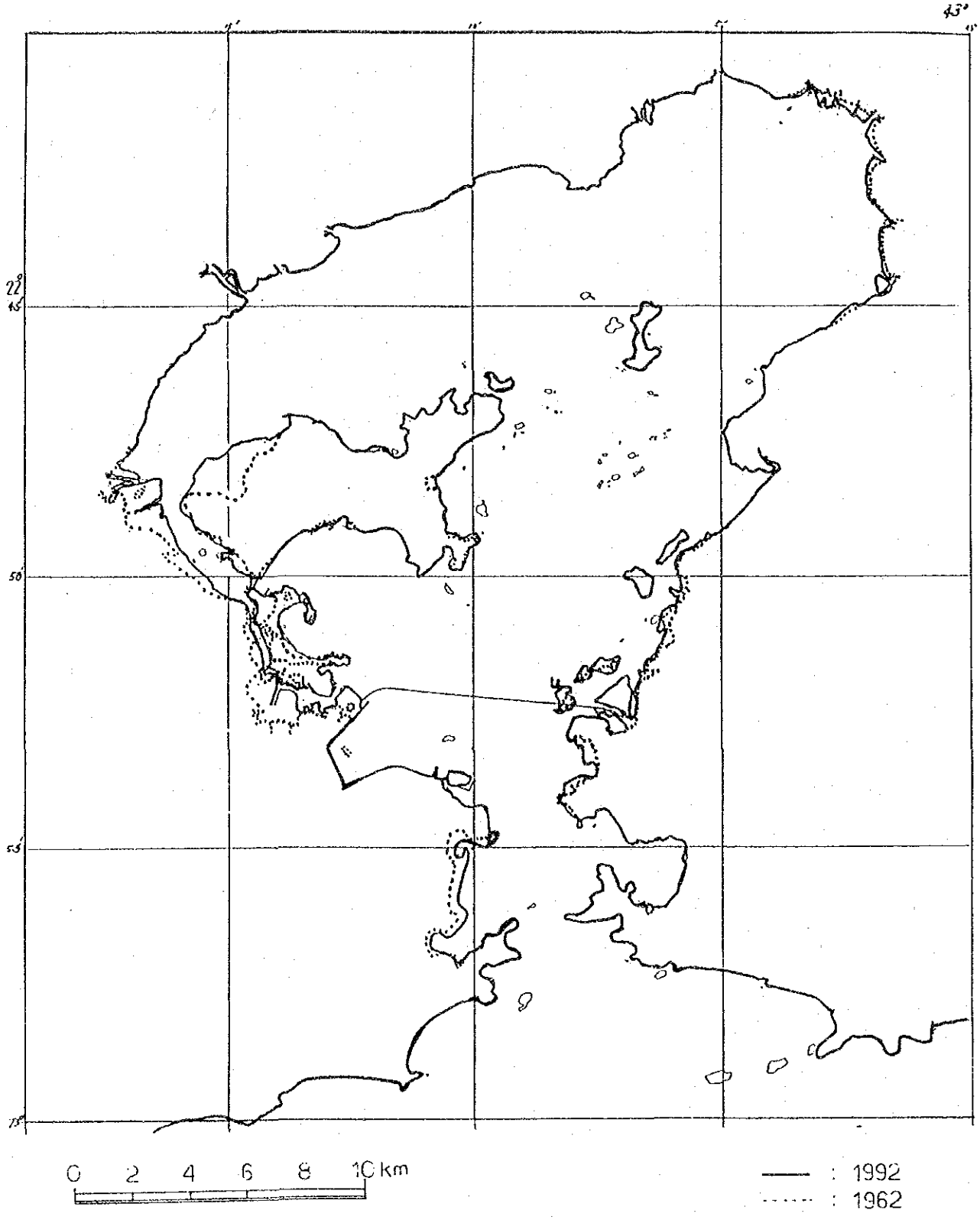


Fig. 1.1-1 Change in the Coastal Line

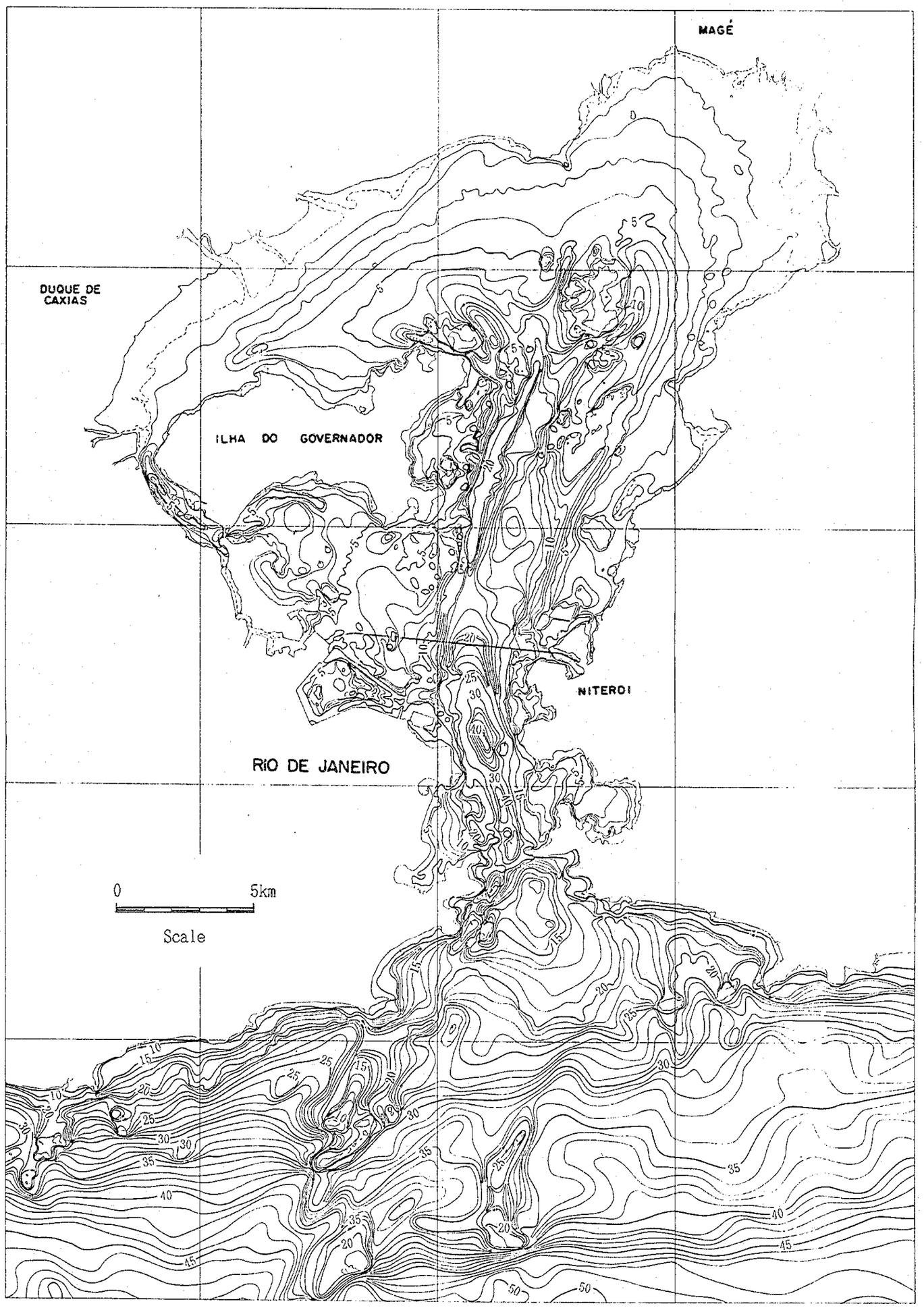


Fig. 1.2-1 Seabed Topography of the Guanabara Bay

There are two guanabara bay charts published by DHN, one in 1962 and an edition revised in 1992.

For the water depth in the bay, the mesh data of one kilometer interval using the 1962 and 1992 charts are shown in Fig. 1.2-2 and Fig. 1.2-3.

Figure 1.2-4 shows the difference of the water depth in 1962 and 1992, the values of which are obtained by subtracting those in 1992 from those in 1962.

This figure shows that the water depth in the inner part of the bay has grown shallower at around one meter within the past thirty years.

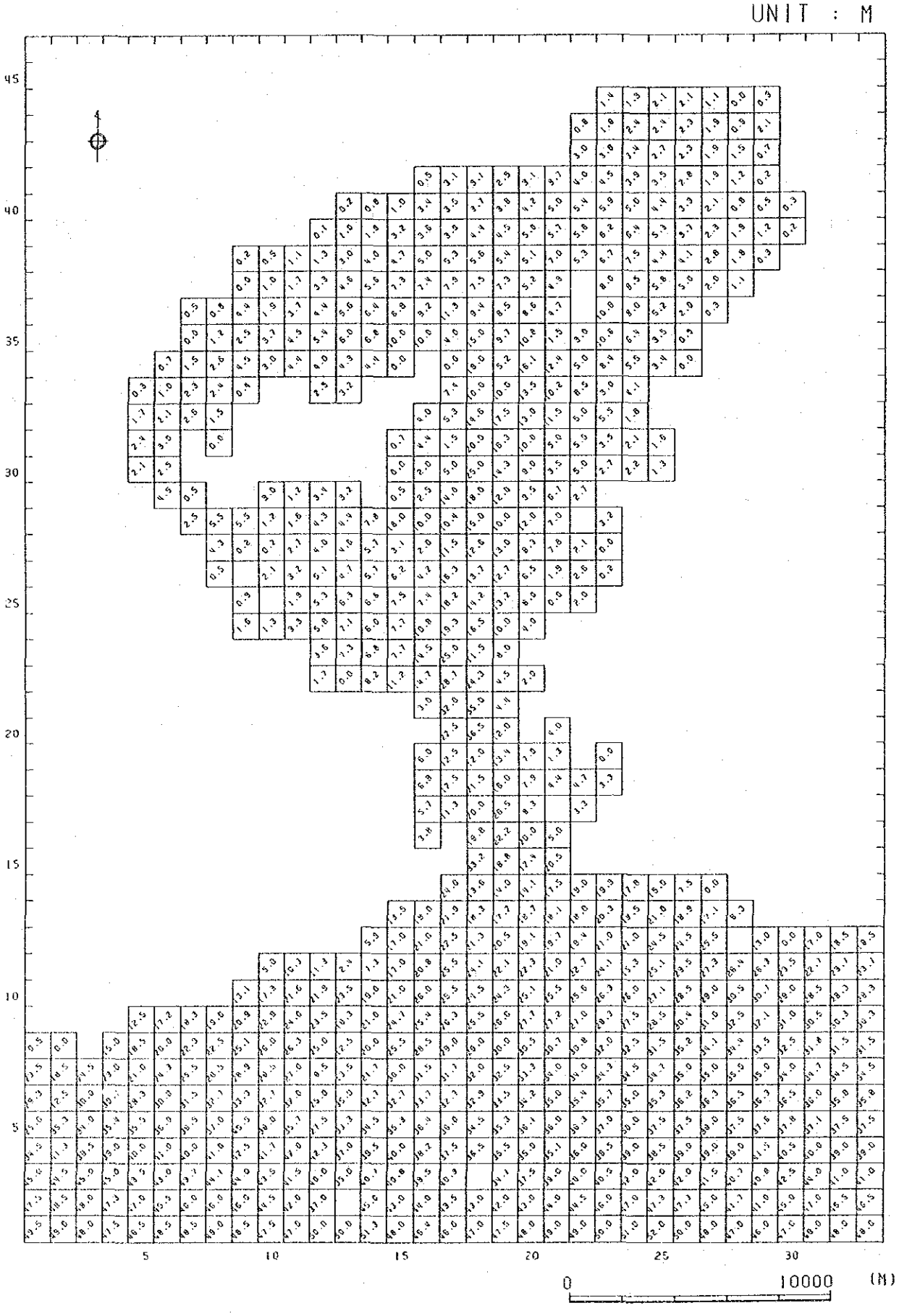


Fig. 1.2-2 Mesh Data of Water Depth in 1962

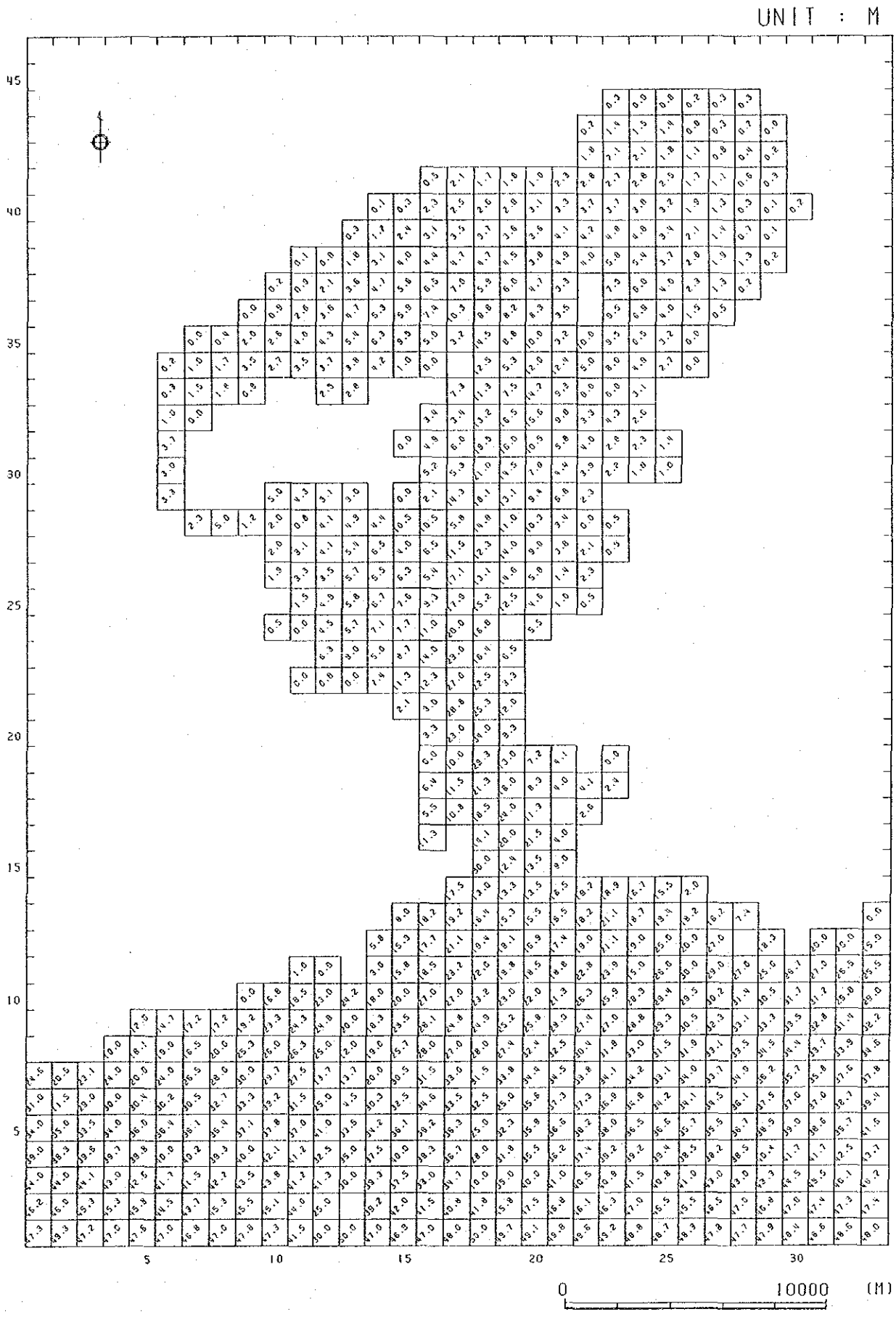


Fig.1.2-3 Mesh Data of Water Depth in 1992

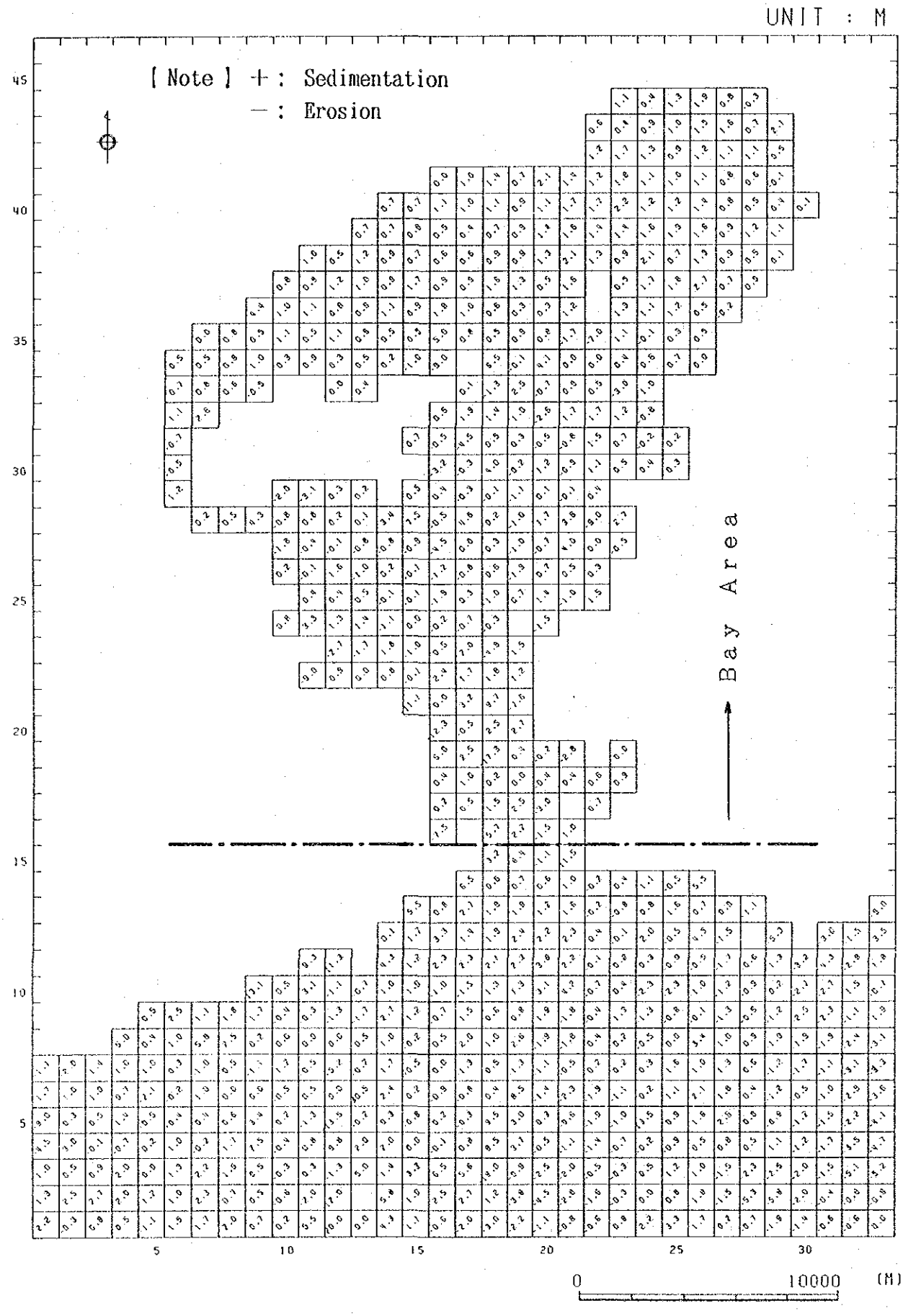


Fig. 1.2-4 Difference in Water Depths between 1962 and 1992

1.3 Water Volume

The water volume in the bay, which was calculated using the mesh data from the existing chart published in 1992, is shown in Table 1.3-1. An average water volume is estimated at 2.2 billion m^3.

Using the mesh data of water depths shown in Fig. 1.2-2 and Fig. 1.2-3, we tried to calculate the rough water volume below the chart datum level in the bay. The results of the calculation are as follows;

1992 : 1.95 billion m^3 (No. of meshes : 344,
Mean depth : 5.68 m)

1962 : 2.18 billion m^3 (No. of meshes : 366,
Mean depth : 5.95 m)

In this calculation, the area of the bay was defined as shown in Fig. 1.2-4.

Table 1.3-1 Water Volume of the Guanabara Bay

Tide	Water Volume	Remarks
Mean High Water Springs	2.39×10^9 m^3	MSL + 48.8 cm
Mean High Water Neaps	2.25×10^9 m^3	MSL + 13.0 cm
Mean Low Water Neaps	2.15×10^9 m^3	MSL - 13.0 cm
Mean Low Water Springs	2.02×10^9 m^3	MSL - 48.8 cm
Lowest Low Water	1.95×10^9 m^3	MSL - 69.0 cm

CHAPTER 2

TIDES

2.1 Existing Data of Tides

2.1.1 Tidal Station

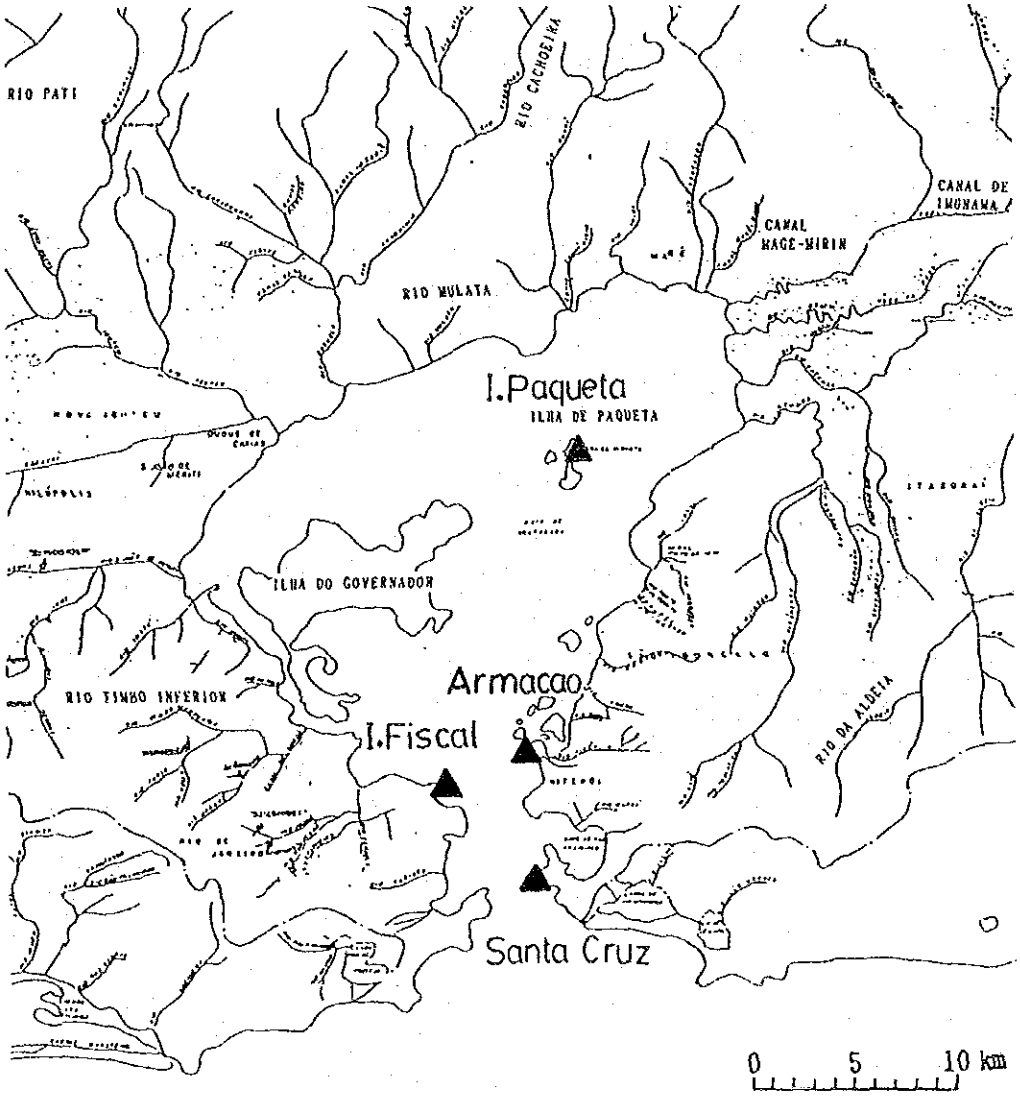
The tidal stations, where the tides of the Guanabara Bay were observed by the Department of Hydrography and Navigation (DHN), are shown in Table 2.1-1 together with Zo, and these stations are plotted in Figure 2.1-1.

Among these stations, the observation period in the three stations of Ilha de Paqueta, Fortaleza de Santa Cruz and Ponta Armacao was very short, lasting only from one month to two years.

At present, tidal observation has been continued only at Ilha Fiscal (Port of Rio de Janeiro) within the Guanabara Bay.

Table 2.1-1 Location of Tidal Stations

Station	Latitude	Longitude	Z_0	Remarks
Ilha Fiscal	22° 53' 47" S	43° 09' 57" W	69.0 cm	DHN, 1988
Ilha Paqueta	22° 45' 38" S	43° 06' 38" W	73.6 cm	DHN, 1973
Santa Cruz	22° 56' 12" S	43° 07' 48" W	69.0 cm	DHN, 1979
Ponta Armacao	22° 52' 59" S	43° 08' 05" W	75.2 cm	DHN, 1988
Ilha Guaiba	22° 00' 24" S	44° 02' 00" W	69.1 cm	DHN, 1981



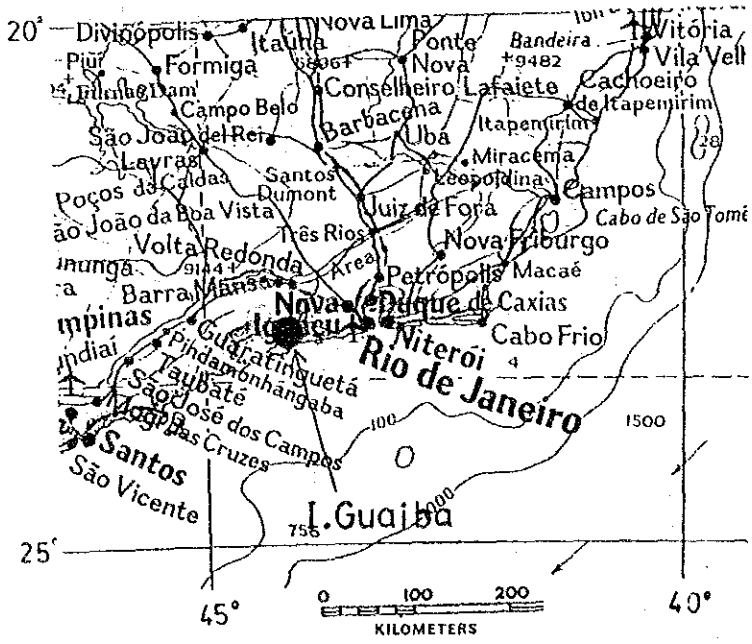


Fig. 2.1-1 Location of Tidal Stations

2.1.2 Harmonic Constants of Tides

The existing harmonic constants of tides at each station calculated by DHN are shown in Table 2.1-2.

Is shown in Table 2.1-3, the semi-diurnal tides such as M_2 and S_2 constituents predominate.

No, which is expressed as the sum of the principal four constitution of M_2, S_2, K_1 and O_1, is 69.0 cm to 69.1 cm at Ilha Fiscal (Port of Rio de Janeiro), Fortaleza de Santa Cruz and Ilha Guaiba according to the existing data.

On the other hand, Z_0 at Ilha de Paqueta is 73.6 cm, indicating 4.6 cm difference between the mouth of the bay and the inner part of the bay.

As a reference, the method of the harmonic analysis of tides is shown in Appendix 1.

Table 2.1-3 Harmonic Constants of the Principal Four Constituents

Station	Constituent								
	M_2		S_2		K_1		O_1		Z_0
	H(cm)	G(°)	H(cm)	G(°)	H(cm)	G(°)	H(cm)	G(°)	
Ilha Fiscal (1986)	30.9	83.0	17.9	87.0	5.8	145.7	10.5	87.2	65.1
Ilha Fiscal (1965)	31.8	93.0	17.9	87.6	6.2	143.5	9.2	103.7	65.1
Ilha de Paqueta	32.0	87.3	19.0	97.0	7.6	117.7	12.5	106.8	71.1
Stanta Cruz	31.6	83.0	17.4	86.0	6.5	144.0	10.5	89.0	66.0
Ilha Guaiba	34.9	88.0	19.9	87.0	6.2	152.0	11.7	89.0	72.7

Table 2.1-2

Harmonic Constants of Tides

PRINCIPAL HARMONIC CONSTITUENTS

【 Semi-Diurnal 】

M_2 :	the principal lunar semidiurnal constituent,	with speed 28.984° per mean solar hour
N_2 :	the larger lunar elliptic semidiurnal constituent,	with speed 28.440° per mean solar hour
L_2 :	the smaller lunar elliptic semidiurnal constituent,	with speed 29.528° per mean solar hour
S_2 :	the principal solar semidiurnal constituent,	with speed 30.000° per mean solar hour
T_2 :	the principal solar elliptic semidiurnal constituent,	with speed 29.959° per mean solar hour
K_2 :	the luni-solar declinational semidiurnal constituent,	with speed 30.082° per mean solar hour

【 Diurnal 】

O_1 :	a lunar declinational diurnal constituent,	with speed 13.943° per mean solar hour
Q_1 :	a lunar diurnal constituent,	with speed 13.399° per mean solar hour
M_1 :	a lunar diurnal constituent,	with speed 14.492° per mean solar hour
J_1 :	a lunar diurnal constituent,	with speed 15.585° per mean solar hour
K_1 :	the luni-solar declinational diurnal constituent,	with speed 15.041° per mean solar hour
P_1 :	the solar declinational diurnal constituent,	with speed 14.959° per mean solar hour

【 Long Period 】

Mf:	the lunar fortnightly constituent,	with speed 1.098° per mean solar hour
Mm:	the lunar monthly constituent,	with speed 0.544° per mean solar hour
Ssa:	the solar semi-annual constituent,	with speed 0.082° per mean solar hour
Sa:	the solar annual constituent,	with speed 0.041° per mean solar hour

Harmonic Constants of Tides at Ilha Fiscal
(Period : Jan. 1986 to Dec. 1986)

PORTO DO RIO DE JANEIRO(I.FISCAL)
01/01/86-31/12/86 22-53.8S 43-09.9W

	SPEED (deg/hour)	H (cm)	KAPPA (deg)	G (deg)
S0		67.0		
(1)LONG PERIOD TIDE				
MM	0.544	-	-	-
MSF	1.016	-	-	-
(2)DIURNAL TIDE				
Q1	13.399	3.0	56.2	59.1
O1	13.943	10.5	85.9	87.2
M1	14.492	1.1	155.3	155.0
K1	15.041	5.8	147.7	145.7
J1	15.585	-	-	-
OO1	16.139	-	-	-
P1	14.959	2.1	139.8	138.1
(3)SEMI-DIURNAL TIDE				
MU2	27.968	2.3	84.0	86.4
N2	28.44	3.9	117.5	118.6
M2	28.984	30.9	83.6	83.0
L2	29.528	2.1	85.1	82.8
S2	30	17.9	90.7	87.0
2SM2	31.016	-	-	-
K2	30.082	4.8	76.0	72.1
NU2	28.513	-	-	-
T2	29.959	2.6	175.7	172.2
(4)THIRD-DIURNAL TIDE				
MO3	42.927	-	-	-
M3	43.476	0.5	200.7	199.8
MK3	44.025	-	-	-
(5)QUARTER-DIURNAL TIDE				
MN4	57.424	2.2	32.3	32.7
M4	57.968	4.6	74.5	73.2
SN4	58.44	0.8	148.3	145.6
MS4	58.984	2.2	164.2	159.9
(6)SIXTH-DIURNAL TIDE				
2MN6	86.408	-	-	-
M6	86.952	-	-	-
MSN6	87.424	-	-	-
2MS6	87.968	-	-	-
2SM6	88.984	-	-	-

Harmonic Constants of Tides at Ilha Fiscal
(Period : Jan. 1965 to Dec. 1965)

PORTO DO RIO DE JANEIRO(I.FISCAL)
01/01/65-31/12/65 22-53.8S 43-09.9W

	SPEED (deg/hour)	H (cm)	KAPPA (deg)	G (deg)
S0		69.0		
(1)LONG PERIOD TIDE				
MM	0.544	1.8	97.4	95.8
MSF	1.016	3.1	164.6	161.6
(2)DIURNAL TIDE				
Q1	13.399	2.6	106.7	109.7
O1	13.943	9.2	102.4	103.7
M1	14.492	-	-	-
K1	15.041	6.2	145.5	143.5
J1	15.585	0.7	47.6	44.0
OO1	16.139	-	-	-
P1	14.959	2.1	139.5	137.8
(3)SEMI-DIURNAL TIDE				
MU2	27.968	1.1	153.9	156.3
N2	28.44	2.6	172.5	173.5
M2	28.984	31.8	93.6	93.0
L2	29.528	1.4	48.3	46.0
S2	30	17.9	91.3	87.6
2SM2	31.016	0.3	244.6	237.9
K2	30.082	5.7	22.1	18.2
NU2	28.513	-	-	-
T2	29.959	-	-	-
(4)THIRD-DIURNAL TIDE				
MO3	42.927	-	-	-
M3	43.476	0.7	202.6	201.7
MK3	44.025	-	-	-
(5)QUARTER-DIURNAL TIDE				
MN4	57.424	2.0	223.7	224.1
M4	57.968	4.8	97.6	96.4
SN4	58.44	0.4	206.7	204.0
MS4	58.984	3.1	190.0	185.7
(6)SIXTH-DIURNAL TIDE				
2MN6	86.408	-	-	-
M6	86.952	-	-	-
MSN6	87.424	-	-	-
2MS6	87.968	-	-	-
2SM6	88.984	-	-	-

Harmonic Constants of Tides at Ilha de Paqueta
(Period : July 1973 to Aug. 1973)

ILHA DE PAQUETA
17/07/73-17/08/73 22-45.6S 43-06.6W

	SPEED (deg/hour)	H (cm)	KAPPA (deg)	G (deg)
S0		74.0		
(1)LONG PERIOD TIDE				
MM	0.544	8.1	329.5	327.9
MSF	1.016	13.4	196.7	193.7
(2)DIURNAL TIDE				
Q1	13.399	4.7	60.7	63.6
O1	13.943	12.5	105.5	106.8
M1	14.492	2.1	77.0	76.6
K1	15.041	7.6	119.7	117.7
J1	15.585	1.9	289.9	286.3
OO1	16.139	2.6	311.9	306.6
P1	14.959	2.5	119.5	117.7
(3)SEMI-DIURNAL TIDE				
MU2	27.968	6.3	153.0	155.3
N2	28.44	6.1	54.4	55.3
M2	28.984	32.0	88.0	87.3
L2	29.528	3.0	27.6	25.2
S2	30	19.0	100.8	97.0
2SM2	31.016	2.0	348.6	341.8
K2	30.082	5.2	101.0	97.0
NU2	28.513	1.2	54.6	55.3
T2	29.959	1.1	100.7	97.0
(4)THIRD-DIURNAL TIDE				
MO3	42.927	1.1	5.2	5.7
M3	43.476	1.5	200.1	199.0
MK3	44.025	1.3	34.7	32.0
(5)QUARTER-DIURNAL TIDE				
MN4	57.424	4.5	45.1	45.3
M4	57.968	6.6	84.9	83.4
SN4	58.44	3.0	205.8	202.9
MS4	58.984	4.1	234.8	230.3
(6)SIXTH-DIURNAL TIDE				
2MN6	86.408	0.4	329.5	328.9
M6	86.952	0.7	26.5	24.3
MSN6	87.424	0.6	158.2	154.6
2MS6	87.968	0.5	48.1	42.9
2SM6	88.984	0.9	132.9	124.6

Harmonic Constants of Tides at Fortaleza de Santa Cruz
(Period : May 1979 to June 1979)

FORTALEZA DE SANTA CRUZ
01/05/79-01/06/79 22-56.1S 43-08.3W

	SPEED (deg/hour)	H (cm)	KAPPA (deg)	G (deg)
S0		69.0		
(1)LONG PERIOD TIDE				
MM	0.544	6.9	124.6	123.0
MSF	1.016	7.8	126.0	123.0
(2)DIURNAL TIDE				
Q1	13.399	2.5	55.1	58.0
O1	13.943	10.5	87.7	89.0
M1	14.492	0.2	38.3	38.0
K1	15.041	6.5	146.0	144.0
J1	15.585	1.2	268.6	265.0
OO1	16.139	0.7	293.3	288.0
P1	14.959	2.1	141.7	140.0
(3)SEMI-DIURNAL TIDE				
MU2	27.968	0.5	109.6	112.0
N2	28.44	4.6	122.0	123.0
M2	28.984	31.6	83.7	83.0
L2	29.528	2.6	131.3	129.0
S2	30	17.4	89.7	86.0
2SM2	31.016	0.8	280.8	274.0
K2	30.082	4.7	90.0	86.0
NU2	28.513	0.9	116.3	117.0
T2	29.959	1.0	89.6	86.0
(4)THIRD-DIURNAL TIDE				
MO3	42.927	-	-	-
M3	43.476	0.9	180.0	179.0
MK3	44.025	0.5	144.7	142.0
(5)QUARTER-DIURNAL TIDE				
MN4	57.424	1.6	16.7	17.0
M4	57.968	3.7	70.4	69.0
SN4	58.44	1.0	138.8	136.0
MS4	58.984	1.7	167.4	163.0
(6)SIXTH-DIURNAL TIDE				
2MN6	86.408	0.2	113.4	113.0
M6	86.952	0.2	138.0	136.0
MSN6	87.424	0.2	21.4	18.0
2MS6	87.968	0.4	239.1	234.0
2SM6	88.984	0.2	187.1	179.0

Harmonic Constants of Tides at Ilha Guaiba
(Period : Jan. 1980 to Dec. 1981)

ILHA GUAIBA
01/01/80-31/12/81 23-00.4S 44-02.0W

	SPEED (deg/hour)	H (cm)	KAPPA (deg)	G (deg)
S0		74.0		
(1)LONG PERIOD TIDE				
MM	0.544	17.4	309.6	308.0
MSF	1.016	9.0	10.0	7.0
(2)DIURNAL TIDE				
Q1	13.399	3.1	58.2	62.0
O1	13.943	11.7	86.8	89.0
M1	14.492	0.6	97.4	98.0
K1	15.041	6.2	153.1	152.0
J1	15.585	0.2	355.7	353.0
OO1	16.139	0.1	74.4	70.0
P1	14.959	2.1	89.8	89.0
(3)SEMI-DIURNAL TIDE				
MU2	27.968	2.2	71.8	76.0
N2	28.44	4.5	131.3	134.0
M2	28.984	34.9	86.9	88.0
L2	29.528	3.7	56.5	56.0
S2	30	19.9	88.9	87.0
2SM2	31.016	0.2	64.0	59.0
K2	30.082	5.4	89.2	87.0
NU2	28.513	0.9	131.5	134.0
T2	29.959	1.2	88.8	87.0
(4)THIRD-DIURNAL TIDE				
MO3	42.927	0.7	346.7	350.0
M3	43.476	1.2	197.3	199.0
MK3	44.025	1.2	236.0	236.0
(5)QUARTER-DIURNAL TIDE				
MN4	57.424	4.0	47.1	51.0
M4	57.968	8.6	100.8	103.0
SN4	58.44	0.8	309.2	310.0
MS4	58.984	3.1	193.8	193.0
(6)SIXTH-DIURNAL TIDE				
2MN6	86.408	0.1	140.0	145.0
M6	86.952	0.8	141.7	145.0
MSN6	87.424	0.3	107.1	109.0
2MS6	87.968	0.1	297.7	298.0
2SM6	88.984	0.1	9.8	7.0

2.1.3 Annual Change of Mean Sea level

The monthly mean sea level at Ilha Fiscal is shown in Fig. 2.1-2 for the period of December 1988 to July 1991.

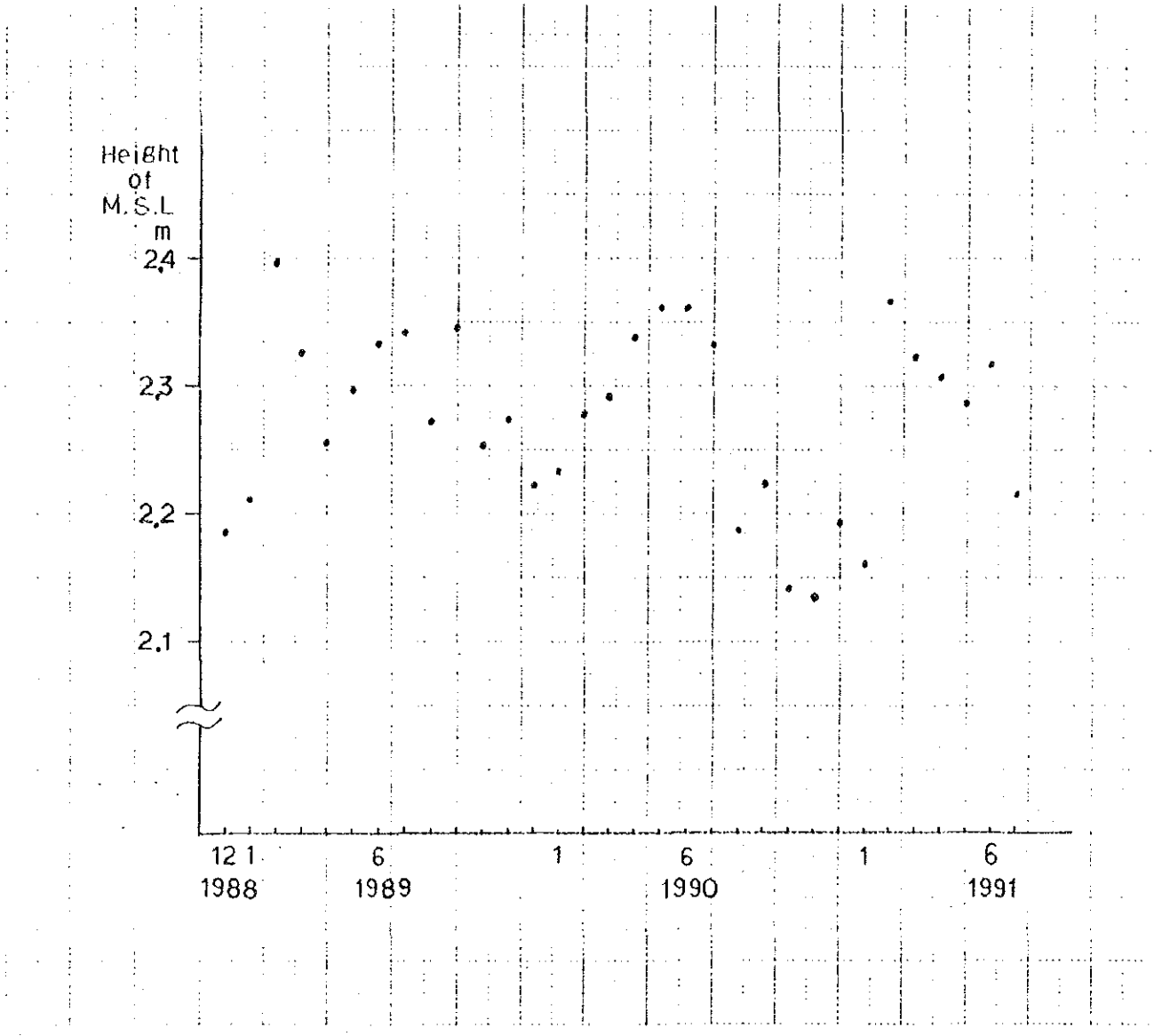


Fig. 2.1-2 Monthly Mean Sea Level at Ilha Fiscal

2.2 Tidal Variation during Study Period

2.2.1 Ilha Fiscal

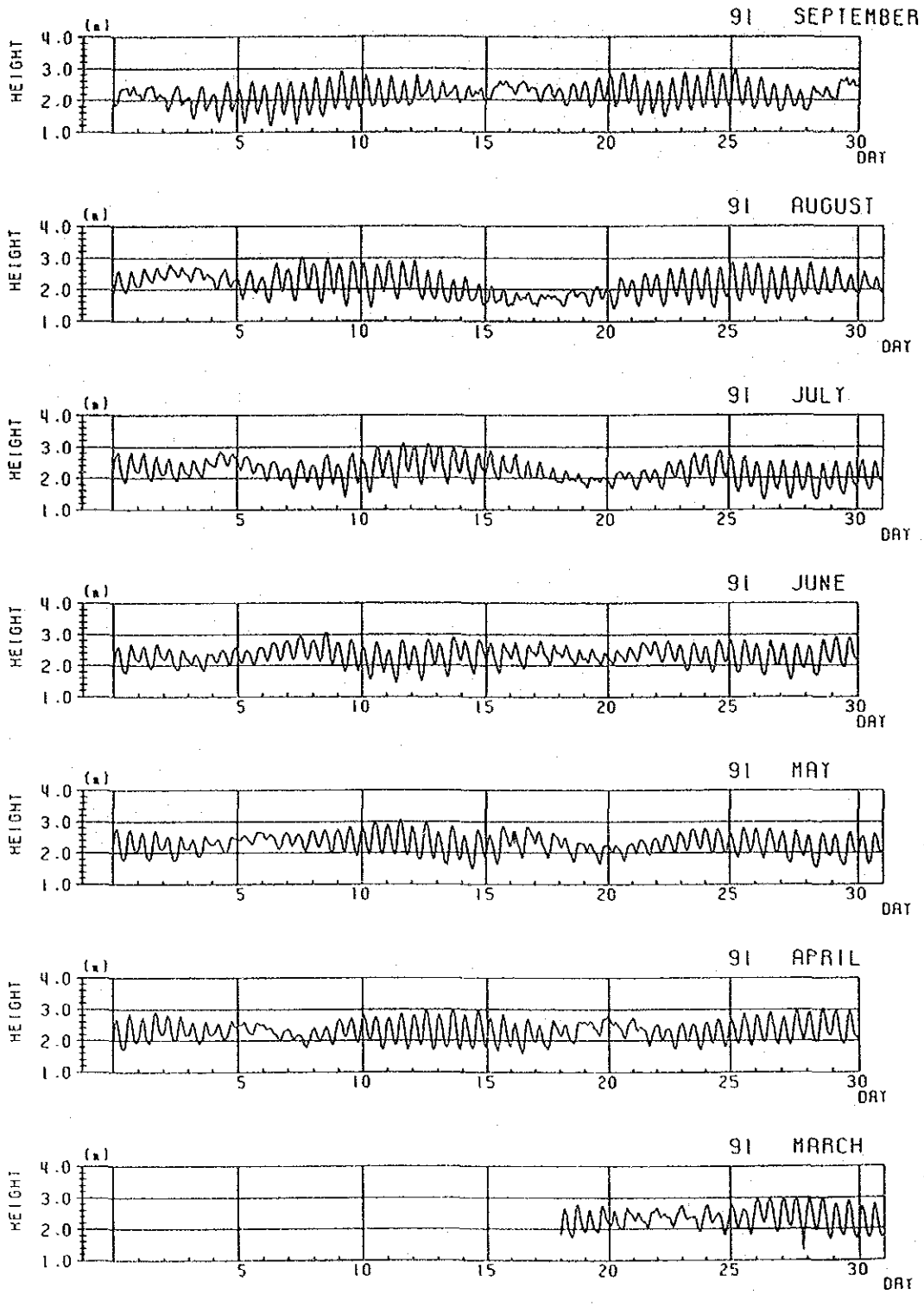
The tidal curves at Ilha Fiscal are shown in Fig. 2.2-1 for the period of March 1991 to July 1992.

These are predicted values which are calculated using the existing harmonic constants.

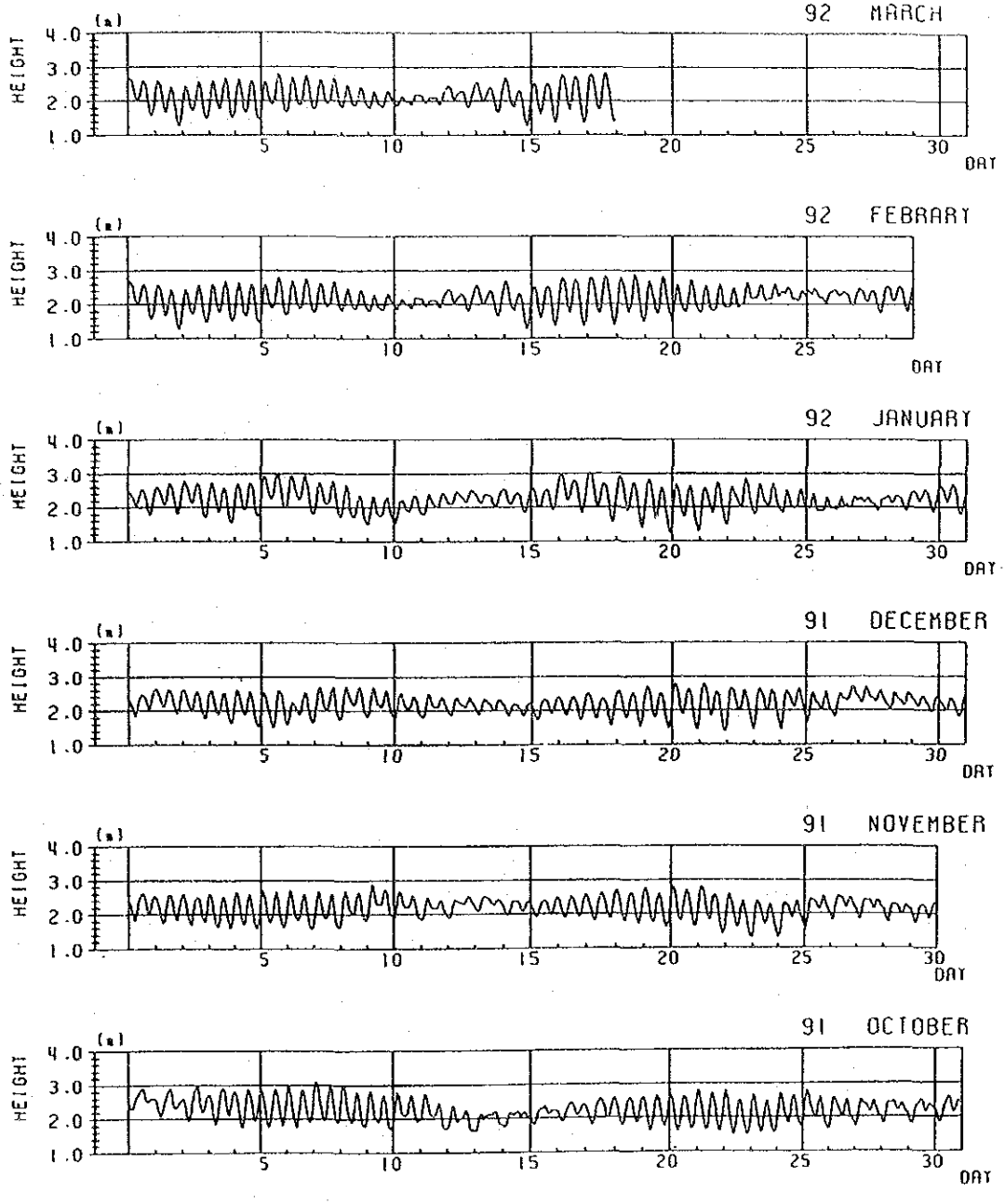
Hourly heights of the tides at Ilha Fiscal are shown in Appendix 2 for the period of March 1991 to July 1992.

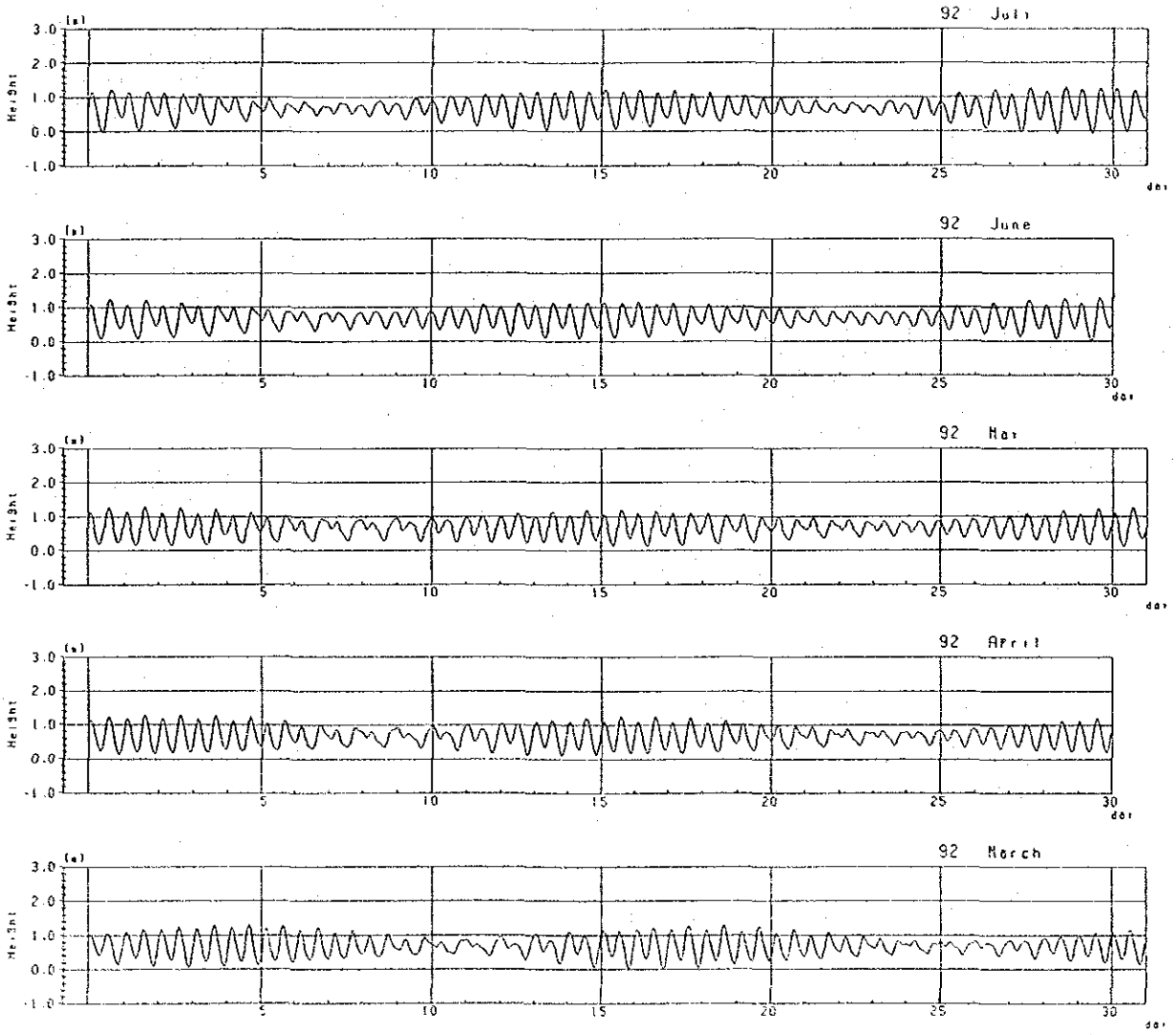
Fig. 2.2-1

Tidal Curves at Ilha Fiscal



Tidal Curves at Ilha Fiscal
(March 1991 to March 1992)


92 MARCH
92 FEBRARY
92 JANUARY
91 DECEMBER
91 NOVEMBER
91 OCTOBER
HEIGHT
(m)
4.0
3.0
2.0
1.0
5
10
15
20
25
30
DAY



Tidal Curves at Ilha Fiscal
(March to July 1992)

2.2.2 Ilha de Paqueta

The continuous observation of tides was carried out at the ferry pier of the Ilha de Paqueta for the period of Oct. 20 to Nov. 25, 1992 using a tide gauge (Fig. 2.2-2).

Coordinate of the station : 22° 45' 43'' S
43° 06' 26'' W

During the observation period, the checking survey using a tide pole was also performed to confirm the normal operation and decide the reduced percentage of the gauge (Fig. 2.2-3).

Above that, the relation between the tide gauge level and the existing Bench Mark (DHN-733) was obtained by a direct levelling through the fireplug in the park in front of the ferry pier. The relation is shown in Fig. 2.2-4 and the calculation of the relation is also shown in Fig. 2.2-5 for the reference.

The tidal curves at Ilha de Paqueta are shown in Fig. 2.2-6 for the period of June to July 1992 and October to November 1992.

Hourly heights of the tides at Ilha de Paqueta are shown in Appendix 2 for the period of June to July 1992 and October to November 1992.

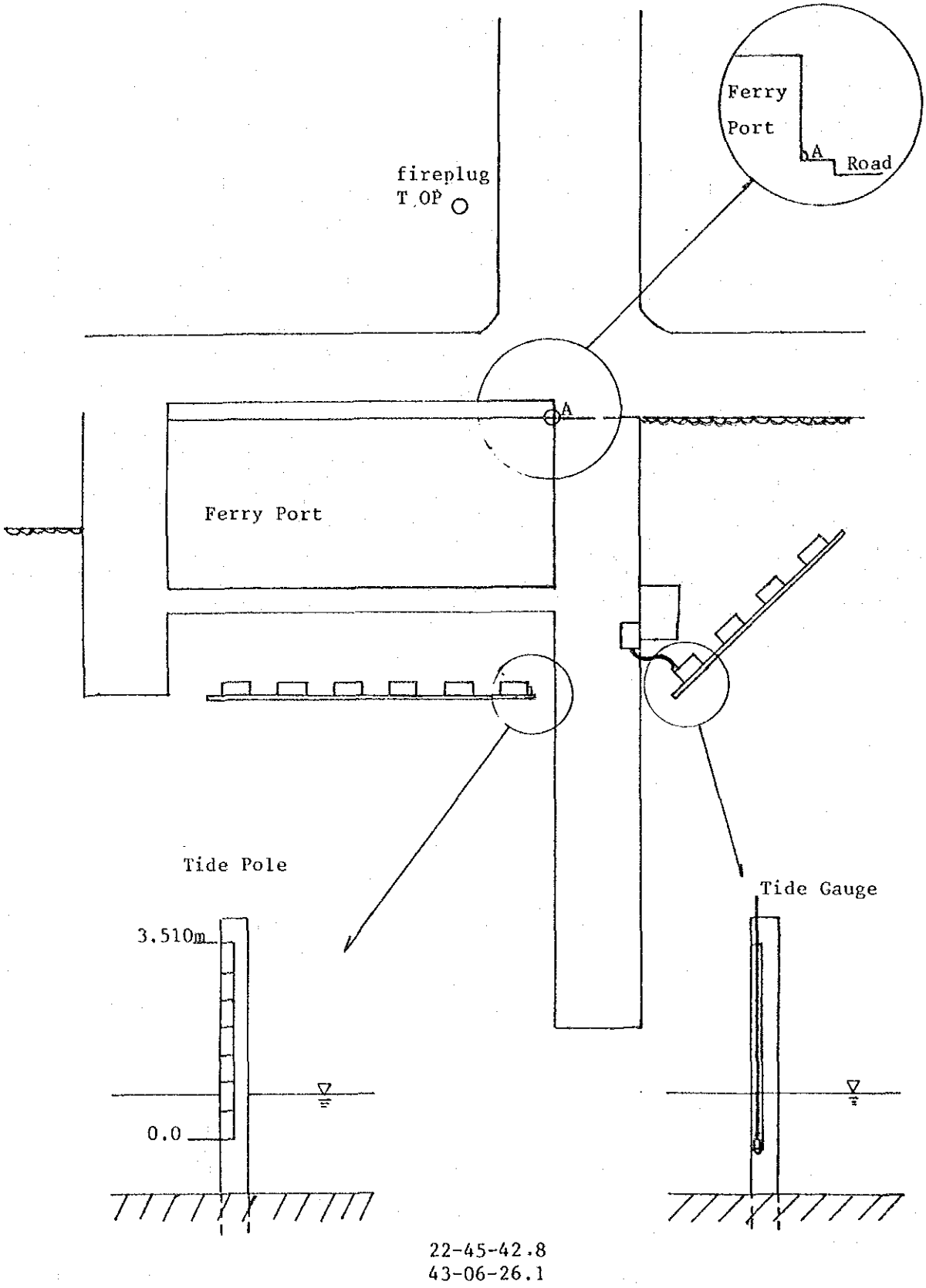


Fig. 2.2-2 Location Map of tide Gauge at Ilha de Paqueta

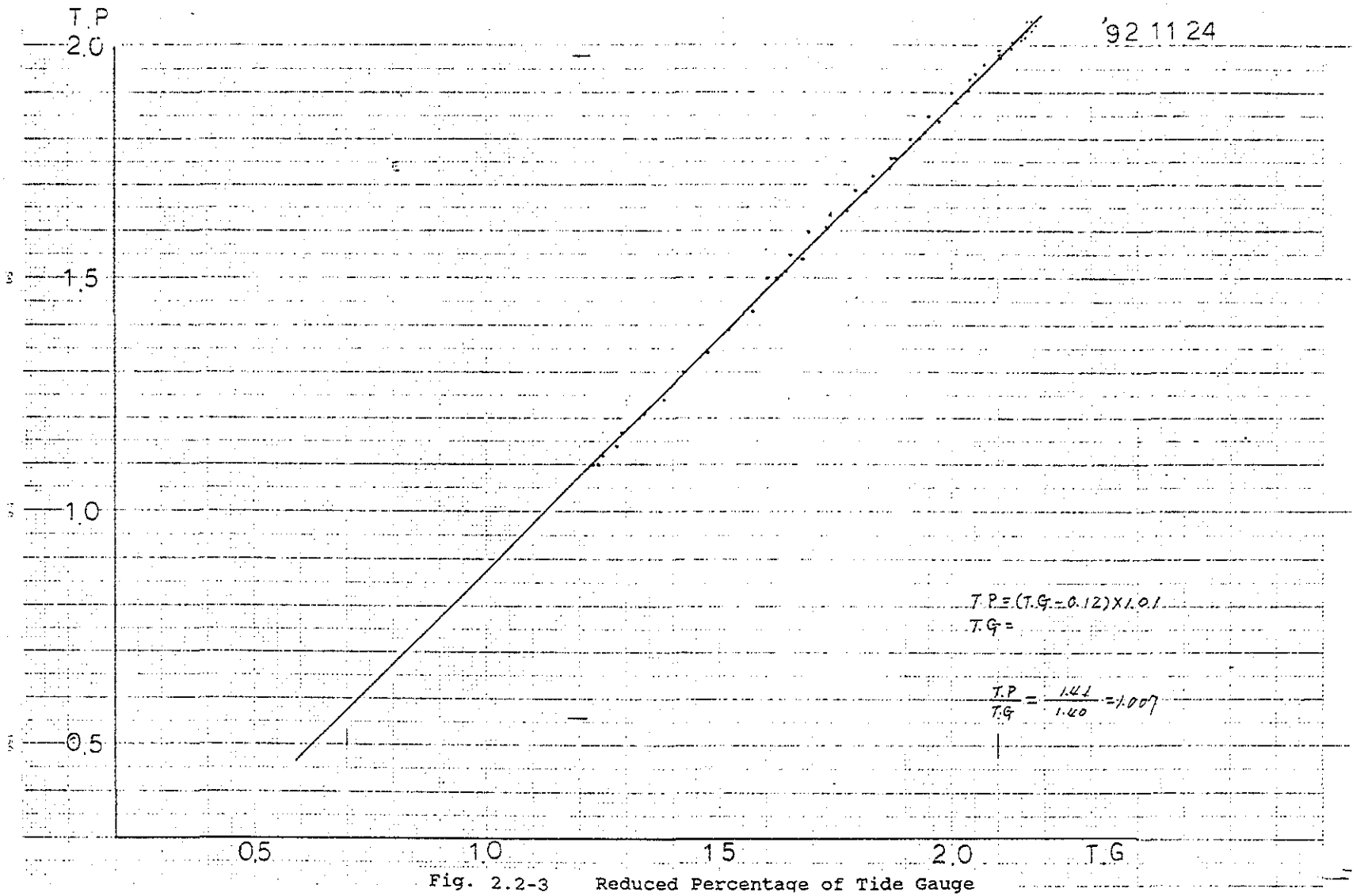


Fig. 2.2-3 Reduced Percentage of Tide Gauge

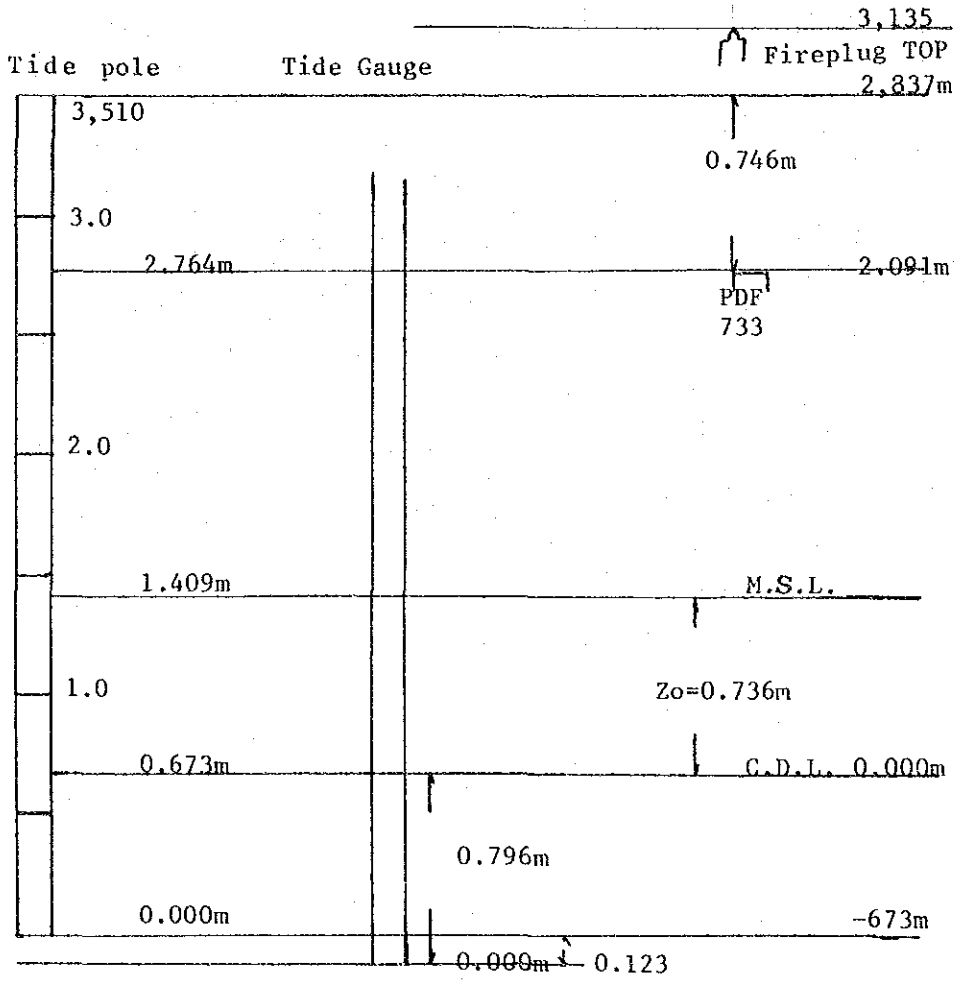


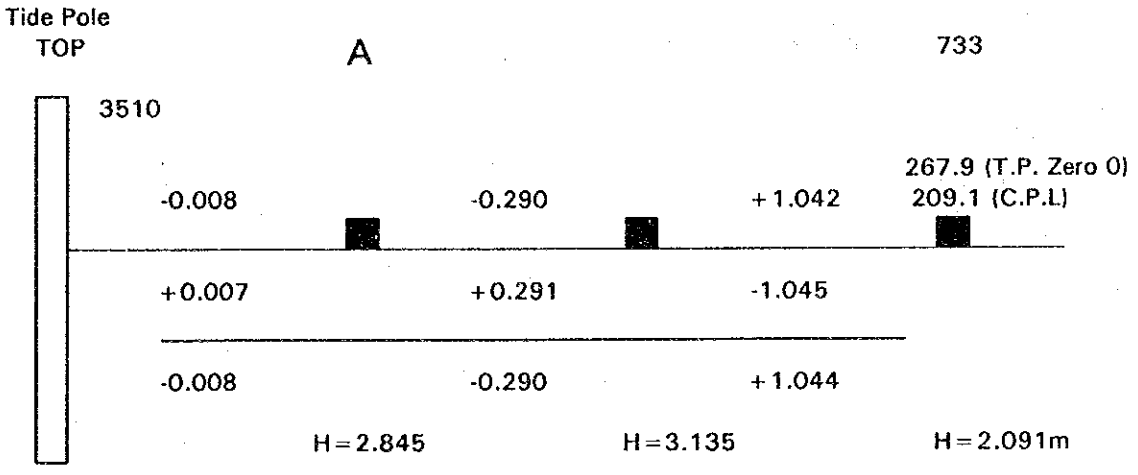
Fig. 2.2-4 Tidal Diagram at Ilha de Paqueta

A	1.302	
Tide Pole TOP		1.310
	1.302	1.310
		-0.008

Tide pole TOP	1.282	
A		1.275
	1.282	1.275
		+0.007

A	0.642		
fireplug TOP	1.092	0.351	+0.291
	1.149	0.705	
	0.115	0.404	
	0.703	1.637	
	1.238	1.135	
733 (placa de metal)	1.217	1.461	-1.045
	1.458	1.269	
RN-1		0.902	+0.504

RN-1	0.909		
	1.455	1.514	
733	1.457	1.352	-0.502
	1.022	1.254	
	1.368	0.724	
	1.512	0.230	
	0.659	1.686	
fireplug TOP	0.357	1.082	+1.042
A		0.647	-0.290



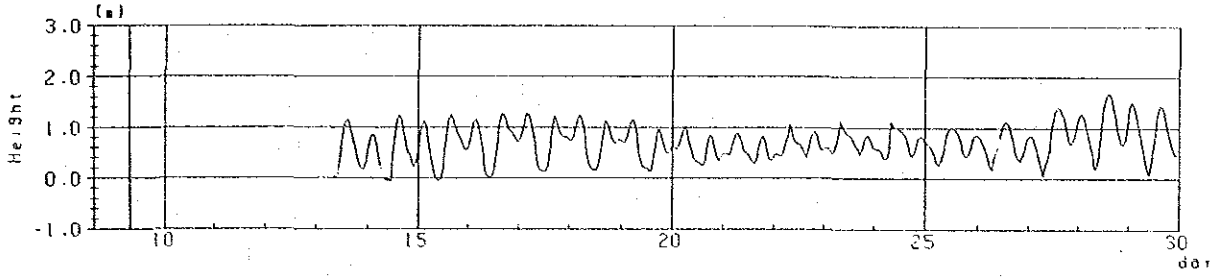
T.P. top H = 2.837m
T.P. Zero H= -0.673m

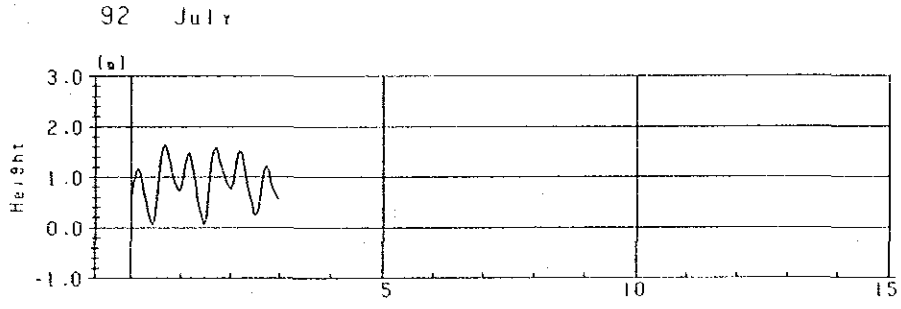
Fig. 2.2-5 Calculation of Levelling

Fig. 2.2-6

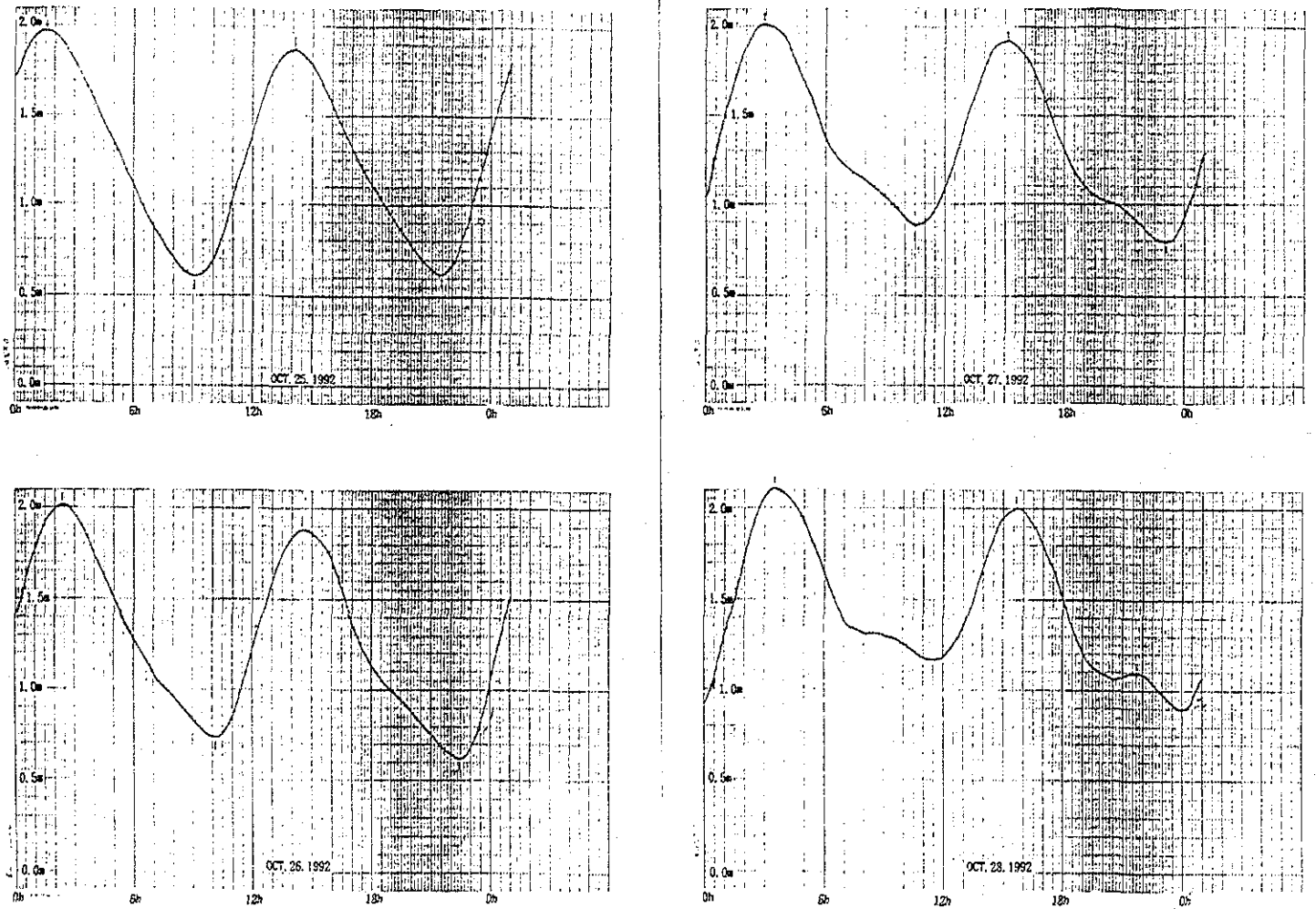
Tidal Curve at Ilha de Paqueta

(Oct. 25, 1992 - Nov. 24, 1992)

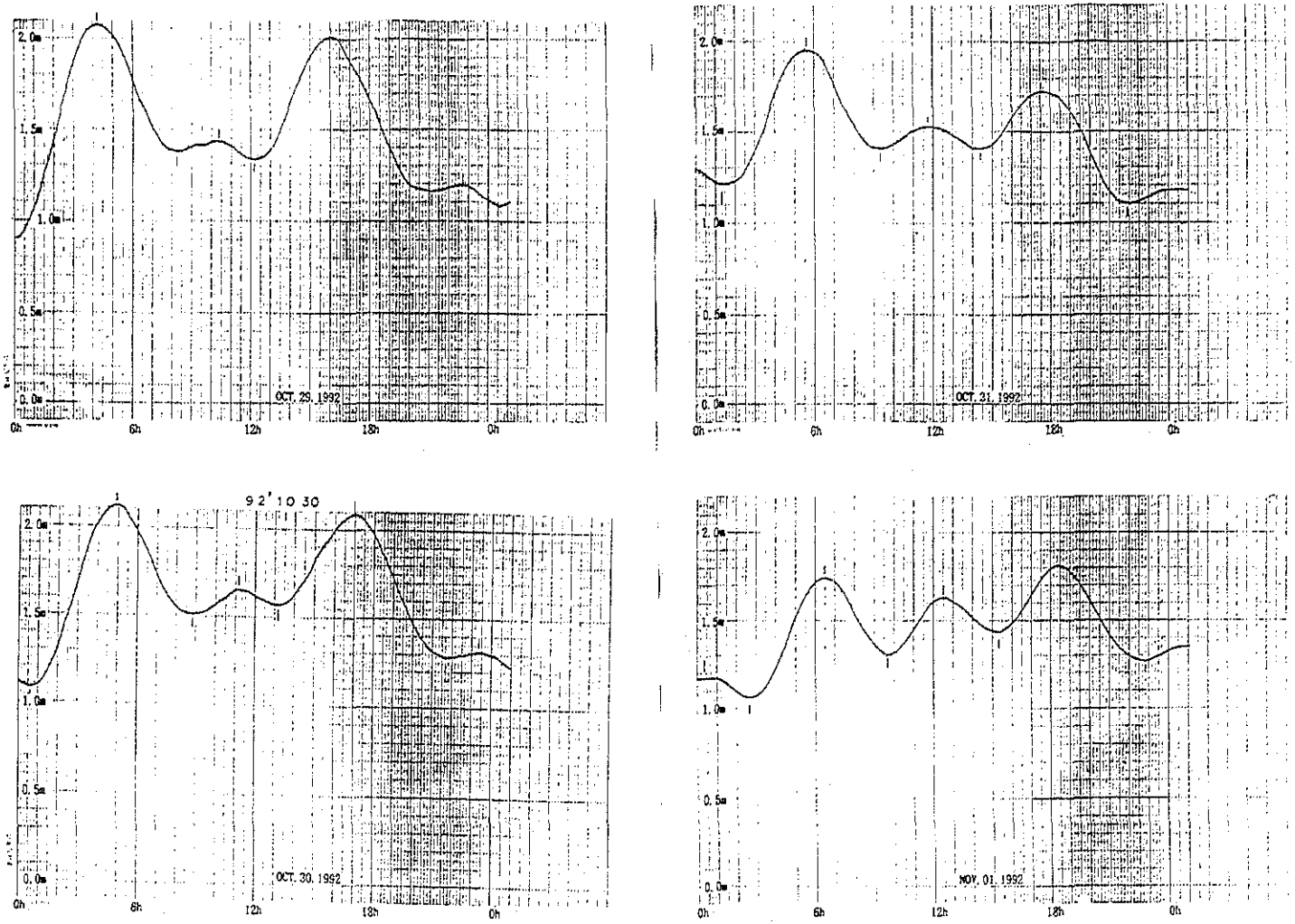




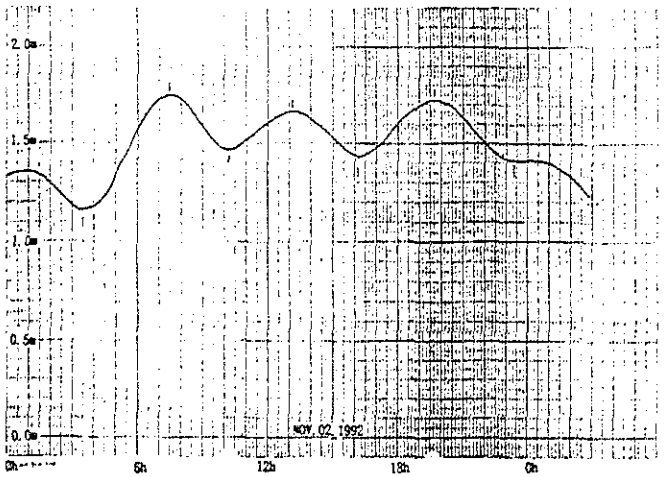
Tidal Curves at Ilha de Paqueta
(June to July 1992)

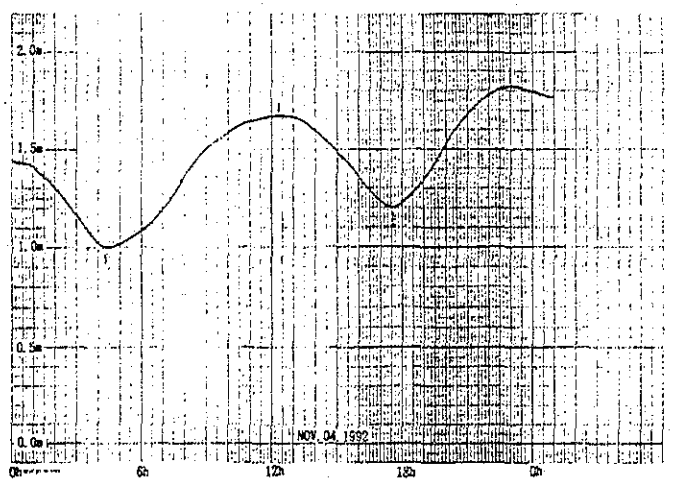


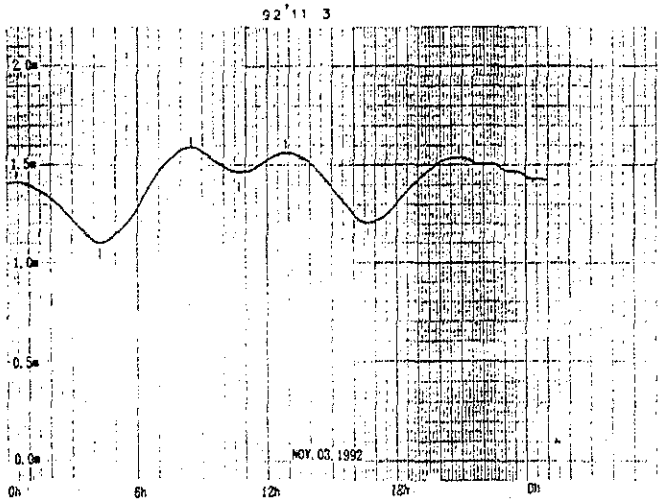
Tidal Curves at Ilha de Paqueta (Oct.25 to Oct.28,1992)

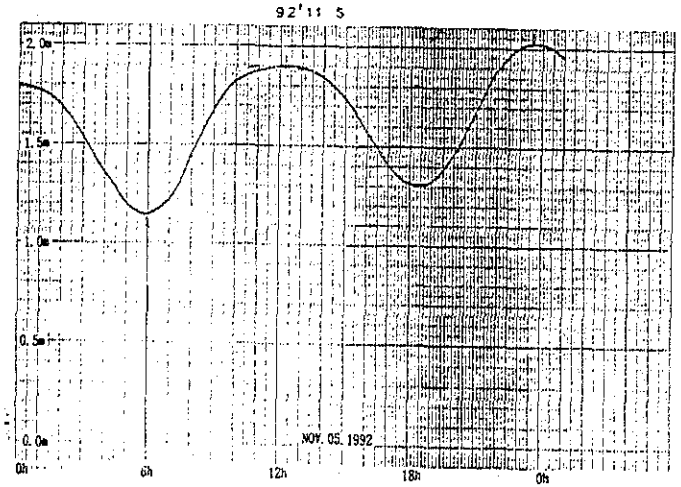


Tidal Curves at Ilha de Paqueta (Oct.29 to Nov.01,1992)

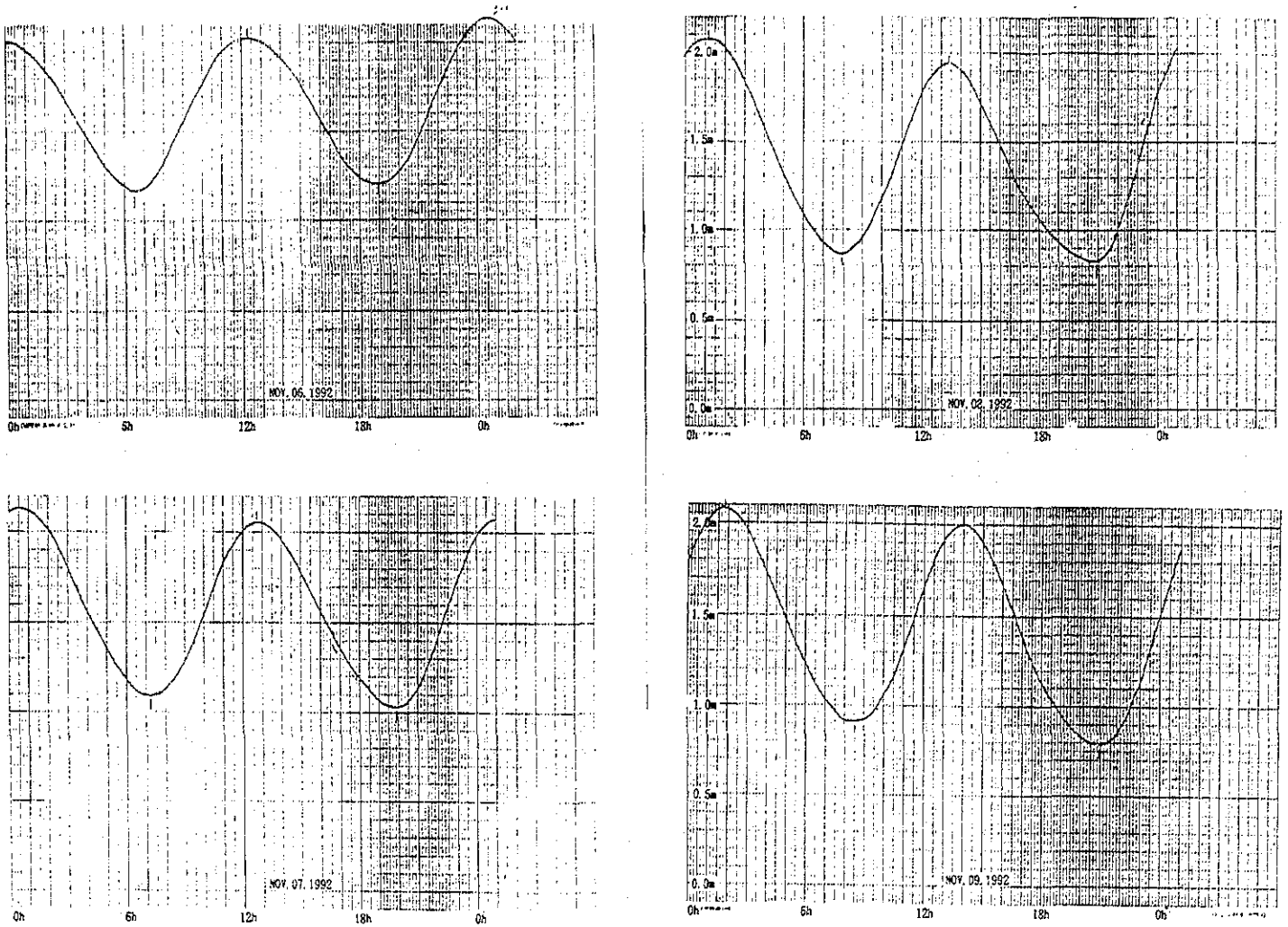




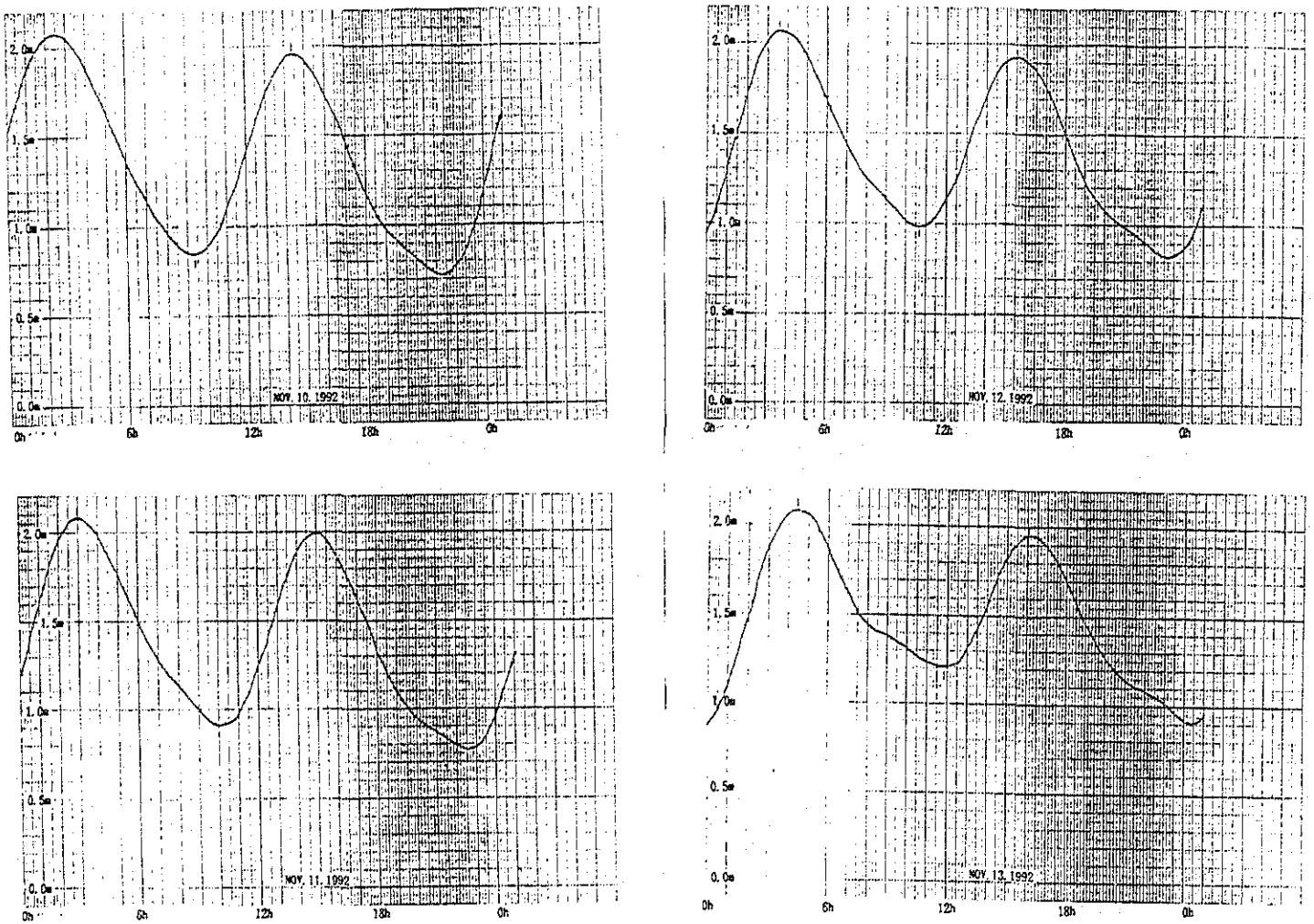




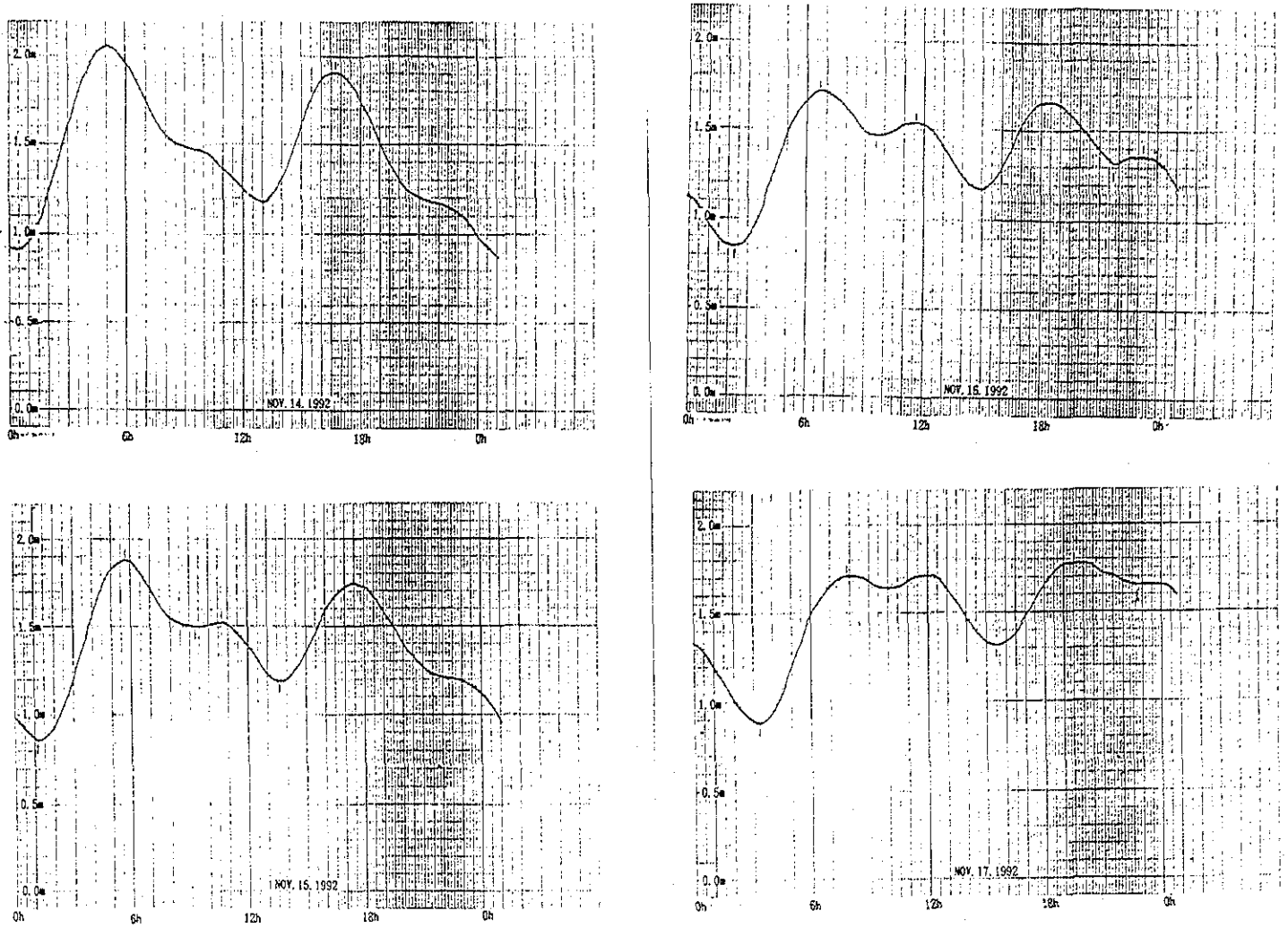
Tidal Curves at Ilha de Páqüeta (Nov.02 to Nov.05,1992)



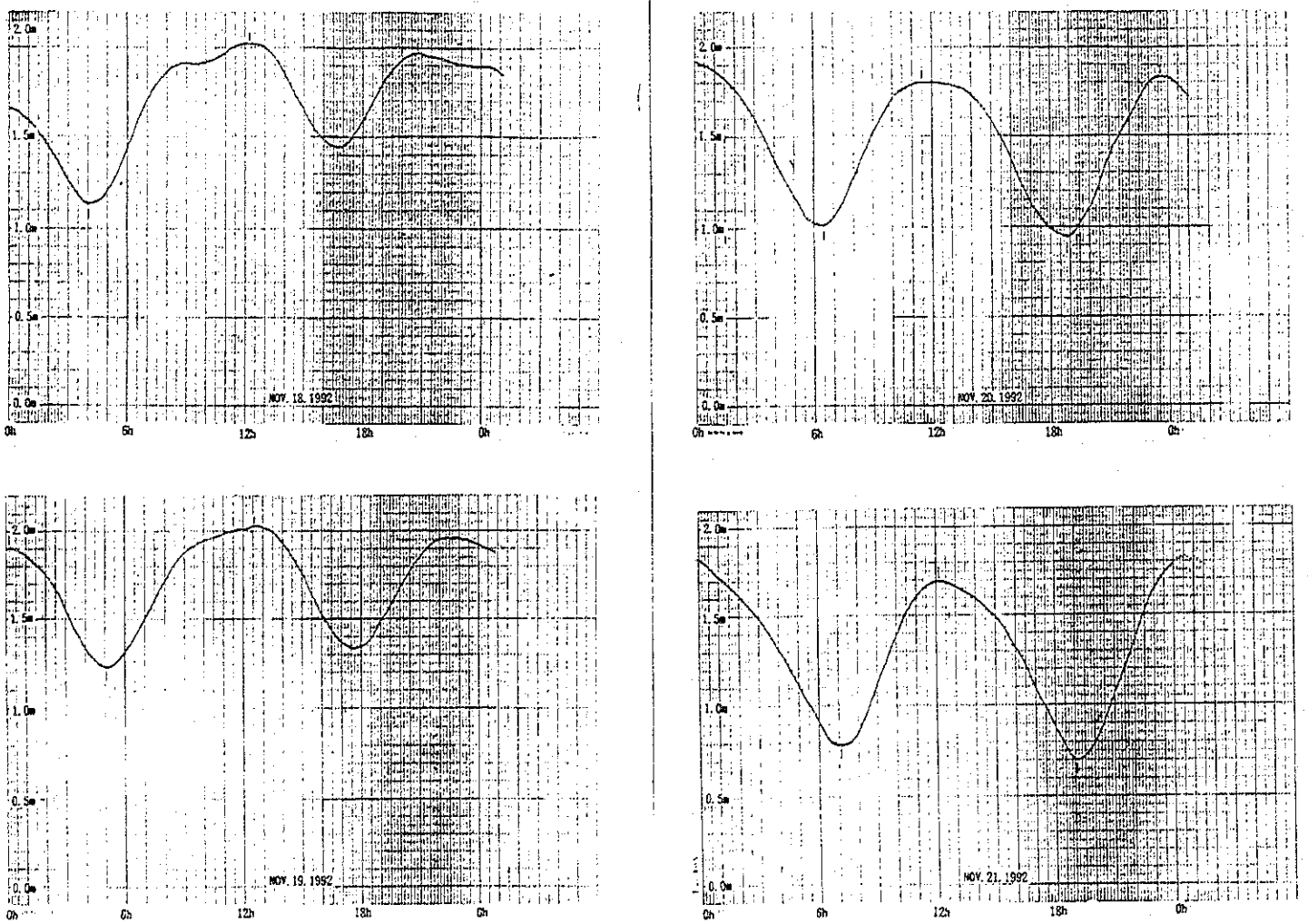
Tidal Curves at Ilha de Paqueta (Nov.06 to Nov.09,1992)



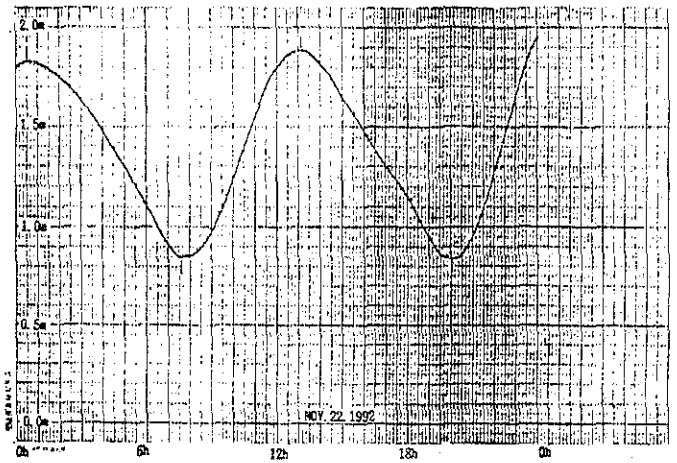
Tidal Curves at Ilha de Paqueta (Nov.10 to Nov.13,1992)

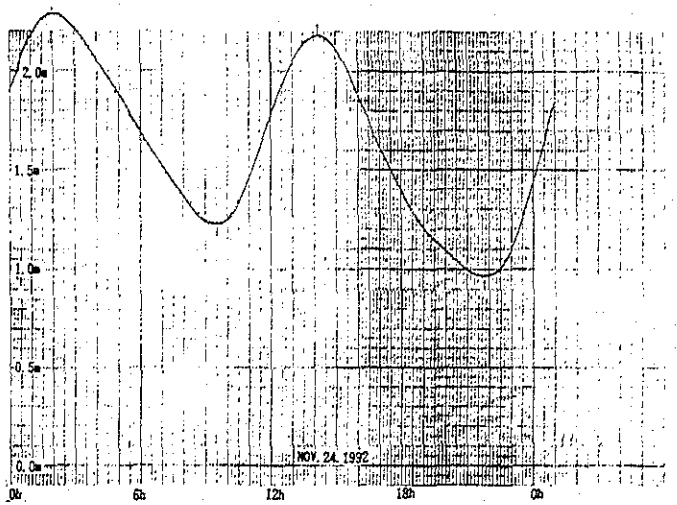


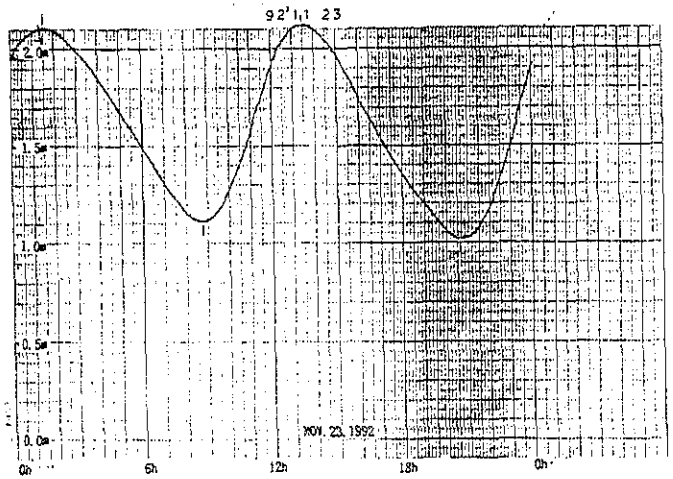
Tidal Curves at Ilha de Paqueta (Nov.14 to Nov.17,1992)



Tidal Curves at Ilha de Paqueta (Nov.18 to Nov.21,1992)







Tidal Curves at Ilha de Paqueta (Nov. 22 to Nov. 24, 1992)

2.3 Characteristics of Tides

2.3.1 Tidal Diagram

The tidal diagram at Ilha Fiscal, which is the standard of the Rio de Janeiro port, is shown in Fig. 2.3-2 using the one year data of March 19, 1991 to March 18, 1992. The maximum and average tidal spring range was 1.46 m and 1.26 m respectively. the highest high water was recorded to be 99.0 cm above Mean Sea Level and the lowest low water was 94.0 cm below Mean Sea Level.

Fig. 2.3-3 is the tidal diagram at Ponta da Armacao near the mouth of the bay and at Ilha de Paqueta in the inner part of the bay conducted for one month on the same period, from October 25, 1992 to November 24, 1992. The diagram shows that there was a difference of 16 cm at highest high water.

2.3.2 Harmonic Constants of Tides

In the Guanabara Bay, semi-diurnal tides such as M_2 and S_2 constituents are predominant. This means that the period of tides in the bay is semi-diurnal (about 12.5 hours). Harmonic constants at the four stations in the bay are shown in Table 2.3-1.

2.3.3 Comparison of Tides in the Bay

Fig. 2.3-4 shows the tidal curves at Ponta da Armacao near the mouth of the bay and at Ilha de Paqueta in the northern part of the bay on November 10, 1992.

By comparing the two curves in spring tide, the range of the tide at Paqueta is 12 - 13 cm larger than armacao.

On the other hand, the time of high water and low water tends to be faster at Paqueta and at Armacao, respectively and the high and low water intervals seem to be almost the same.

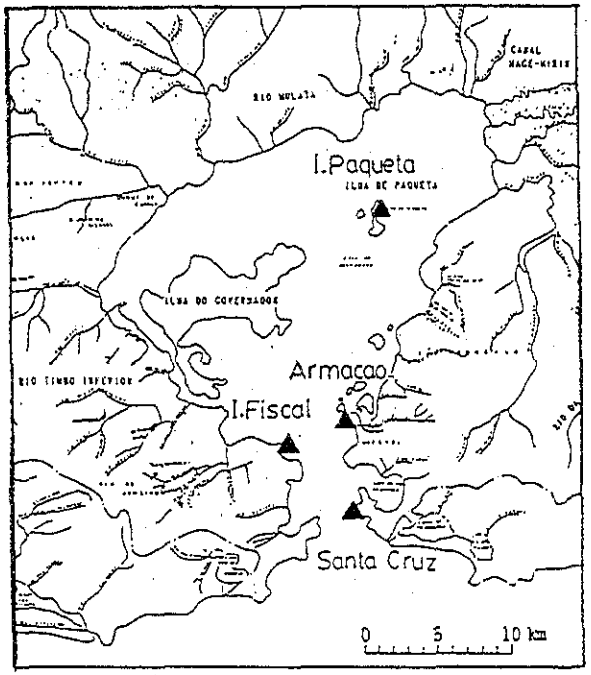


Fig. 2.3-1 Location Tidal Station

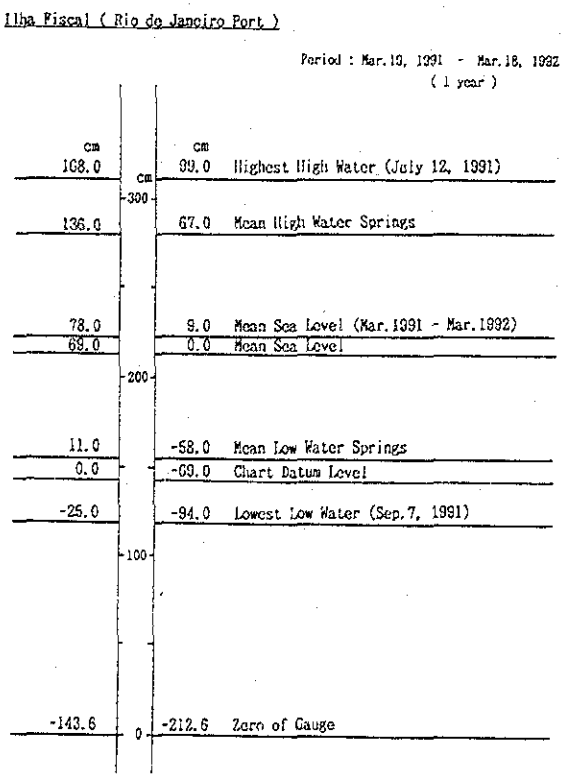


Fig. 2.3-2 Tidal Diagram at Ilha Fiscal

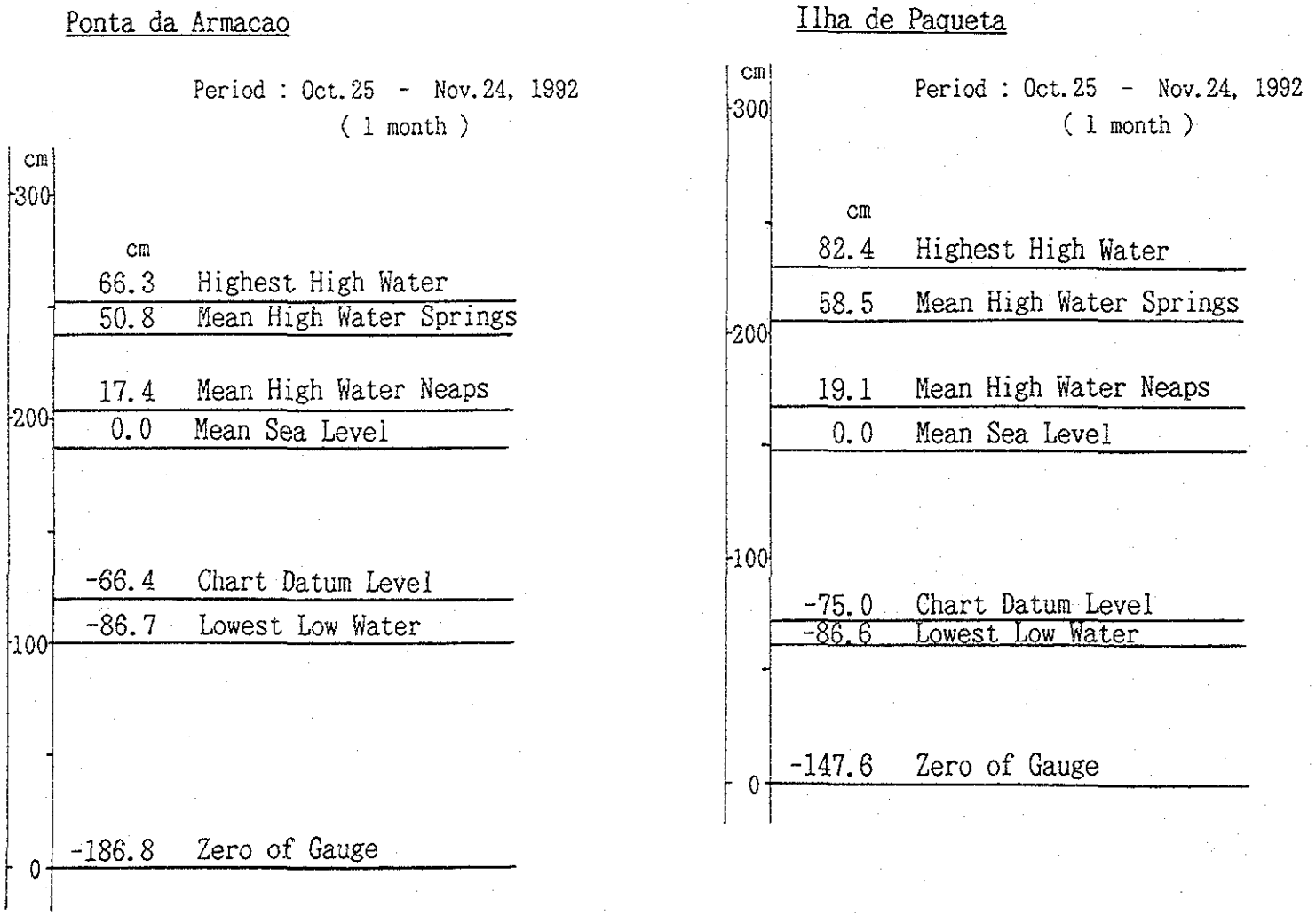


Fig. 2.3-3 Tidal Diagram at Armacao and Paqueta

Table 2.3-1 Harmonic Constants of the Principal Four Constituents

Station	Coordinates	Constituent (Height in cm)				$H=H_m+H_s$ +H'+H_o	Remarks
		$M_2(H_m)$	$S_2(H_s)$	$K_1(H')$	$O_1(H_o)$		
Fiscal	22°53'47''S 43°09'57''W	30.9	17.9	5.8	10.5	65.1 cm	DHN,1986 (1 year)
Santa Cruz	22°56'12''S 43°07'48''W	31.6	17.4	6.5	10.5	66.0 cm	DHN,1979 (1 month)
Armacao	22°52'59''S 43°08'05''W	34.1	16.7	5.4	10.2	66.4 cm	JICA,1992 (1 month)
Paqueta	22°45'43''S 43°06'26''W	38.8	19.7	6.0	10.6	75.0	JICA,1992 (1 month)

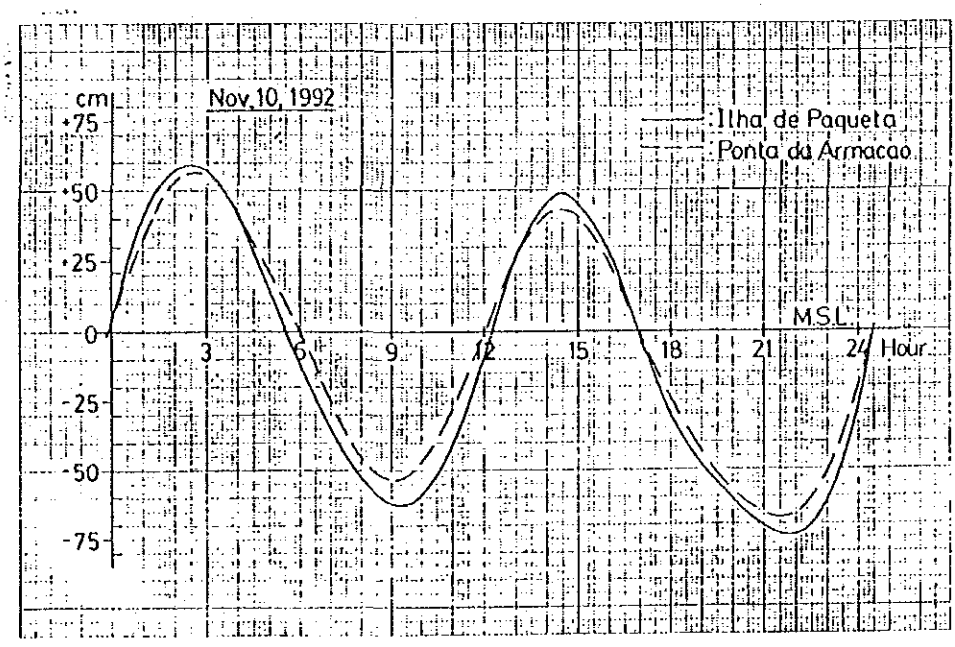


Fig. 2.3-4 Comparison of Tidal Curves

CHAPTER 3

TIDAL CURRENTS

3.1 Tidal Current Observation

Tidal current observation was performed continuously in June 15 to June 18, 1992 (Phase 1), in October 24 to November 13, 1992 (Phase 2) and in March 23 to March 26, 1993 (Phase 3) using self-recording type current meters (RCM-7).

The location and other information are shown in Table 3.1-1 and Fig. 3.1-1.

At St. A and St. B located at the mouth of the bay, and St. D at the central part of the bay, tidal currents were observed for a period of fifteen days and nights during the 2nd Phase of the Study. Twenty-five hour observation was performed at other stations.

In the channel at the west side of Ilha do Governador which is an important place in view of water exchanges of the inner part of the bay, the supplemental tidal current observation was performed at two (02) points of St. H and St. J for the period of three (03) days and nights in spring tides during the 3rd Phase.

The observation was carried out in two layers at St. A and St. B, at the mouth of the bay, that is three meters below sea surface and five meters above sea bottom, and in one layer, three meters below sea surface, at other stations.

Table 3.1-1 Location of Tidal Current Obdservation

Station St.	No. of layers	Coordinate	Water depth	Observation Period		
				Phase 1 (1992)	Phase 2 (1992)	Phase 3 (1993)
A	2	22°54.3'S 43°09.2'W	31 m	June 15 -June 16	Oct.28 -Nov.13	-
B	2	22°54.3'S 43°08.5'W	22 m	-ditto-	-ditto-	-
C	1	22°51.9'S 43°10.0'W	11 m	June 16 -June 17	Oct.24 -Oct.25	-
D	1	22°50.0'S 43°09.2'W	23 m	-ditto-	Oct.28 -Nov.13	-
E	1	22°46.5'W 43°07.7'W	12 m	-	Oct.24 -Oct.25	-
F	1	22°44.4'S 43°05.8'W	07 m	June 17 -June 18	-ditto-	-
G	1	22°46.0'S 43°11.7'W	06 m	-	-ditto-	Mar.23 -Mar.26
H	1	22°48.7'S 43°16.1'W	06 m	-	-ditto-	-
I	1	23°01.0'S 43°09.1'W	30 m	-	-ditto-	Mar.23 -Mar.26
J	1	22°50.0'S 43°15.0'W	8 m	-	-	

[Note] 01 layer : 3.0 m below sea level
02 layers
upper layer: 3.0 m below sea level
lower layer: 5.0 m above sea level

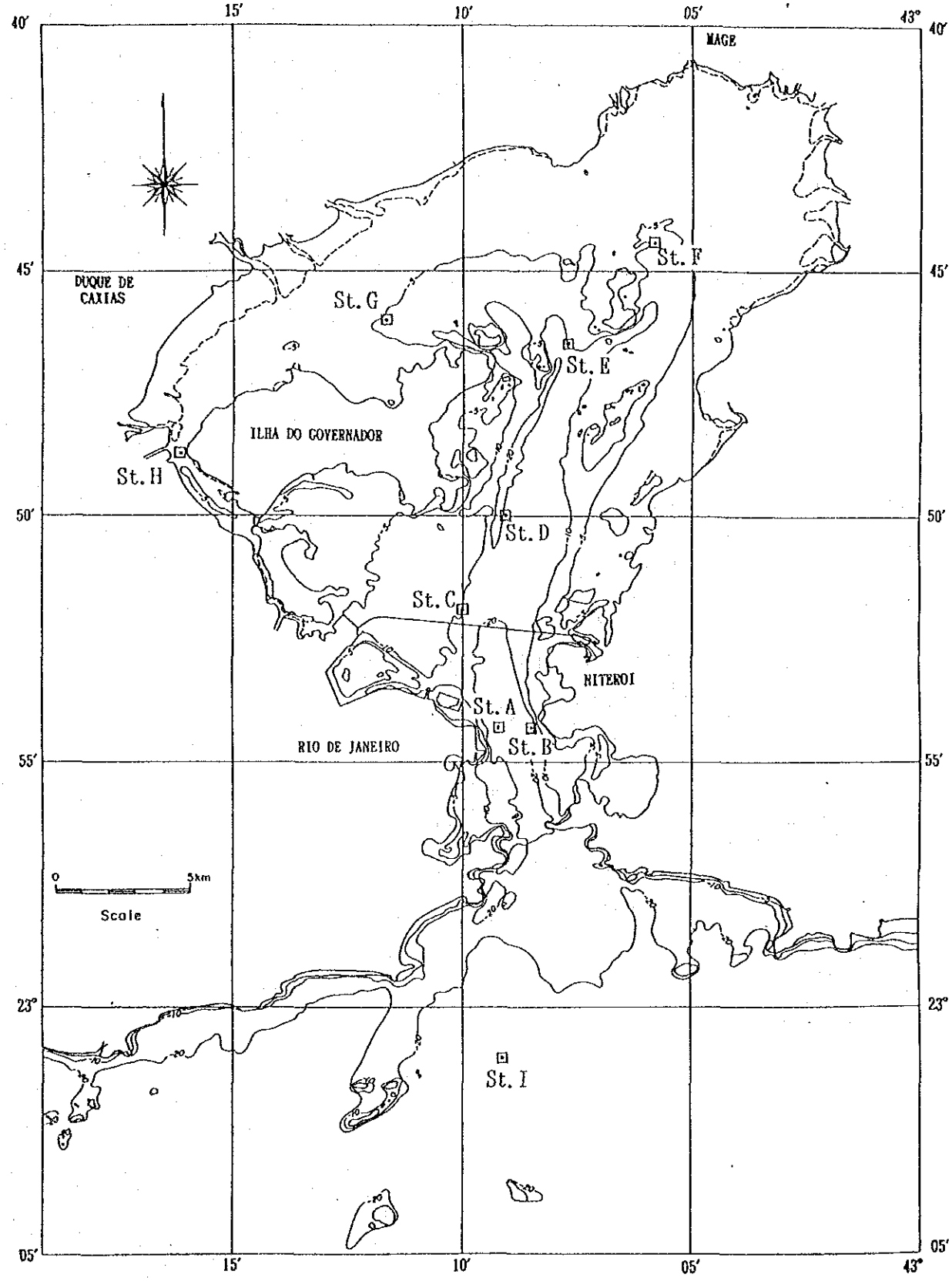


Fig. 3.1-1 Location Map of Tidal Current Observation

3.2 Results of Tidal Current Observation

3.2.1 Tidal current curves

The results of the tidal current observation are shown in Fig. 3.2-1, indicating continuous curves of velocities and directions for each station together with temperature.

The tidal current data every ten minutes for each station are shown in Data Book.

3.2.2 Frequency Distribution of Tidal Currents

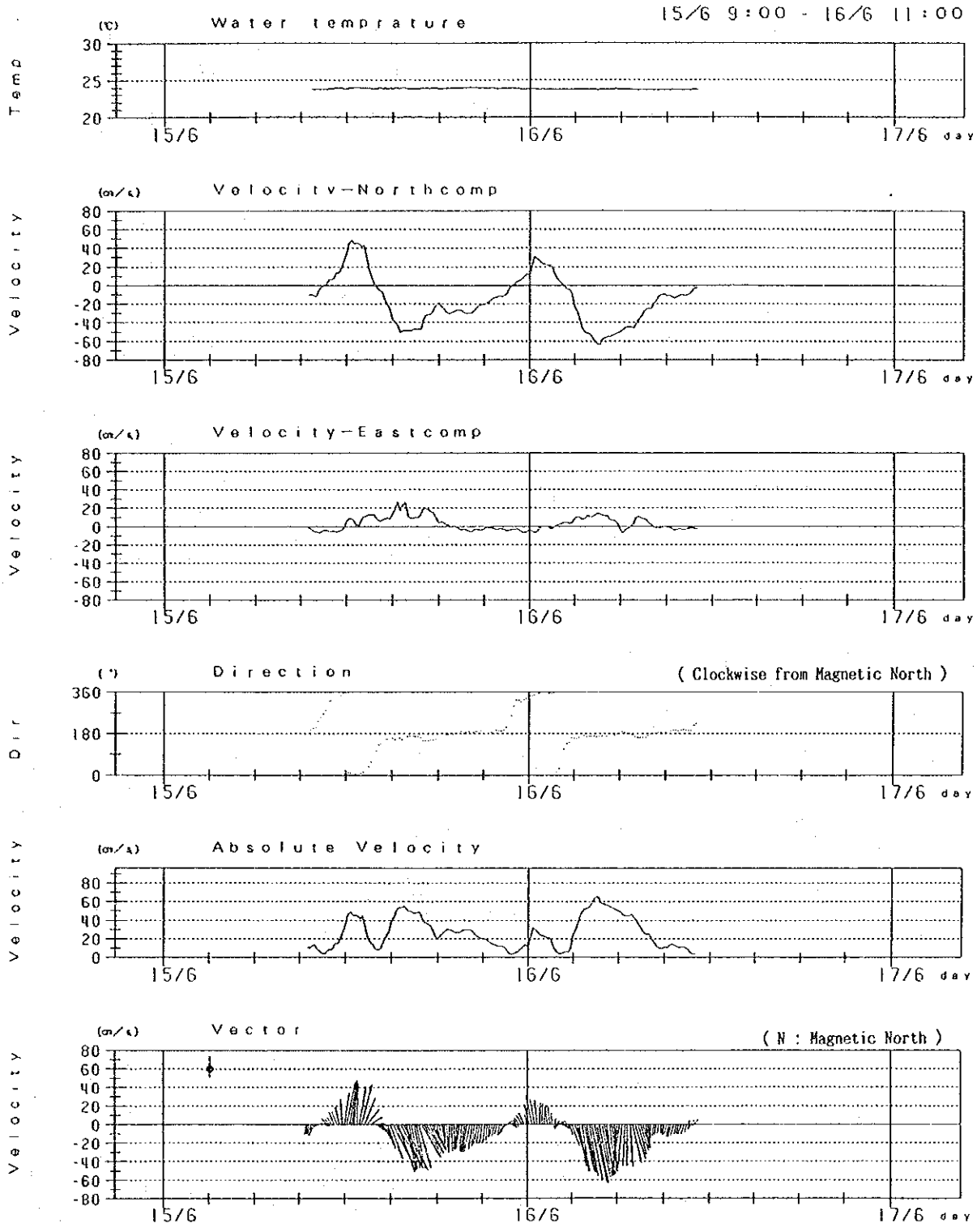
The frequency of direction and speed of tidal currents in each station is shown in Appendix 1.

Fig. 3.2-1

Tidal Current Curves

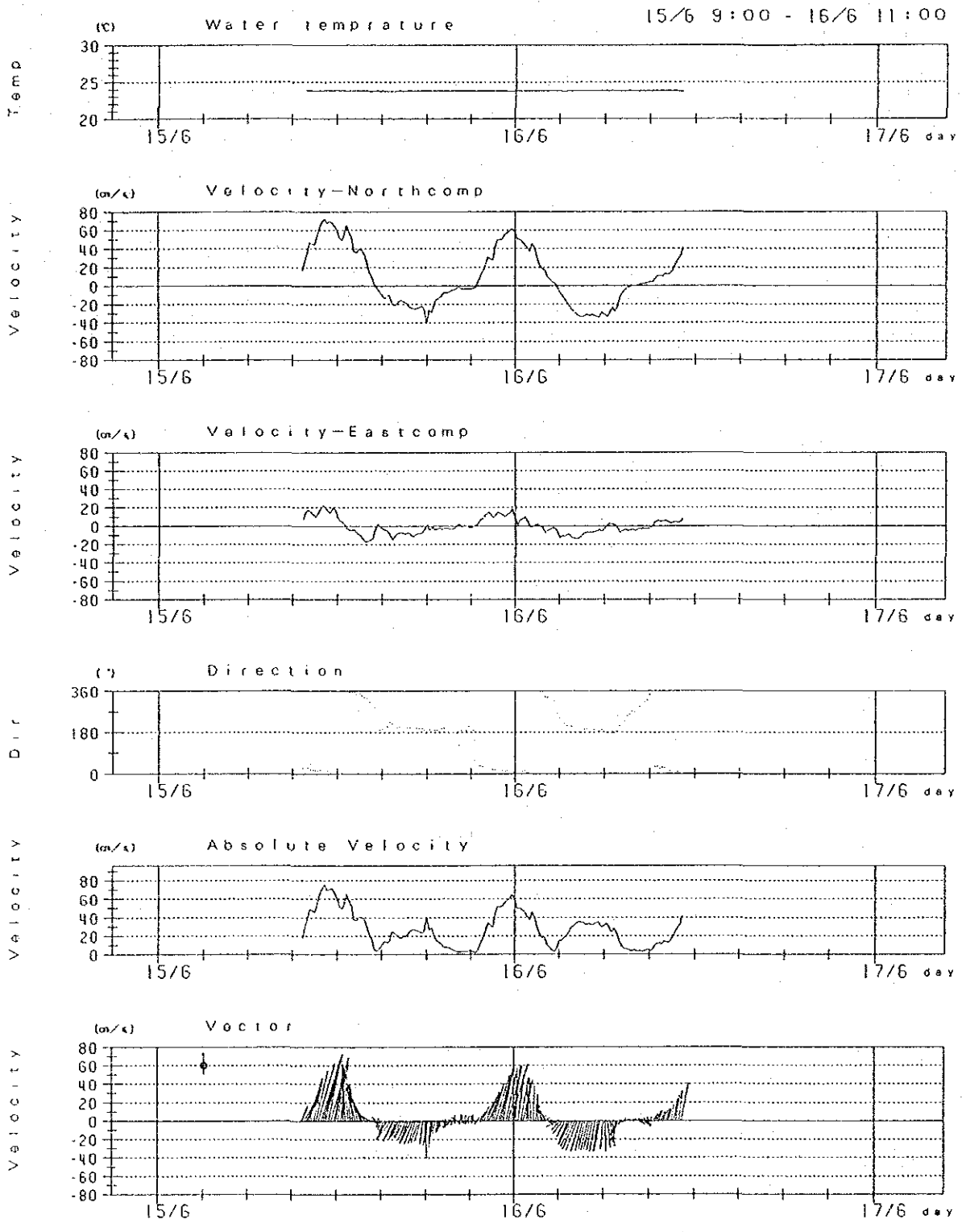
Phase 1

St. A (upper)

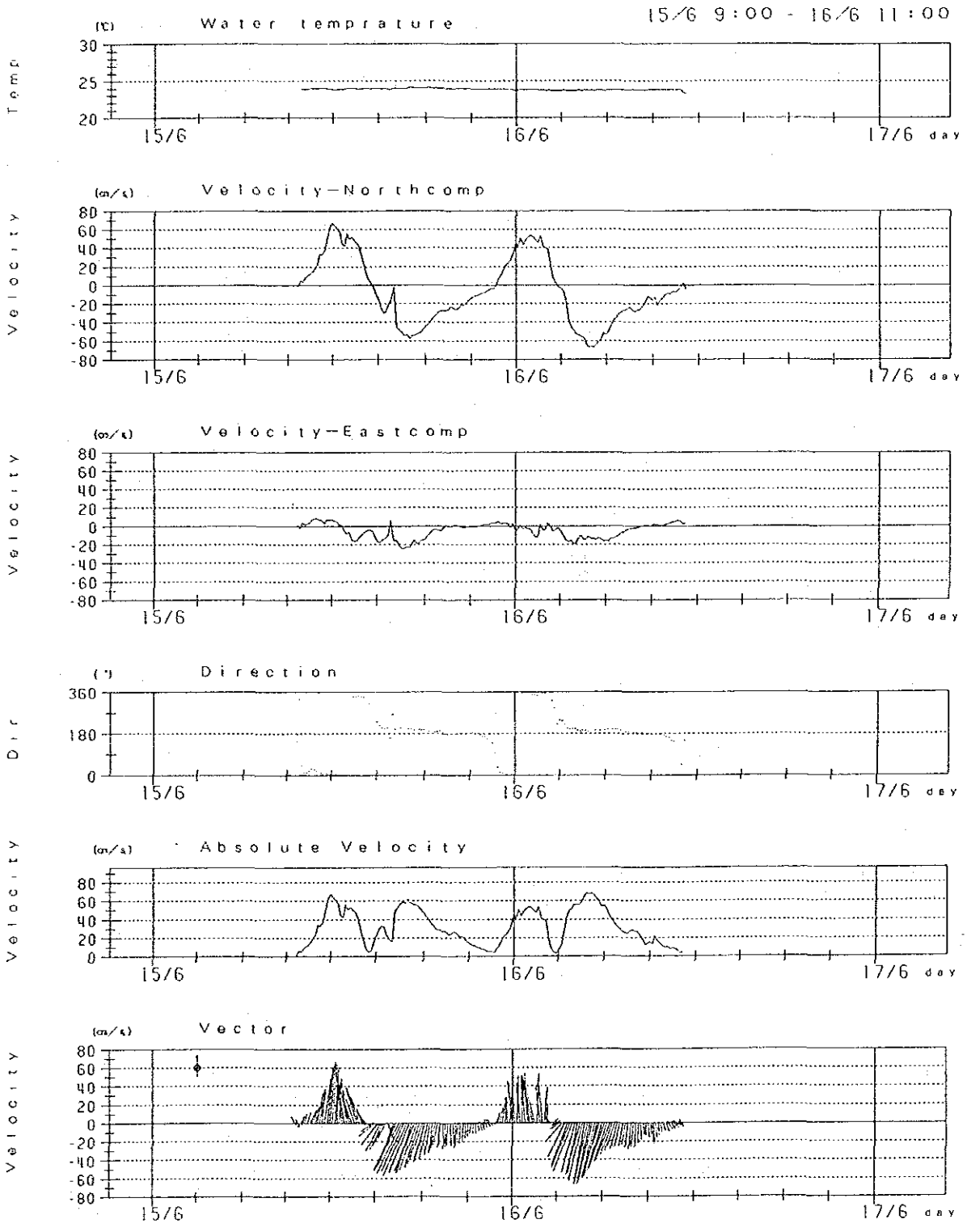


Tidal Current Curves

St. A (lower)


15/6 9:00 - 16/6 11:00
Water temprature
(℃)
Temp
30
25
20
Velocity-Northcomp
(cm/s)
Velocity
80
60
40
20
0
-20
-40
-60
-80
Velocity-Eastcomp
(cm/s)
Velocity
Direction
(°)
Dir
360
180
0
Absolute Velocity
(cm/s)
Velocity
Vector
(cm/s)
Velocity
15/6
16/6
17/6
day

St.B (upper)


15/6 9:00 - 16/6 11:00
Water temprature
(℃)
Temp
30
25
20
15/6
16/6
17/6 day
Velocity-Northcomp
(cm/s)
Velocity
80
60
40
20
0
-20
-40
-60
-80
Velocity-Eastcomp
Direction
(°)
Dir
360
180
0
Absolute Velocity
Vector