

Water Quality Variation from 1991 to 2000 without Measure

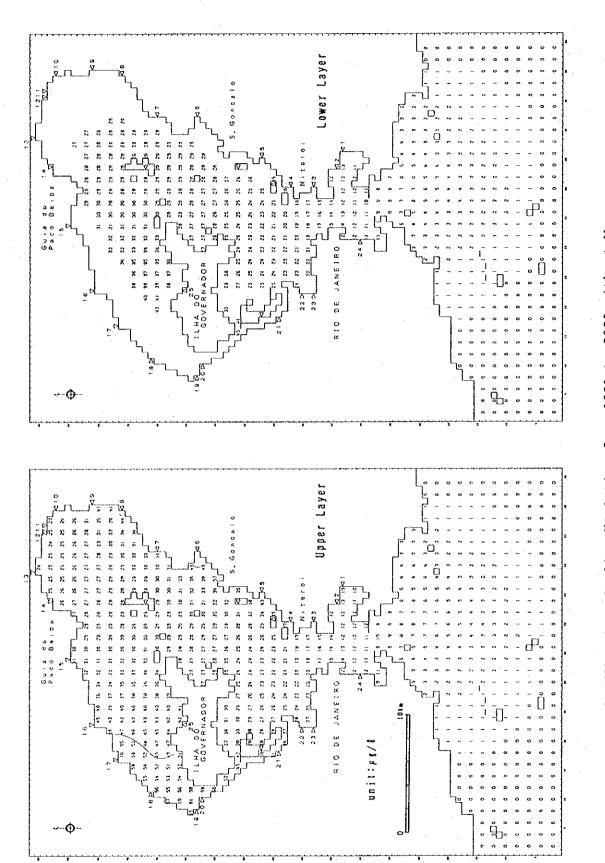


Fig. 4.3-4(2) Water Quality Variation from 1991 to 2000 without Measure (T-P)

4-22

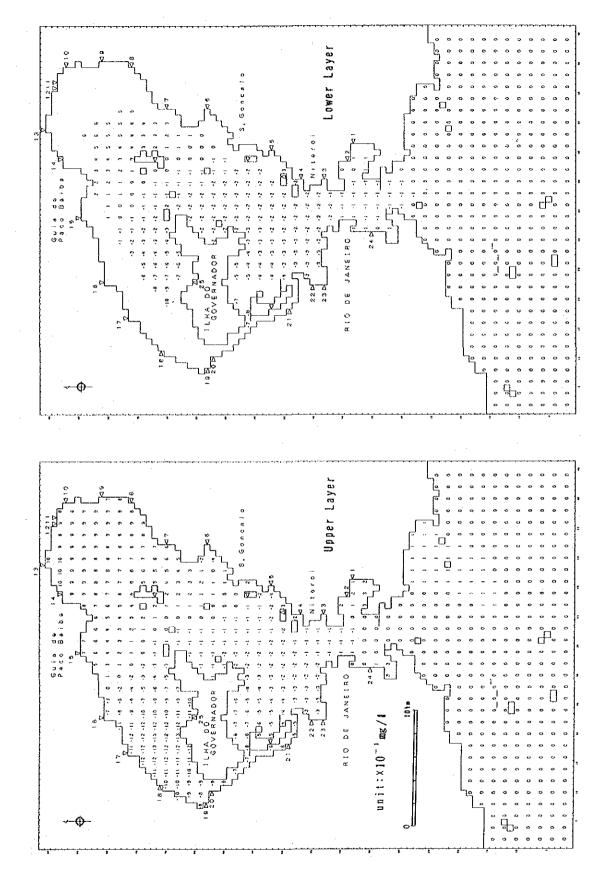


Fig. 4.3-4(3) Water Quality Variation from 1991 to 2000 without Measure

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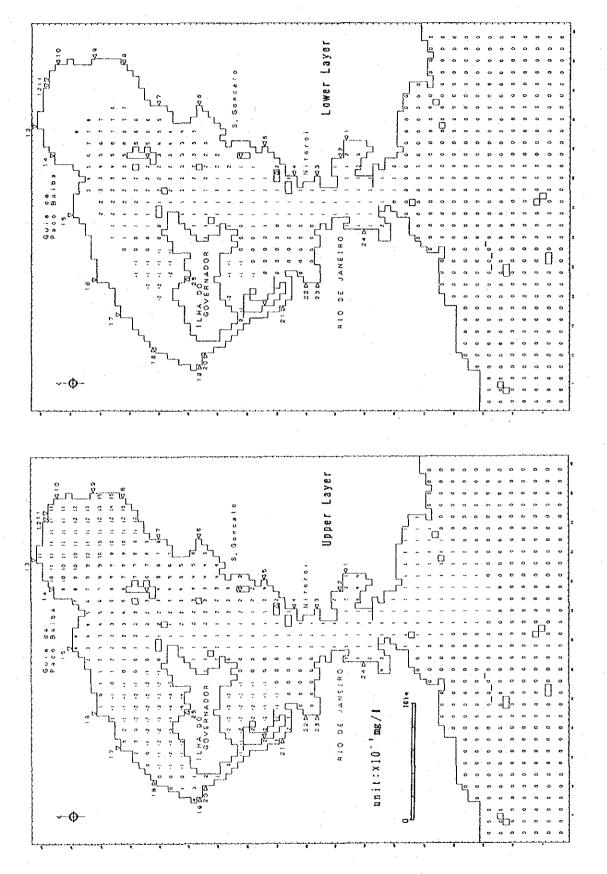
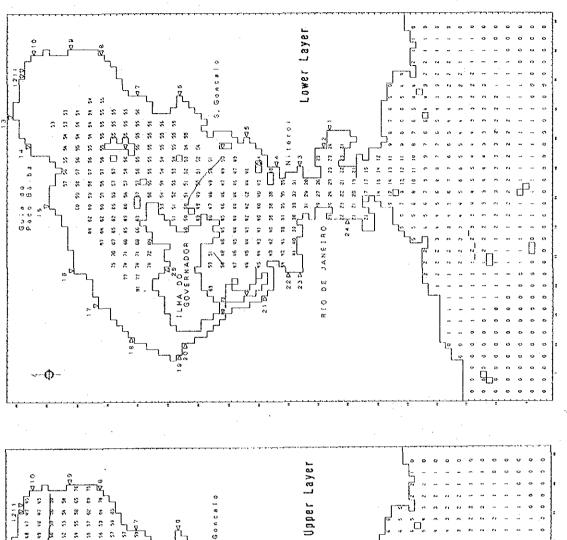


Fig. 4. 3-5(1) Water Quality Variation from 1991 to 2010(scenario-1) without Measure

4-24



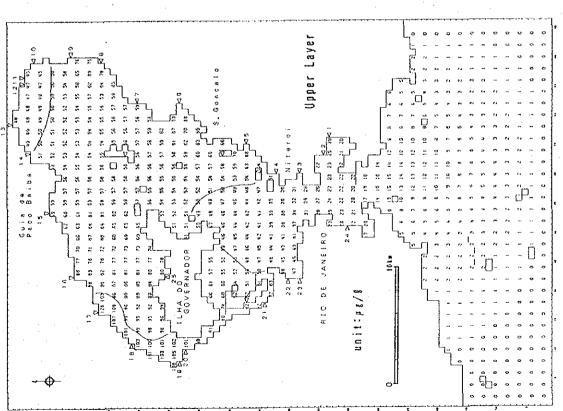
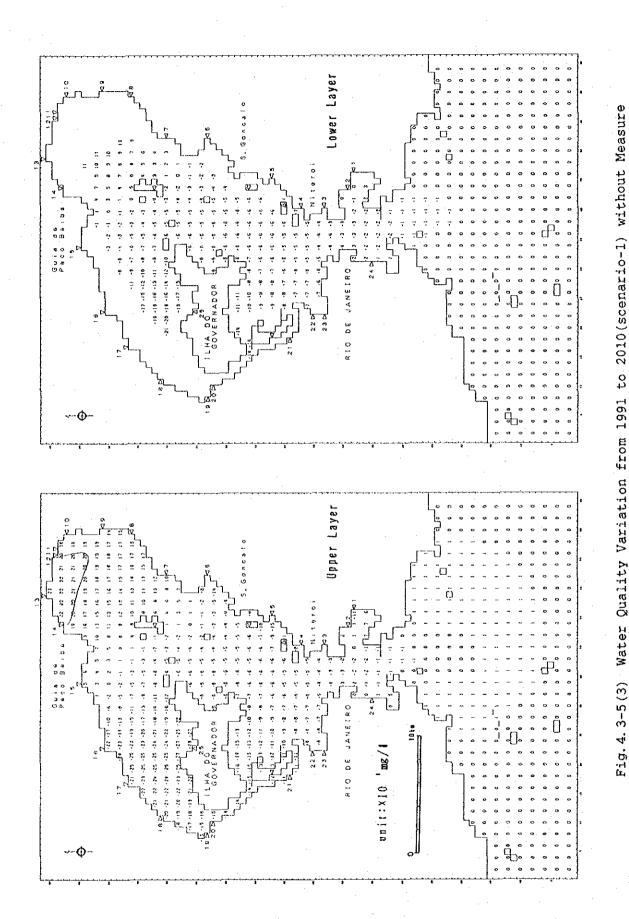


Fig. 4.3-5(2) Water Quality Variation from 1991 to 2010(scenario-1) without Measure





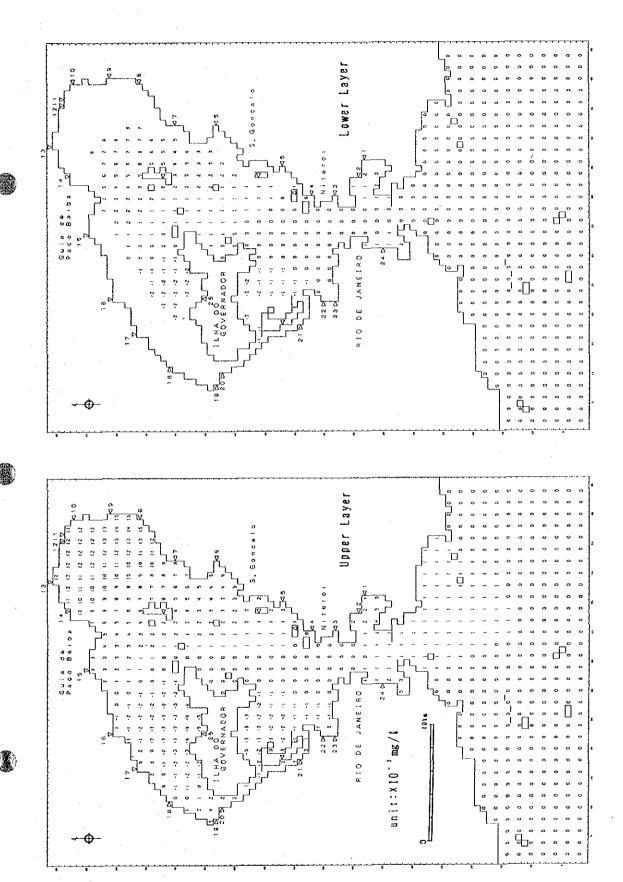
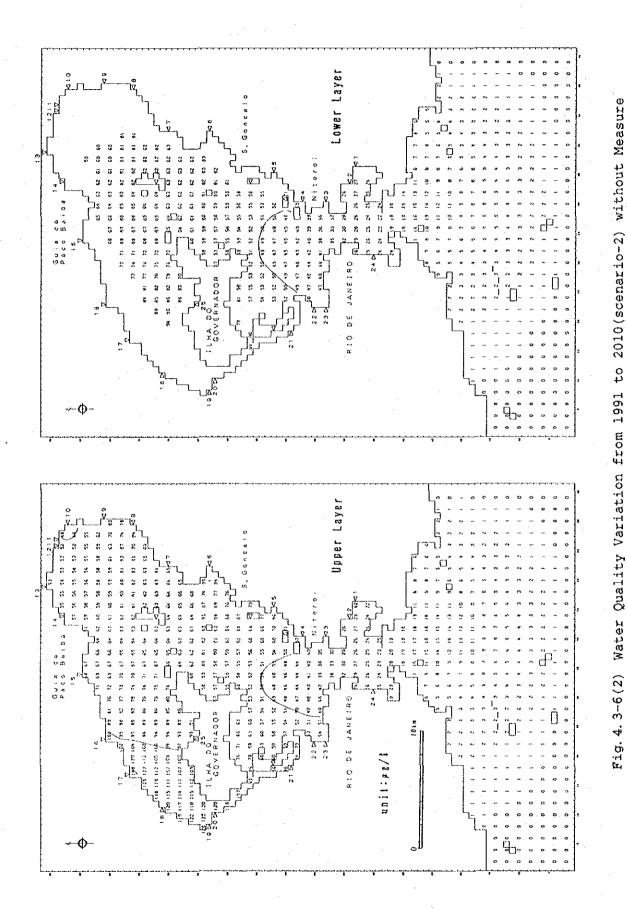


Fig. 4. 3-6(1) Water Quality Variation from 1991 to 2010 (scenario-2) without Measure

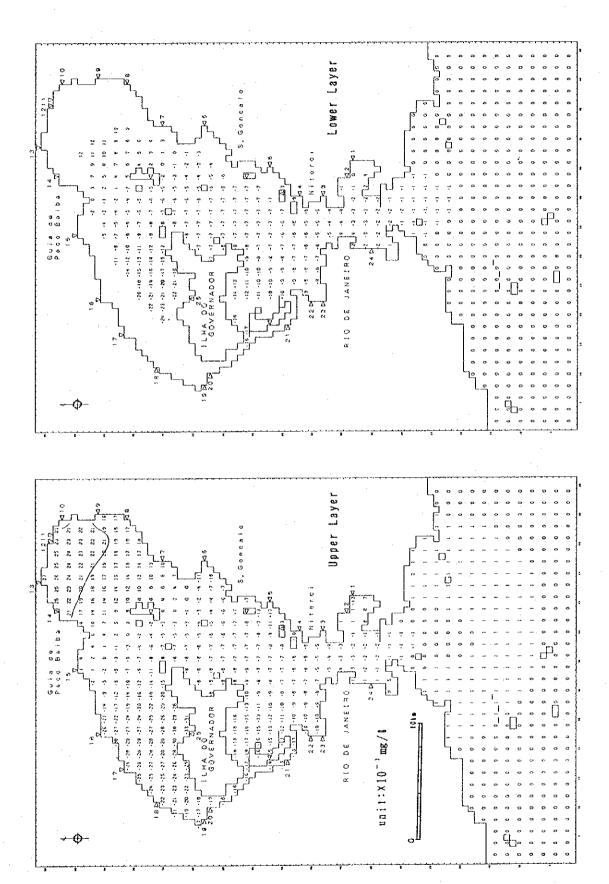


(T-P)

. 4-28



000)



#### 4.4 Evaluation of Calculation Results

The inflowing loads and river discharges from each basin are summarized in Table 4.4-1 for each case, and the change of loads and discharges are shown in Fig.4.4-1 by each basin.

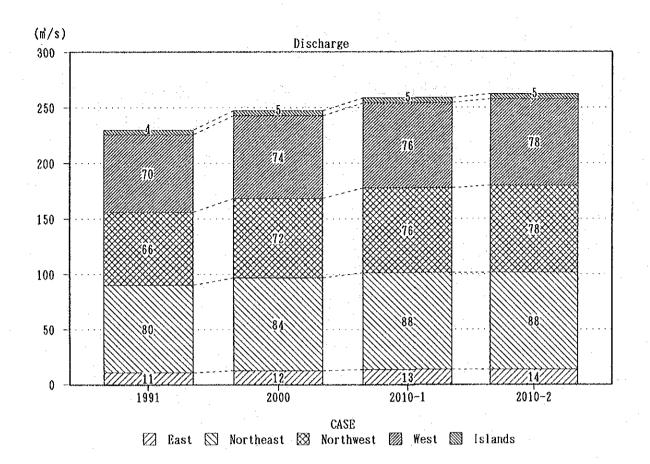
Fig. 4.4-2 and Fig. 4.4-3 show the change of the mean water quality in each water area for BOD, T-P and DO.

The future water quality of these indeces is estimated as follows;

- BOD: Strong rise of concentration is seen in Block F situated in the inner northeastern part as 4.6 mg/l in 2000, 4.9 mg/l in 2010 from 4.0 mg/l in 1991.
- T-P: Concentration rise of 0.05 mg/l to 0.1 mg/l is seen in the whole bay.
- DO : Concentration becomes worse in the whole, particularly water areas of Block C, D and El show 1 mg/l to 2 mg/l decrease.

Table 4.4-1 External Load from Sub-Basin Groups

Case	Sub Basin	Discharge	BOD	P04-P	0-P
0400	Group	(m3/s)	(t/day)	(t/day)	(t/day)
	East	12. 41	44. 44	0.67	1.002
	Northeast	84. 23	55. 58	1. 28	1, 920
2000	Northwest	71.63	114. 79	2. 62	3. 936
	West	74. 38	176.41	4.48	6.726
	Islands	4. 51	8, 29	0. 21	0.318
	Total	247. 16	399. 50	9. 27	13. 902
	East	13. 47	47. 27	0.75	1.122
ł	Northeast	87.75	64. 27	1.49	2. 232
2010-1	Northwest	76. 32	127.45	2. 94	4. 404
	West	76.46	182.01	4.64	6. 954
	Islands	4.60	8. 54	0. 22	0. 330
	Total	258.60	429. 53	10.03	15.042
	East	13. 55	47. 50	0.76	1. 134
1	Northeast	87. 82	64. 47	1. 49	2. 239
2010-2	Northwest	78. 30	132, 80	3.06	4. 597
	West	77. 92	185.99	4.74	7. 111
	Islands	4.65	8.69	0. 22	0. 336
	Total	262. 24	439. 44	10. 28	15. 416



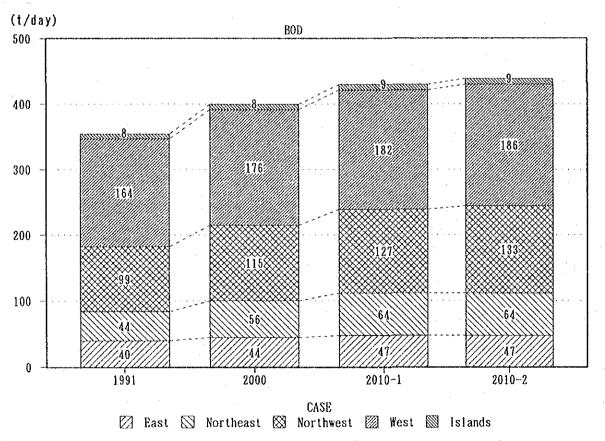
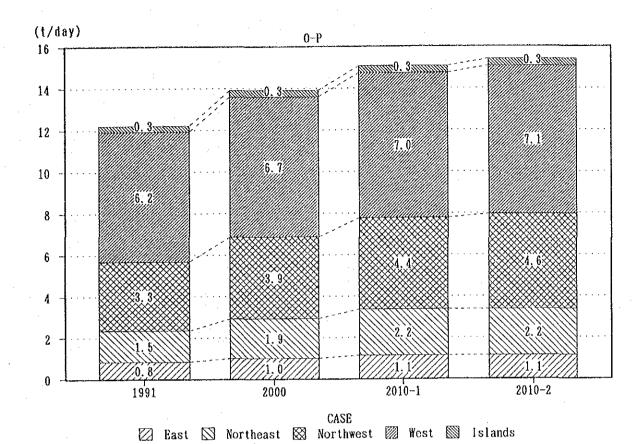


Fig. 4.4-1(1) External Load from Sub-Basin Groups



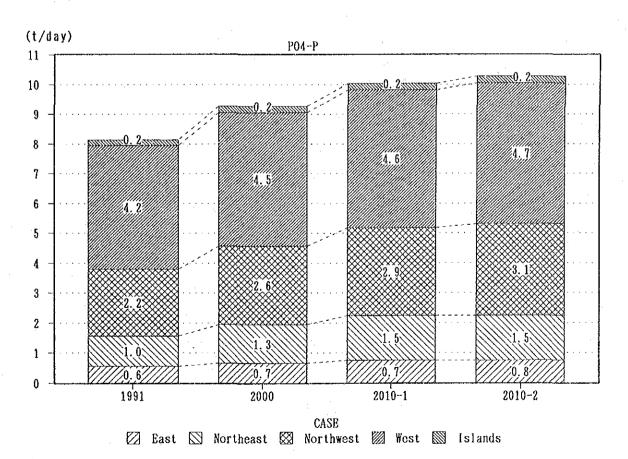


Fig. 4.4-1(2) External Load from Sub-Basin Groups

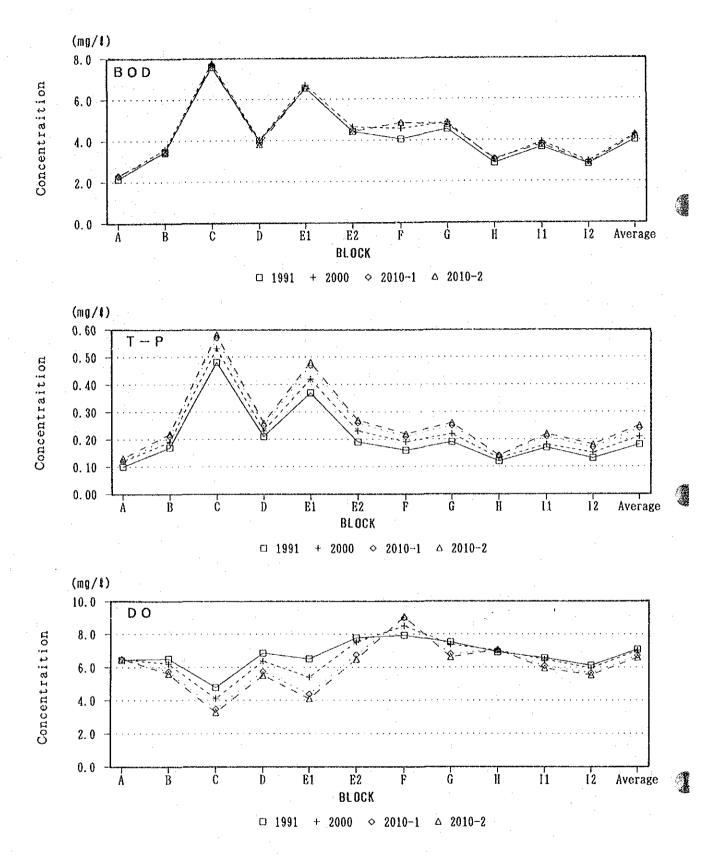


Fig. 4.4-2 Water Quality Change in each block

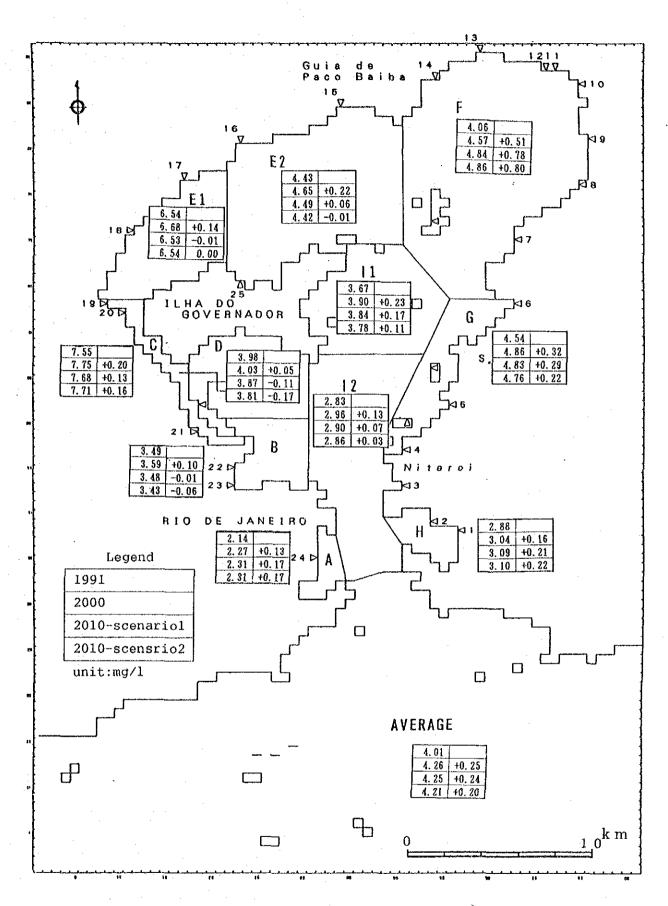


Fig. 4.4-3(1) BOD Concentration and Variation in each Block

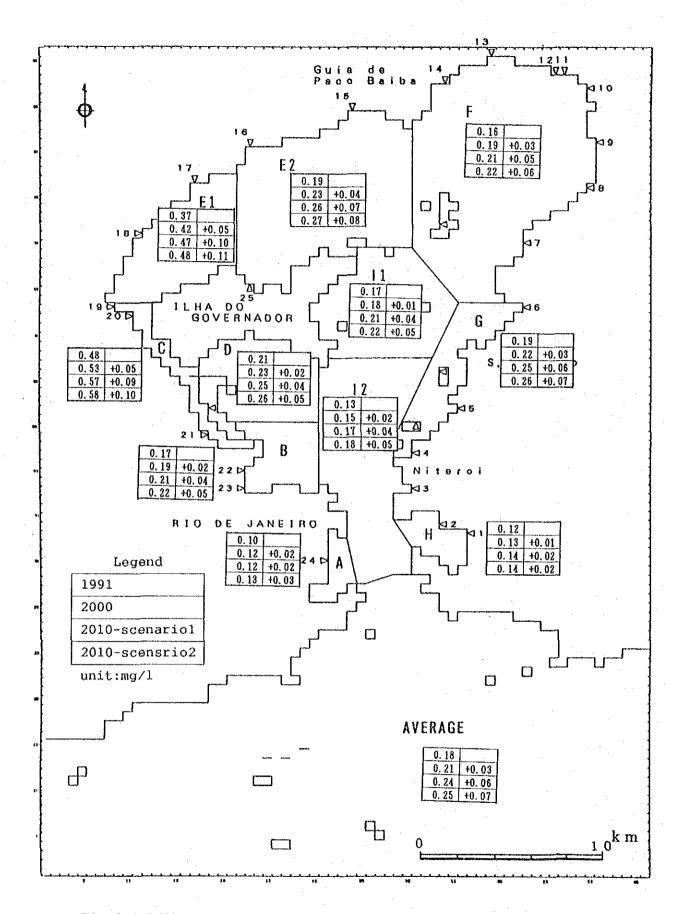


Fig. 4. 4-3(2) T-P Concentration and Variation in each Block

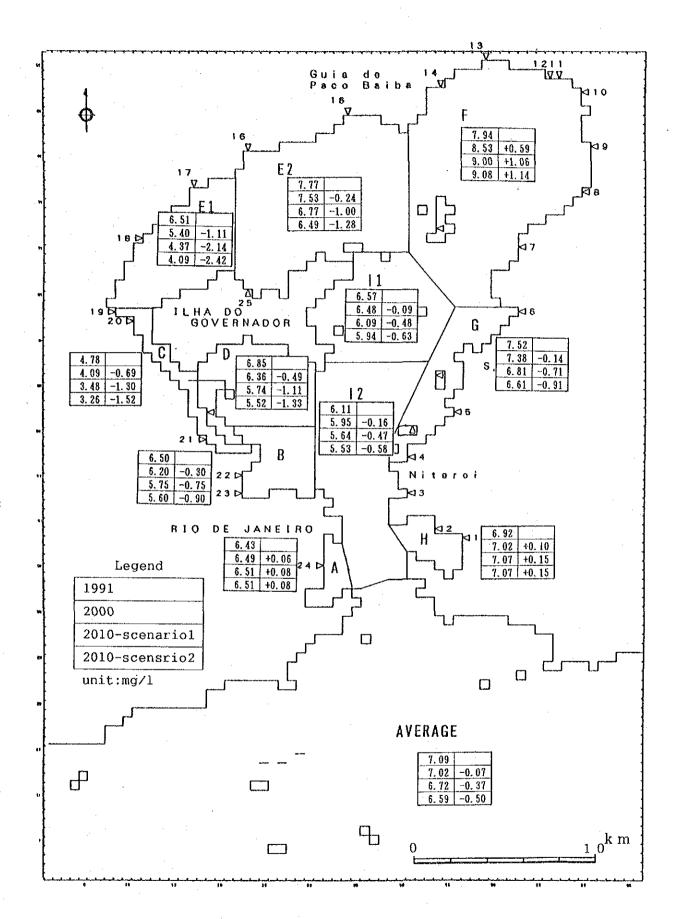


Fig. 4. 4-3(3) DO Concentration and Variation in each Block

# CHAPTER 5

# EFFICIENCY EVALUATION OF SEVERAL MEASURES

#### 5.1 Case of Calculation

The efficiency evaluation for applicable measures is performed for the following cases;

#### (1) IDB/OECF Program

Case 1-1: Completion of sewage treatment plants (primary treatment) in the year of 2000.

Case 1-2: Completion of sewage treatment plants (secondary treatment) in the year of 2010.

# (2) Additional Sewage Treatment Plants

Case 2 : Case 1-2, plus

Preparation of additional sewage treatment

plants (primary treatment) in urban areas in
the year of 2010.

#### (3) Ocean Outfall System

Case 3-1: Case 1-1, plus

Ocean outfall system applying to sanitary
districts south of the Pavuna's sanitary
district and south of the Toque-Toque's
sanitary district in the year of 2010.

Case 3-2: Case 1-1, plus

Ocean outfall system applying to sanitary
districts south of the Penha's sanitary
district and south of the Toque-Toque's
sanitary district in the year of 2010.

Case 3-3: Case 1-1, plus

Ocean outfall system applying to sanitary districts south of the Alegria's and Fundao's sanitary district and south of the Toque-Toque's sanitary district in the year of 2010.

Case 3-4: Case 1-1, plus

Ocean outfall system applying to sanitary
districts south of the Botafogo's sanitary
district and south of the Icarai's sanitary
district in the year of 2010.

#### (4) High-Grade Sewage Treatment

Case 4-1: Case 1-2, plus
20% reduction of T-P from secondary
treatment plants of IDB/OECF Program in the
year of 2010.

Case 4-2: Case 1-2, plus

40% reduction of T-P from secondary
treatment plants of IDB/OECF Program in the
year of 2010.

Case 4-3: Case 1-2, plus
80% reduction of T-P from secondary
treatment plants of IDB/OECF Program in the
year of 2010.

# (5) Dredging of Polluted Sediments

Case 5-1: Case 1-2, plus

Dredging of polluted sediments in Block C.

Case 5-2: Case 1-2, plus

Dredging of polluted sediments in Block D.

Case 5-3: Case 1-2, plus

Dredging of polluted sediments in Block E1.

Case 5-4: Case 1-2, plus

Dredging of polluted sediments in Block E2.

# (6) Deepening and Widening of Channels

Case 6-1: Case 1-2, plus

Dredging of channels.

Case 6-2: Case 1-2, plus

Dredging and widening of channels.

#### 5.2 Conditions of Calculation

The inflowing loads used for the above cases are shown in Table 5.2-1 and the total loads for each basin are summarized in Table 5.2-2.

Table 5.2-1(1) External Load used for simulation in Case 1-1

RIVER	INFLOW			1DB/OECF (PR	IMARY) IN 2		CASE 1-1
,		_		Discharge	BOD	P04-P	0-Р
NO	NAME.	_1_	J	(±3/s)	(t/day)	(t/day)	(t/day)
	ver load					2.004	
1	BCHARITAS	46	38	1. 23	1. 23	0.064	0.096
2 3	CANAL CANTO DO RIO	43	39 43	0.97	0.97 0.87	0. 048 0. 044	0.072
4	BCATEDRAR BNORTE CENTRO	40	47	1.01	1.01	0.052	0.066
5	RIO BOMBA	45	52	4.48	5. 32	0. 244	0.366
6		52	63	3.82	7. 85	0. 200	0.300
	ern Sub Total	02	- 00	12.41	17. 25	0. 652	0. 978
7	BITAOCA	52	70	0.89	1. 84	0.048	0.072
8	RIO ALCANTARA	59	76	13.41	25. 33	0.612	0.918
9	RIO CACEREBU	60	81	29. 54	19. 46	0.420	0.630
10	RIO GUAPIMIRIN	59	87	32.76	5. 22	0.116	0.174
11	CANAL DE MAGE	57	88	0.70	0.45	0.012	0.018
12	RIO RONCADOR	56	88	3. 78	1.96	0.044	0.066
13	RIO IRIRI	49	90	1.00	0.58	0.012	0.018
	RIO SURUI	44	87	2, 15	0.74	0.016	0. 024
	leastern Sub Total			84. 23	55. 58	1. 280	1. 920
	BMAUA	34	84	0.99	0.47	0.012	0.018
	RIO ESTRELA	23	80	15.05	15. 44	0.348	0. 522
	R10 IGUACU	17	76	29. 35	38, 30	0.868	1. 302
	RIO SARAPUI	17	76	22. 87	42.87	1. 204	1.806
	BCABO DO BRITO	12	71	3. 37	5. 82	0.172	0. 258
	western Sub Total			71.63	102. 90	2. 604	3. 906
19		9	63	30.19	62. 53	1.724	2. 586
20	RIO IRAJA	- 11	62	9. 83	15. 51	0.600	0. 900
21	CANAL DO CUNHA	19	49	15.99	22.67	0.948	1.422
22	BS. CRISTOVAO	23	45	1. 28	1.69	0.072	0.108
23	CANAL DO MANGUE	23	43	9. 99	16, 65	0.592	0.888
	BBOTAFOGO	32	35	7. 10	15.04	0.444	0, 566
	rn Sub Total			74. 38	134.09	4.380	6, 570
	I. DO GAVANADOR	23	66	3, 76	5. 45	0.172	0.258
	I. DO FUNDAO	18	52	0.26	0. 20	0.004	0.006
	1. DE PAQUETA	43	72	0.11	0.15	0.004	0.006
	1. DO ENGENHO	43	56	0. 25	0, 53	0.016	0, 024
	1. DE S. CRUZ	41	51	0.13	0. 23	0.008	0.012
	ds Sub Total			4. 51	6. 56	0. 204	0. 308
	load Total		-	247. 16	316. 38	9. 120	13. 680
***************************************	rect Load	10	0.0				
007		43	36	-	2. 13		
001		46	55		6. 70		
004		46	56	-	2. 40	_	
800		44	51 47		2. 10 1. 94		
009		45	52		0.80		
					0.66		
034 044		46 46	57 57		0.51		
047		46	57		0. 48	<del>-</del> -	
062		48	59		0.48		
113	<u></u>	51	62		0. 38		
	ern Sub Total	<u>^ 7 T</u>	0.6		18. 32	_	
015	in our iotal	17	76		1. 32		
018		17	76		1. 20		
075		17	76		0. 33		
029		17	76	_	0.79		
086		17	76	- 1	0.31		
137		10	68		0.16		_
	western Sub Total	1		- 1	4. 11	-	
030		11	62		0.72	-	
042		11	62	_	0. 52	-	**
051		32	36	-	0.45		<del></del>
	ern Sub Total	<del></del>		_	1.69		
	t Load Total				24. 11		
Total				247. 16	340.49	9. 120	13,680
				<del></del>	<del></del>		

Table 5.2-1(2) External Load used for simulation in Case 1-2

	INFLOW		·	IDB/OECF (SE			
MA	4741201			Discharge		P04-P	0-P
NO .	NAME	1	J	(m3/s)	(t/day)	(t/day)	(t/day)
	ver load	1 40	0.0	1 07	0.42	0.004	0.00
	BCHARITAS	46	38	1. 27	0, 47	0.064	0.09
<u>2</u> _		43	39	1.00	0.37	0.048	0.07
	BCATEDRAR	40	43	0.93	0.33	0.044	0.06
	BNORTE CENTRO	40	47	1.05	0.39	0.052	0.07
	· · · · · · · · · · · · · · · · · · ·	45	52	5.00	2.86	0. 272	0.40
6		52	63	4. 30	9. 13	0. 232	0.34
	rn Sub Total	·		13, 55	13. 55	0.712	1.06
7_	BITAOCA	52	70	1.00	2.14	0.056	0.08
8	RIO ALCANTARA	59	76	14.75	28. 99	0.704	1,05
	RIO CACEREBU	60	81	30.89	22. 90	0.500	0.75
10	RIO GUAPIMIRIN	59	87	33, 25	5.97	0.132	0.19
11	CANAL DE MAGE	57	88	0.73	0.55	0.012	0.01
12	RIO RONCADOR	56	88	3. 94	2. 35	0.052	0.07
13	RIO IRIRI	49	90	1.05	0.69	0.016	0.02
	RIO SURUI	44	87	2. 21	0.88	0.020	0.03
	eastern Sub Total			87. 82	64. 47	1. 492	2. 23
	BMAUA	34	84	1:03	0. 56	0.012	0.01
16	RIO ESTRELA	23	80	16.19	18. 47	0. 420	0.63
	RIO IGUACU	17	76	31. 93	45. 29	1. 032	1. 54
	RIO SARAPUI		76		43. 98	1. 032	2.04
	BCABO DO BRITO	17	71	25. 30	6.11		
		1 12	11	3.85		0. 204	0.30
	vestern Sub Total	1 0		78. 30	114.41	3, 028	4. 54
	RIO S. J. DE MERITI	9	63	31.88	62.09	1.824	2.73
	RIO IRAJA	11	62	10. 25	11.10	0.612	0.91
	CANAL DO CUNITA	19	49	16.66	13.86	0. 964	1.44
22	BS. CRISTOVAO	23	45	1. 33	1.02	0.076	0.11
		23	43	10, 40	13.07	0.608	0. 91
24	BBOTAFOGO	32	35	7.40	14. 52	0.460	0.69
Weste	ern Sub Total			77. 92	115.66	4.544	6:81
	I. DO GAYANADOR	23	66	3.89	4.63	0.180	0. 27
	I. DO FUNDAO	18	52	0. 26	0.17	0.008	0.01
	1. DE PAQUETA	43	72	0.11	0. 16	0.004	0.00
	I. DO ENGENHO	43	56	0. 25	0.58	0.016	0.02
	1. DE S. CRUZ	41	51	0.14	0. 24	0.008	0.01
	ids Sub Total	<u></u>		4. 65	5. 76	0. 216	0. 32
	load Total			262. 24	313.85	9. 992	14. 98
	rect Load			800.01	7,7,00		111.00
007		43	36		2. 13		
001		46	55		6, 70		
004		46	56 51		2.40		
008		<del></del>			2. 10	<u>-</u>	
009	<u> </u>	40	47		1. 94	: =	
027	<u> </u>	45	52	-	0.80		
034		46	57		0.66		
044		46	57		0.51		
047		46	57	<del>-</del>	0.48	-	·
062		48	59	_	0.38		
113		51	62		0. 22		
Easte	rn Sub Total			_	18. 32	-	-
015	:	17	76	-	1. 32	-	-
018		17	76	-	1. 20	-	-
075		17	76	_	0.33		
029		17	76		0. 79		
086		17	76		0, 31		
137		10	68		0. 16		
	western Sub Total	_111	00		4.11		
	Megretti onn torst	11	E o				
	I	11	62		0.72		<del></del>
030		44	5.0				
030 042		11	62	-	0. 52		<del></del>
030 042 051		32	62 36	-	0.45		
030 042 051 Weste	rn Sub Total			- - -	0.45 1.69		
030 042 051 Weste	t Load Total			262. 24	0.45	- - - 9, 992	14. 98

Table 5.2-1(3) External Load used for simulation in Case 2

	INFLOW	<del></del>				) IN 2010	
				Discharge		PO4-P	0-P
NO	NAME		J	(m3/s)	(t/day)	(t/day)	(t/day)
	ver load						
	BCHARITAS	46	38	1, 27	0.47	0.064	0.09
2		43	39	1.00	0, 37	0.048	0.07
	BCATEDRAR	40	43	0.93	0. 33	0.044	0.06
	BNORTE CENTRO	40	47	1.05	0. 39.	0,052	0.07
	R10 BOMBA	45	52	5.00	2. 86	0. 272	0.40
6	RIO IMBOASSU	52	63	4.30	6, 53	0, 228	0.34
aste	rn Sub Total			13, 55	10. 95	0.708	1.06
7	BITAOCA	52	70	1.00	2. 14	0, 056	0.08
8	RIO ALCANTARA	59	76	14. 75	22. 23	0. 688	1.03
	RIO CACEREBU	60	81	30.89	21. 28	0.496	0. 74
10	RIO GUAPIMIRIN	59	87	33. 25	5. 91	0.128	0.19
11	CANAL DE MAGE	57	88	0.73	0. 55	0.012	0.01
12	RIO RONCADOR	56	88	3. 94	2. 35	0.052	0.07
13	RIO IRIRI	49	90	1.05	0. 69	0.016	0.02
	RIO SURUI	44	87	2. 21	0.88	0.020	0.03
	eastern Sub Total			87. 82	56.03	1.468	2. 20
	BMAVA	34	84	1.03	0.56	0.012	0. 01
	RIO ESTRELA	23	80	16.19	16. 57	0.416	0. 62
	RIO IGUACU	17	76	31. 93	38. 46	1.016	1. 52
	RIO SARAPUI	17	76	25. 30	35. 62	1. 340	2. 01
	BCABO DO BRITO	12	71	3.85	5. 69	0. 204	0. 30
	vestern Sub Total	, , , ,		78.30	96. 90	2. 988	4. 48
	RIO S. J. DE MERITI	9	63	31. 88	43. 68	1. 780	2. 67
	RIO IRAJA	11	62	10. 25	8. 66	0. 604	0. 90
21	CANAL DO CUNHA	19	49	16.66	13.86	0.964	1.4
	BS. CRISTOYAO	23	45	1. 33	0. 95	0. 076	0. 1
23	CANAL DO MANGUE	23	43	10.40	13. 07	0.608	0. 9
	BBOTAFOGO	32	35	7.40	11.00	0.452	0. 67
	rn Sub Total	1 00	00	77. 92	91. 22	4. 484	6. 72
	I. DO GAVANADOR	23	66	3. 89	3. 91	0.176	0. 26
	I. DO GAVARADOR  I. DO FUNDAO	18	52	0. 26	0. 17	0.008	0. 21
	1. DE PAQUETA	43	72	0. 20	0.16	0.004	0.00
	1. DO ENGENHO	43	56	0. 25	0. 56	0.016	0.02
	1. DE S. CRUZ	41	51	0. 23	0. 34	0.018	0. 01
	ds Sub Total	] 41	01	4. 65	5. 04	0. 212	0, 31
	load Total			262. 24	260. 14	9. 860	14, 79
*	rect Load			202.24		3. 000	14, 15
007	rect Load	43	36	_	2. 13		
001		46	55		6. 70		
	<del></del>			1			
004	_ <del></del>	46	56	-	2, 40		
800		44	51		2. 10		
009		40	47		1. 94		
027		45	52	-	0.80		
034		46	57		0.66		
044	<u> </u>	46	57		0.51		
047		46	57		0.48	-	<u> </u>
062		48	59		0.38		
		1 -	6.2	-	0, 22	_	
113	·	51	62	· · · · · · · · · · · · · · · · · · ·		1	
113 Easte	rn Sub Total			-	18. 32		
113 Easte 015	rn Sub Total	17	76	-	18. 32 1. 32		
113 Easte 015 018	rn Sub Total	17	76 76	 	18. 32 1. 32 1. 20	-	
113 Easte 015 018 075	rn Sub Total	17 17 17	76 76 76	   	18. 32 1. 32 1. 20 0. 33		- -
113 Easte 015 018 075 029	rn Sub Total	17	76 76 76 76	- - - -	18. 32 1. 32 1. 20 0. 33 0. 79	-	
113 Easte 015 018 075	rn Sub Total	17 17 17	76 76 76		18. 32 1. 32 1. 20 0. 33	-	
113 Easte 015 018 075 029	rn Sub Total	17 17 17 17	76 76 76 76	- -	18. 32 1. 32 1. 20 0. 33 0. 79	-	- - - -
113 Easte 015 018 075 029 086 137	rn Sub Total	17 17 17 17 17	76 76 76 76 76	- -	18. 32 1. 32 1. 20 0. 33 0. 79 0. 31		-
113 Easte 015 018 075 029 086 137		17 17 17 17 17	76 76 76 76 76	- -	18. 32 1. 32 1. 20 0. 33 0. 79 0. 31 0. 16		-
113 Easte 015 018 075 029 086 137 North		17 17 17 17 17 17 10	76 76 76 76 76 68	- -	18. 32 1. 32 1. 20 0. 33 0. 79 0. 31 0. 16 4. 11		-
113 Easte 015 018 075 029 086 137 North		17 17 17 17 17 17 10	76 76 76 76 76 76 68	- -	18. 32 1. 32 1. 20 0. 33 0. 79 0. 31 0. 16 4. 11 0. 72		-
113 Easte 015 018 075 029 086 137 North 030 042 051	Western Sub Total	17 17 17 17 17 17 10	76 76 76 76 76 68	- -	18. 32 1. 32 1. 20 0. 33 0. 79 0. 31 0. 16 4. 11 0. 72 0. 52 0. 45		
113 Caste 015 018 075 029 086 137 Northwood 042 051 Vester	western Sub Total	17 17 17 17 17 17 10	76 76 76 76 76 68	- -	18. 32 1. 32 1. 20 0. 33 0. 79 0. 31 0. 16 4. 11 0. 72 0. 52		

Table 5, 2-1(4) External Load used for simulation in Case 3-1

RIVER	INFLOW			BYPASSI IN			CASE 3-1
110	n com			Discharge	BOD	P04-P	0-P
NO 12 4	NAME ver load	1_	1	(m3/s)	(t/day)	(t/day)	(t/day)
1	BCHARITAS	46	38	0. 12	0.07	0.008	0.012
2	CANAL CANTO DO RIO	43	39	0. 10	0.06	0.004	0.006
3	BCATEDRAR	40	43	0.09	0.05	0.004	0.006
4	BNORTE CENTRO	40	47	0.10	0.06	0.004	0.006
5	RIO BOMBA	45	52	4.77	6. 07	0. 280	0.420
6	RIO IMBOASSU	52	63	4.30	9.13	0. 232	0.348
Easte	rn Sub Total			9. 48	15. 44	0. 532	0.798
7	BITAOCA	52	70	1.00	2. 14	0.056	0.084
8	RIO ALCANTARA	59	. 76	14. 75	28. 99	0.704	1,056
. 9	RIO CACEREBU	60	81	30.89	22. 90	0.500	0.750
10	RIO GUAPIMIRIN	59	87	33, 25	5. 97	0.132	0.198
11	CANAL DE MAGE	57	88	0.73	0. 55	0.012	0.018
12	RIO RONCADOR	56	88	3. 94	2. 35	0.052	0.078
13	RIO IRIRI	49	90	1.05	0.69	0.016	0. 024
14	RIO SURUI	44	87	2. 21	0.80	0.020	0.030
	eastern Sub Total			87.82	64. 39	1. 492	2. 238
	BMAUA	34	84	1.03	0. 56	0.012	0.018
16	RIO ESTRELA	23	80	16.19	18. 47	0.420	0.630
	RIO IGUACU	17	76	31. 93	45. 29	1.032	1. 548
	RIO SARAPUI	17	76	24. 96	48.59	1, 372	2. 058
18	BCABO DO BRITO	12	- 71	3.79	6. 90	0. 208	0, 312
	western Sub Total			77. 90	119. 81	3.044	4.566
	RIO S. J. DE MERITI	9	63	26.16	59.87	1. 524	2. 286
20	RIO IRAJA	11	62	4.02	8. 59	0. 256	0.384
21	CANAL DO CUNHA	19	49	4.64	9. 04	0. 288	0. 432
	BS. CRISTOVAO	23	45	0.36	0.66	0.020	0.030
23	CANAL DO MANGUE	23	43	5.01	10.94	0. 308	0.462
24	BBOTAFOGO	32	35	5, 91	13. 93	0. 376	0. 564
	rn Sub Total			46.10	103.03	2. 772	4. 158
	1. DO GAYANADOR 1. DO FUNDAO	23	66	3.80	5. 70	0. 184	0. 276
		18 43	52	0.16	0.16	0.004	0.006
	1. DO ENGENHO	43	72 56	0. 11 0. 25	0. 16 0. 56	0.004 0.016	0.006 0.024
	1. DE S. CRUZ	41	51	0. 23	0. 24	0.008	0.024
	ds Sub Total	<u> </u>	. 01	4. 46	6. 82	0. 216	0. 324
	load Total			225. 76	309.49	8. 056	12.084
	rect Load			220.10	000.10	J. 500	10.001
007		43	36		2. 13		
091		46	55		6. 70	. –	
004		46	56		2. 40		-
008		44	51	-	2. 10	-	
009		40	47		1. 94	-	
027		45	52	-	0.80	_	<del></del>
034		46	57	-	0. 56	-	
044		46	57	-	0. 51	_	-
047		46	57		0.48	_	
062		48	59		0.38		-
113		51	62	_	0. 22	-	-
Easte	rn Sub Total			-	18. 32	-	
015		17	76		1. 32		_
018		17	76	-	1. 20		-
075		17	76	-	0. 33	-	4
029		17	76		0.79	-	
086		17	76	-	0. 31	**	_
137		10	68	-	0.16		-
	western Sub Total				4, 11		<u> </u>
030		11	62		0.72		<del>-</del>
		11	62	l <u> </u>	0. 52		
042							
042 051		32	36	-	0.45		
042 051 Weste	rn Sub Total	32	36	-	1.69	-	
042 051 Weste	rn Sub Total t Load Total	32	36	} <del></del> }		- - - 8, 056	- - 12. 084

Table 5.2-1(5) External Load used for simulation in Case 3-2

RIVER	INFLOW			BYPASS2 IN			CASE 3-2
				Discharge	BOD	P04-P	0-P
NO 12 Z	ver load		J	(m3/s)	(t/day)	(t/day)	(t/day)
. <u>IX 1</u>	ver load BCHARITAS	46	38	0.12	0. 08	0.008	0.012
2	CANAL CANTO DO RIO	43	39	0.12	0.06	0.004	0.006
3	BCATEDRAR	40	43	0.09	0.05	0.004	0.006
4	BNORTE CENTRO	40_	47	0.10	0.06	0.004	0.006
5	RIO BOMBA	45	52	4. 77	6.07	0. 280	0.420
6		52_	63	4, 30	9. 13	0. 232	0.348
	rn Sub Total	<del></del>	1 00	9. 48	15. 45	0. 532	0.798
7	BITAOCA	52	70	1.00	2. 14	0.056	0.084
<u>8</u>	RIO ALCANTARA RIO CACEREBU	59 60	76 81	14.75 30.89	28. 99 22. 90	0. 704 0. 500	1.056 0.750
10	RIO GUAPIMIRIN	59	87	33, 25	5. 97	0. 500	0.130
11	<del></del>	57	88	0.73	0. 55	0.012	0.018
12		56	88	3. 94	2. 35	0.052	0.078
13	RIO IRIRI	49	90	1.05	0.69	0, 016	0.024
14	RIO SURUI	44	87	2. 21	0.88	0.020	0.030
North	eastern Sub Total			87. 82	64. 47	1. 492	2. 238
15	BMAUA	34	84	1.03	0, 56	0.012	0.018
16	RIO ESTRELA	23	80	16. 19	18, 47	0.420	0.630
171	RIO IGUACU	17	76	31. 93	45. 29	1.032	1.548
172		17	76	24.96	48. 59	1. 372	2. 058
18	BCABO DO BRITO Western Sub Total	12	71	3. 79 77. 90	6. 90 119. 81	0. 208 3. 044	0.312 4.566
10	RIO S. J. DE MERITI	9	63	31.56	66. 64	1.840	2. 760
20	RIO IRAJA	11	62	4.02	8. 59	0. 256	0.384
21	CANAL DO CUNHA	19	49	4.64	9.04	0. 288	0.432
22	BS. CRISTOVAO	23	45	0.36	0.66	0.020	0.030
23		23	43	5. 01	10. 94	0.308	0.462
24		32	35	5, 91	13. 93	0.376	0. 564
Weste	ern Sub Total			51.50	109.80	3.088	4.632
25	I. DO GAYANADOR	23	66	3. 80	5. 70	0. 184	0. 276
26		18	52	0. 16	0. 16	0.004	0.006
27		43	72 56	0. 11 0. 25	0. 16 0. 56	0.004 0.016	0.006 0.024
<u>28</u>	I. DO ENGENHO I. DE S. CRUZ	43	51	0. 23	0. 36	0.008	0.024
	ds Sub Total	) <u>41.</u> .j		4. 46	6. 82	0. 216	0. 324
	load Total			231.16	316.35	8. 372	12.558
	rect Load						
007		43	36	_	2. 13	-	
001		46	55	<del>-</del> .	6. 70	-	
004		46	56	-	2. 40		
008		44	51		2, 10		
009		40	47	-	1. 94	-	
027	:	45	52	-	0.80		
034		46	57	-	0.66	-	
044 047		46	57 57		0.51 0.48		<del></del>
062		48	59		0.48		
113		51	62	_	0. 22		
	ern Sub Total	لثبنا		-	18. 32		
015	:	17	76	-	1. 32	-	
018		17	76	_	1, 20	_	
075		17	76		0.33	- ]	
029		17	76	<u> </u>	0.79	-	
086		17	76		0.31	-	
137		10	68	· -	0.16	-	
	western Sub Total				4.11		
030		11	62	-	0.72		
042		11 32	62 36		0, 52		
	ern Sub Total	ا ۵۷	JU		1.69		
	t Load Total			~	24. 11		<del>-</del>
Total				231. 16	340. 46	8. 372	12. 558
			~~~~				

Table 5.2-1(6) External Load used for simulation in Case 3-3

RIVER	INFLOW			BYPASS3-2 1	N 2010		CASE 3-3
		T		Discharge	BOD	P04-P	0-P
NO L	NAME		J	(m3/s)	(t/day)	(t/day)	(t/day)
	ver load BCMARITAS	140	90	0.10	0.00	0.000	0.012
2	CANAL CANTO DO RIO	46	38 39	0.12 0.10	0.08 0.06	0, 008 0, 004	0.012
	BCATEDRAR	40	43	0.10	0.05	0.004	0.006
4	BNORTE CENTRO	40	47	0.10	0.05	0.004	0.006
	RIO BOMBA	45	52	4.54	6.07	0. 268	0. 402
	RIO IMBOASSU	52	63	4. 30	9. 13	0. 232	0. 348
	rn Sub Total	02		9. 25	15. 45	0. 520	0. 780
7	BITAOCA	52	70	1.00	2. 14	0.056	0.084
8	RIO ALCANTARA	59	76	14.75	28. 99	0.704	1.056
9	RIO CACEREBU	60	81	30.89		0. 500	0.750
10	RIO GUAPIMIRIN	59	87	33. 25	5. 97	0. 132	0. 198
11	CANAL DE MAGE	57	88	0.73	0.55	0.012	0.018
12	RIO RONCADOR	- 56	88	3, 94	2. 35	0.052	0.078
13	RIO IRIRI	49	90	1.05	0.69	0.016	0. 024
14	RIO SURUI	44	87	2. 21	0.88	0.020	0.030
Northe	eastern Sub Total			87.82	64.47	1.492	2. 238
	B MAUA	34	84	1.03	0.56	0.012	0.018
	RIO ESTRELA	23	80	16.19	18.47	0.420	0. 630
	RIO IGUACU	17	76	31.93	45. 29	1. 032	1.548
	RIO SARAPUI	17	76	24. 63	48.59	1. 356	2.034
	BCABO DO BRITO	12	71	3. 73	6. 90	0. 204	0. 306
	restern Sub Total			77. 51	119.81	3. 024	4. 536
	RIO S. J. DE MERITI	9	63	31. 25	66.64	1.820	2. 730
	RIO IRAJA	11	62	9. 57	16. 25	0.608	0.912
21	CANAL DO CUNHA	19	49	4.64	9.04	0. 288	0. 432
	BS. CRISTOVAO	23	45	0.36	0.66	0.020	0. 030
	CANAL DO MANGUE	23	43	5.01	10.94	0.308	0.462
	BBOTAFOGO	32	35	5. 91	13. 93	0. 376	0. 564
	rn Sub Total	00		56.74	117. 46	3. 420	5. 130
	I. DO GAYANADOR	23	66	3.71	5. 70	0, 176	0. 264
	I. DO FUNDAO  I. DE PAQUETA	18	52 72	0.16	0. 16 0. 16	0.004	0.006
	I. DO ENGENNO	43	56	0.11	0. 16	0, 004 0, 016	0.006 0.024
	I. DE S. CRUZ	41	51	0.23	0. 34	0.008	0.024
	ds Sub Total	41	31	4, 37	6.82	0. 208	0. 312
	load Total			235. 69	324. 01	8. 664	12. 996
	rect Load				V84. U1		14,000
007		43	36	-	2. 13		_
001	<del></del>	46	55		6. 70		_
004		46	56		2.40	-	
008		44	51	-	2. 10		
009		40	47	_	1.94	_	
027		45	52		0.80	-	-
034		46	57		0.66		
044		46	57		0.51		_
047		46	57		0. 48		-
062		48	59	-	0.38		·
113		51	62	-	0. 22	_	
	rn Sub Total				18. 32		
015		17	76		1. 32		
018		17	76		1. 20		
075	· · · · · · · · · · · · · · · · · · ·	17	76		0. 33	**	
029	· · · · · · · · · · · · · · · · · · ·	17	76		0.79	<del>-</del> -	: -
086	·	17	76	ļ	0.31		
137		10	68	-	0.16		-
	restern Sub Total	1 1		[	4. 11		
030		11	62		0.72		<del>-</del> .
042		11	62		0.52		
051	. D.1 7.7.3	32	36	- <u>-</u>	0.45		· · · · · <del>·</del>
	n Sub Total				1.69		
	t Load Total			205.20	24. 11		**
Total				235, 69	348. 12	8, 664	12. 996

Table 5. 2-1(7) External Load used for simulation in Case 3-4

RIVER	INFLOW			BYPASS4 IN	2010	. (	CASE 3-4
				Discharge	BOD	P04-P	0-P
NO	NAME	1_1_	J	(m3/s)	(t/day)	(t/day)	(t/day)
Ri	ver load						
1	BCHARITAS	46	38	0.12	0.08	0.008	0.012
2	CANAL CANTO DO RIO	43	39	0.10	0,06	0.004	0.006
3	BCATEDRAR	40	43	0.84	0.91	0.044	0.066
4	BNORTE CENTRO	40	47	0. 95	1.06	0.052	0.078
1	RIO BOMBA	45	52	4.54	6. 07	0. 268	0.402
6	RIO IMBOASSU	52	63	4, 30	9. 13	0, 232	0.348
	rn Sub Total	52	70	10.85 1.00	17. 31 2. 14	0. 608 0. 056	0. 912 0. 084
1 7	BITAOCA R10 ALCANTARA	59	76	14.75	28. 99	0.704	1.056
8		60	81	30.89	22. 90	0. 104	0. 750
<u> </u>	RIO CACEREBU RIO GUAPIMIRIN	59	87	33, 25	5. 97	0. 132	0, 130
10	CANAL DE MAGE	57	88	0.73	0. 55	0. 132	0. 018
11	RIO RONCADOR	56	88	3.94	2. 35	0.012	0.078
	RIO IRIRI	49	90	1.05	0. 69	0.032	0.018
	RIO SURUI	44	87	2. 21	0.88	0.020	0.030
	leastern Sub Total	1 44	VI	87. 82	64. 47	1. 492	2, 238
}	BMAUA	34	84	1.03	0, 56	0.012	0.018
	RIO ESTRELA	23	80	16. 19	18. 47	0.420	0.630
	RIO IGUACU	17	76	31, 93	45. 29	1. 032	1. 548
	RIO SARAPUI	17	76	24. 63	48. 59	1. 356	2. 034
	BCABO DO BRITO	12	71	3, 73	6. 90	0. 204	0. 306
	western Sub Total	1.0		77. 51	119.81	3. 024	4. 536
	RIO S. J. DE MERITI	9	63	31. 25	66. 65	1. 820	2. 730
	RIO IRAJA	11	62	9. 57	16. 25	0.608	0. 912
21	CANAL DO CUNHA	19	49	15.33	23.75	0.956	1.434
22	BS. CRISTOVAO	23	45	1. 22	1.77	0.072	0. 108
23	CANAL DO MANGUE	23	43	9. 81	17. 45	0. 604	0.906
24	BBOTAFOGO	32	35	5, 91	13. 93	0.376	0. 564
	rn Sub Total	1		73.09	139.80	4. 436	6.654
	I. DO GAVANADOR	23	66	3. 71	5. 70	0. 176	0. 264
26	I. DO FUNDAO	18	52	0. 25	0. 21	0.008	0.012
27		43	72	0.11	0. 16	0.004	0.006
28	1. DO ENGENHO	43	56	0. 25	0. 56	0.016	0. 024
29	1. DE S. CRUZ	41	51	0.14	0. 24	0.008	0.012
Islan	ds Sub Total			4. 46	6. 87	0. 212	0. 318
River	load Total			253. 73	348. 26	9. 772	14. 658
Di	rect Load						
007		43	36		2. 13	-	
001		46	55		6. 70	-	
004		46	56		2. 40		~
800		44	51		2. 10		
009		40	47		1. 94		
027		45	52	<u>-</u>	0.80		
034		46	57		0.66		
044		46	57	-	0. 51		
047		46	57	-	0.48		
062		48	-59		0. 38		
113	L. <u>.</u>	51	62	· -	0. 22		
	rn Sub Total				18. 32		
015	<u> </u>	17	76		1. 32		
018		17	76		1. 20		
075		17	76		0. 33		
029		17	76		0.79	-	
086	·	17	76	-	0.31		
137		10	68	<del>-</del>	0.16		<del></del>
	western Sub Total				4.11		
030	<u> </u>	11	62		0.72		<del></del>
042		11	62	~ '	0.52		
051	an Pub Tatal	32	36		0. 45 1. 69		
	rn Sub Total		·				<del></del>
	t Load Total			253.73	24. 11 372. 37	9. 772	14.658
Total				453. 15	316.31	3.114	14.008

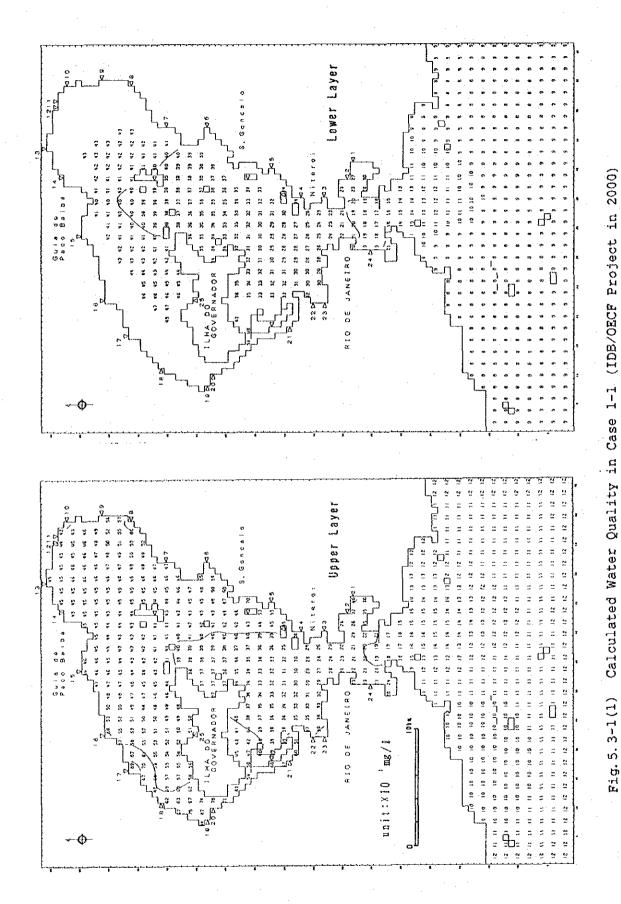
Table 5.2-2 External Load from Sub-Basin Groups

Case	Sub Basin	Discharge	BOD	P04-P	0-P
0400	Group	(m3/s)	(t/day)	(t/day)	(t/day)
· · · · · · · · · · · · · · · · · · ·	East	12. 41	35, 57	0.65	0.98
	Northeast	84. 23	55, 58	1. 28	1. 92
CASE11	Northwest	71.63	107. 01	2. 60	3. 91
ONOBI	West	74. 38	135, 78	4. 38	6. 57
· .	Islands	4. 51	6. 56	0. 20	0. 31
	Total	247. 16		9. 12	13. 68
	East		340. 49 31. 87	0.71	13.08
		13. 55			· · · · · · · · · · · · · · · · · · ·
04004 6	Northeast	87. 82	64. 47	1.49	2. 24
CASE1-2	Northwest	78. 30	118. 52	3.03	4. 54
	West	77. 92	117. 35	4. 54	6. 82
	Islands	4. 65	5. 76	0. 22	0. 32
	Total	262. 24	337. 96	9. 99	14. 99
	Bast	13. 55	29. 27	0. 71	1.06
	Northeast	87. 82	56.03	1. 47	2. 20
CASE2	Northwest	78. 30	101.01	2. 99	4. 48
	West	77. 92	92. 91	4. 48	6. 73
	Islands	4. 65	5.04	0. 21	0. 32
	Total	262. 24	284. 25	9. 86	14. 79
	East	9. 48	33. 76	0. 53	0.80
	Northeast	87.82	64. 39	1. 49	2. 24
CASE3-1	Northwest	77. 90	123. 92	3.04	4. 57
	West	46. 10	104. 72	2.77	4. 16
	Islands	4. 46	6. 82	0. 22	0.32
	Total	225. 76	333. 60	8.06	12.08
	East	9. 48	33. 77	0.53	0.80
	Northeast	87. 82	64.47	1.49	2. 24
CASE3-2	Northwest	77. 90	123. 92	3.04	4. 57
	West	51.50	111. 49	3.09	4.63
	Islands	4.46	6.82	0. 22	0. 32
	Total	231. 16	340.46	8. 37	12. 56
	East	9, 25	33. 77	0. 52	0, 78
	Northeast	87.82	64. 47	1.49	2. 24
CASE3-3	Northwest	77. 51	123. 92	3. 02	4. 54
	West	56.74	119. 15	3. 42	5. 13
	Islands	4.37	6. 82	0. 21	0.31
	Total	235. 69	348. 12	8.66	13.00
	East	10.85	35, 63	0. 61	0. 91
	Northeast	87. 82	64. 47	1. 49	2. 24
CASE3-4	Northwest	77. 51	123. 92	3. 02	4. 54
	West	73.09	141.48	4. 44	6. 65
	Islands	4. 46	6. 87	0. 21	0. 32
	Total	253. 73	372. 37	9. 77	14.66

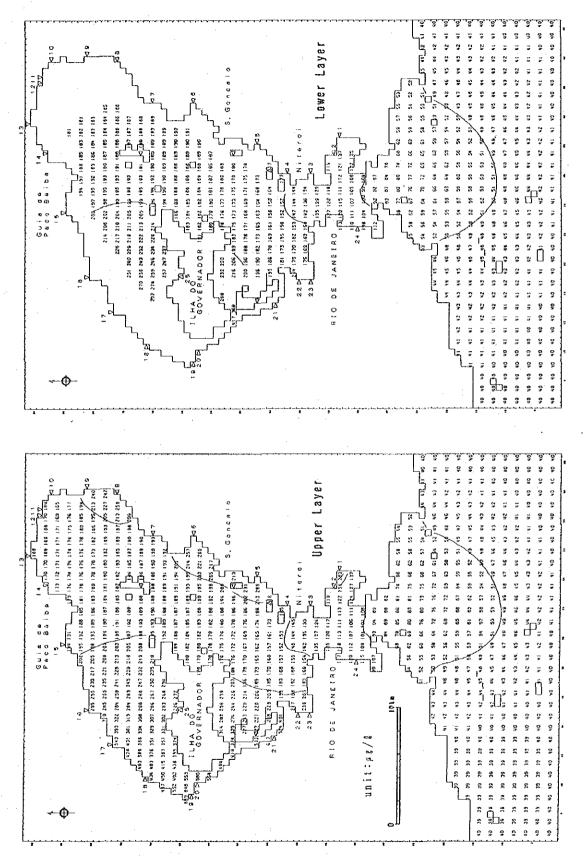
#### 5.3 Results of Calculation

The results of the numerical simulation are shown in figures as concentration distributions. The contents of figures are as follows;

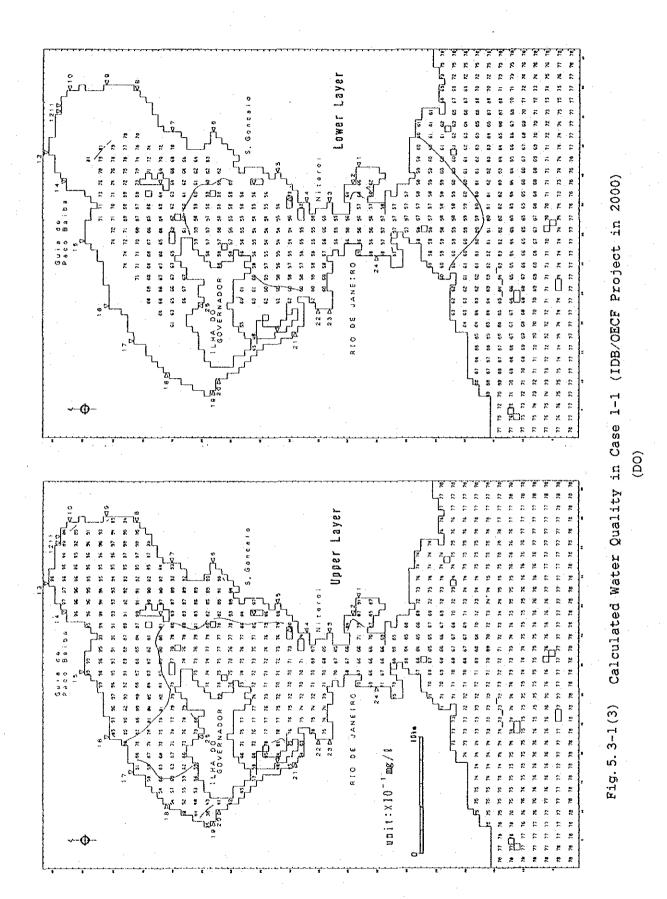
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Fig. 5.3-1: BOD, T-P, DO, PO,-P and O-P distribution for Case 1-1.
Fig. 5.3-2: BOD, T-P, DO, PO4-P and O-P distribution for Case 1-2.
Fig. 5.3-3: BOD, T-P, DO, PO<sub>4</sub>-P and O-P distribution for Case 2.
Fig. 5.3-4: BOD, T-P, DO, PO,-P and O-P distribution for Case 3-1.
Fig. 5.3-5: BOD, T-P, DO, PO<sub>4</sub>-P and O-P distribution for Case 3-2.
Fig. 5.3-6: BOD, T-P, DO, PO4-P and O-P distribution for Case 3-3.
Fig. 5.3-7: BOD, T-P, DO, PO, -P and O-P distribution for Case 3-4.
Fig. 5.3-8: BOD, T-P and DO distribution for Case 4-1.
Fig. 5.3-9: BOD, T-P and DO distribution for Case 4-2.
Fig. 5.3-10: BOD, T-P and DO distribution for Case 4-3.
            BOD, T-P and DO distribution for Case 5-1.
Fig.5.3-11:
Fig.5.3-12:
            BOD, T-P and DO distribution for Case 5-2.
Fig. 5.3-13: BOD, T-P and DO distribution for Case 5-3.
            BOD, T-P and DO distribution for Case 5-4.
Fig.5.3-14:
Fig. 5.3-15: BOD, T-P and DO distribution for Case 6-1.
Fig.5.3-16:
            BOD, T-P and DO distribution for Case 6-2.
            BOD, T-P and DO distribution for Case 6-3.
Fig.5.3-17:
Fig. 5.3-18: BOD, T-P and DO distribution for Case 6-4.
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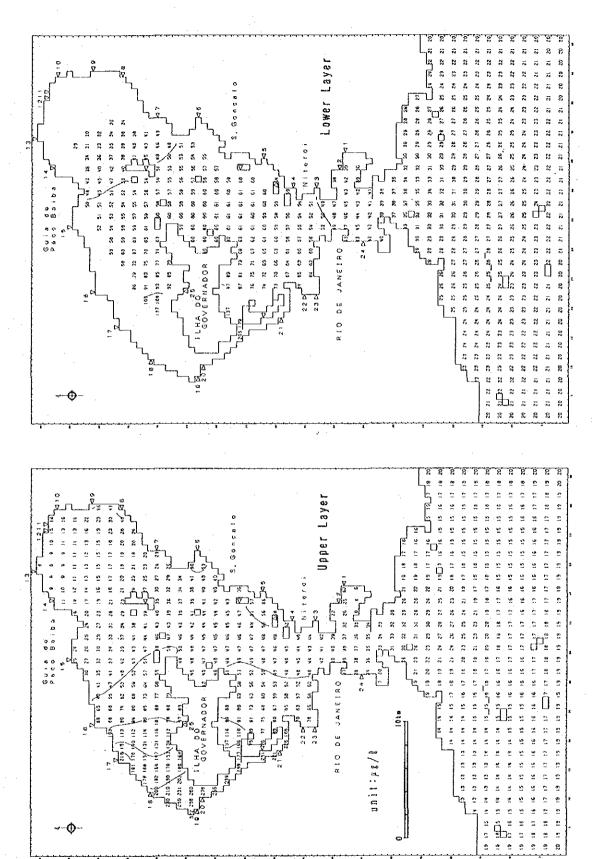


(BOD)



Calculated Water Quality in Case 1-1 (IDB/OECF Project in 2000) Fig. 5.3-1(2)





Calculated Water Quality in Case 1-1 (IDB/OECF Project in 2000) Fig. 5. 3-1(4)

 $(PO_4 - P)$ 

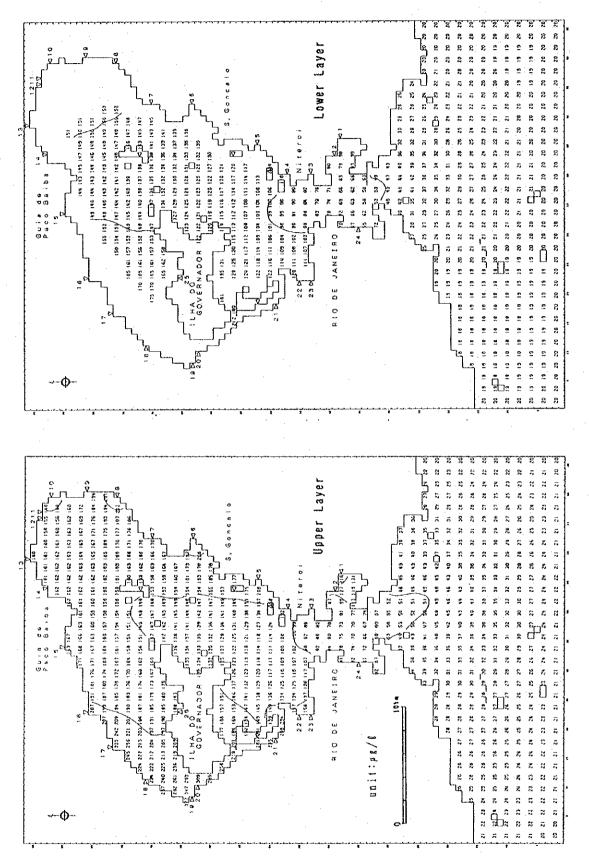


Fig. 5.3-1(5) Calculated Water Quality in Case 1-1 (IDB/OECF Project in 2000)

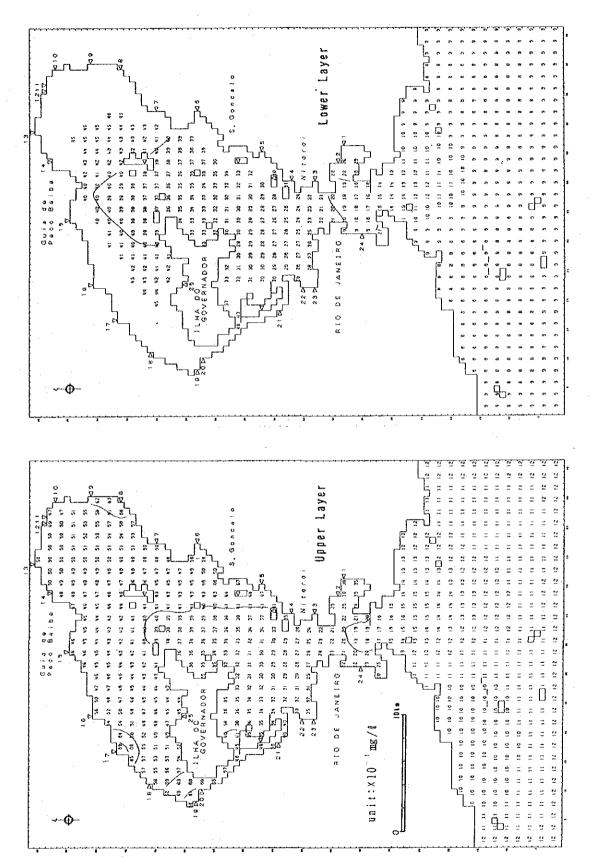
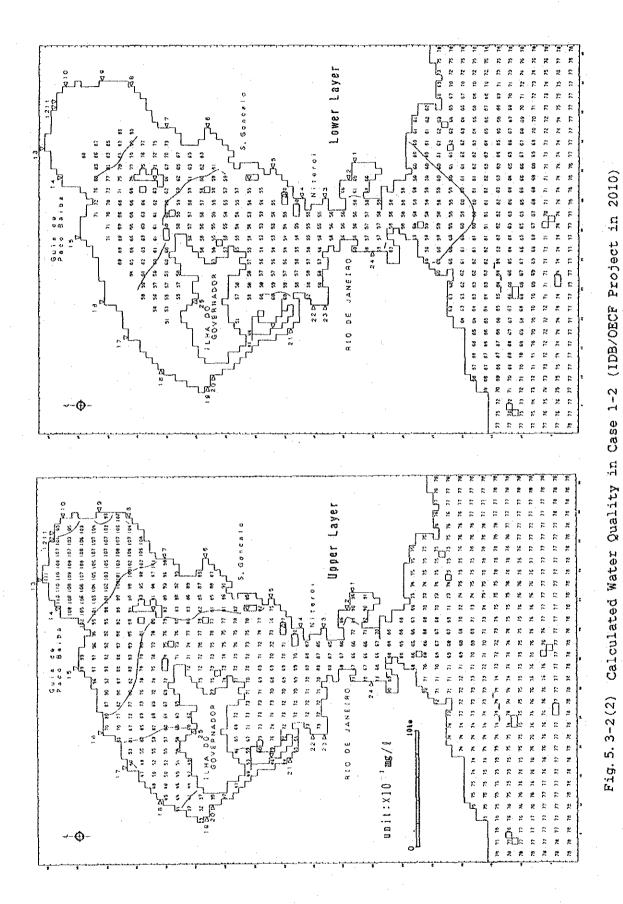
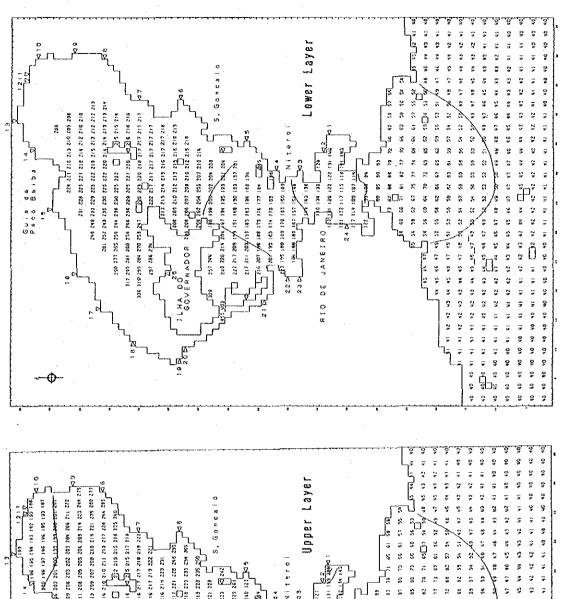


Fig. 5. 3-2(1) Calculated Water Quality in Case 1-2 (IDB/OECF Project in 2010)



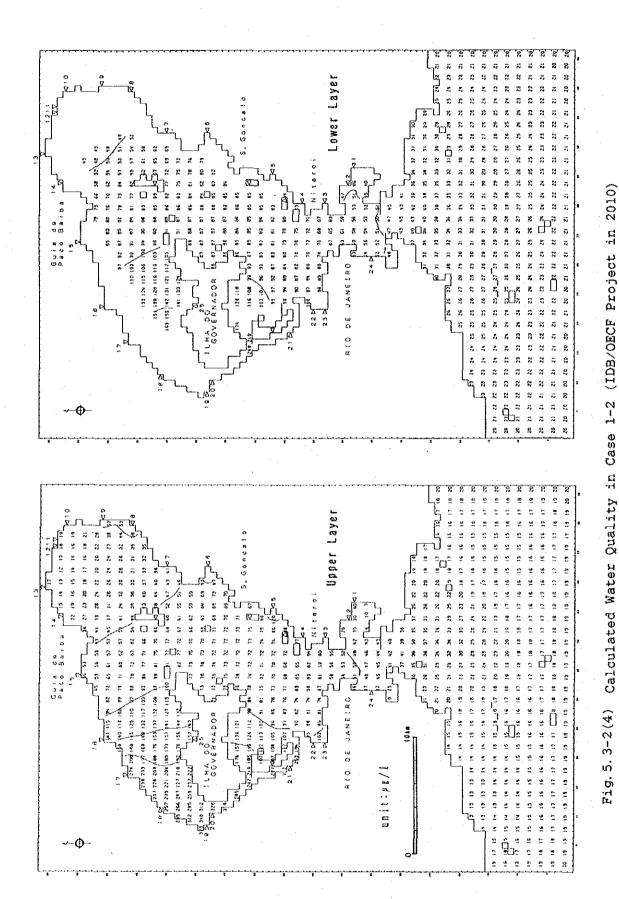
(<u>0</u>0

5-18

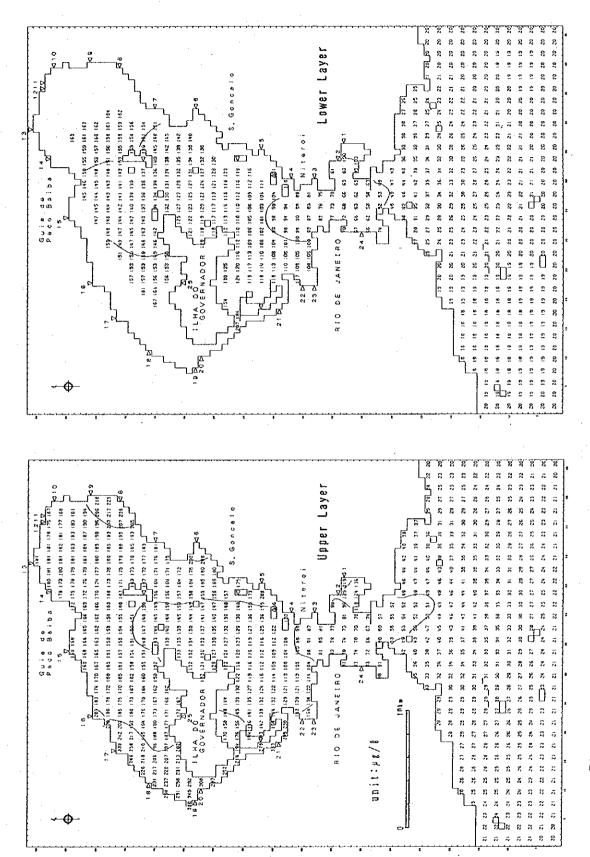


25 531 247 274 257 243 233 225 229 215 213 209 207 208 216 214 221 235 266 277 14 207 262 252 235 230 224 219 215 211 208 205 205 206 205 214 223 244 27 262 NR 922 CIZ CIZ CIZ 112 DIZ BIZ HIZ CIZ 122 922 SEZ LNZ Z62 842 DOS 636 226 064 OPE 275 215 215 215 22 25 55 | 🔘 10 12 125 275 755 755 305 305 306 255 306 107 108 108 26 203 201 MOG 132 202 345 4 25 2 2 3 2 4 12 7 17 5 3 15 4 12 555 VELL 65 555 505 505 505 605 775 100 120 555 505 505 505 505 505 505 505 122 222 612 112 216 217 218 222 237 162 622 KIZ 912 S12 N12 513 513 92 265 205 212 219 228 235 250, RIO DE JANETRO FILIPISI ISTERIO Fel 194 178 202 202 202 218 128 MT 20 311 211 221 38 220 243 228 210 /94 145 182 386 197 212 240 323 Juse 404 018 242 255 230 367 267 256 629 210 229 229 216 216 Guina Ga Paco Saida STED OF LIES 37 132 (29 305 065 185 075 506 136. 15 503 467 434 407 379 344 327 309 294 46 311 283 265 unit:μg/8 56 56 56 50 OF EE EE EE On

Fig. 5.3-2(3) Calculated Water Quality in Case 1-2 (IDB/OECF Project in 2010)



5-20



Calculated Water Quality in Case 1-2 (IDB/OECF Project in 2010) Fig. 5.3-2(5)

(0-P)

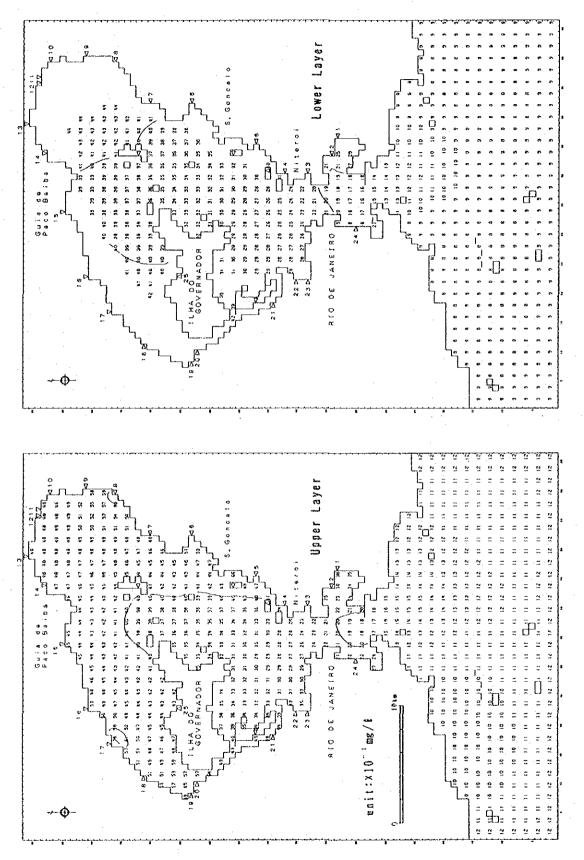
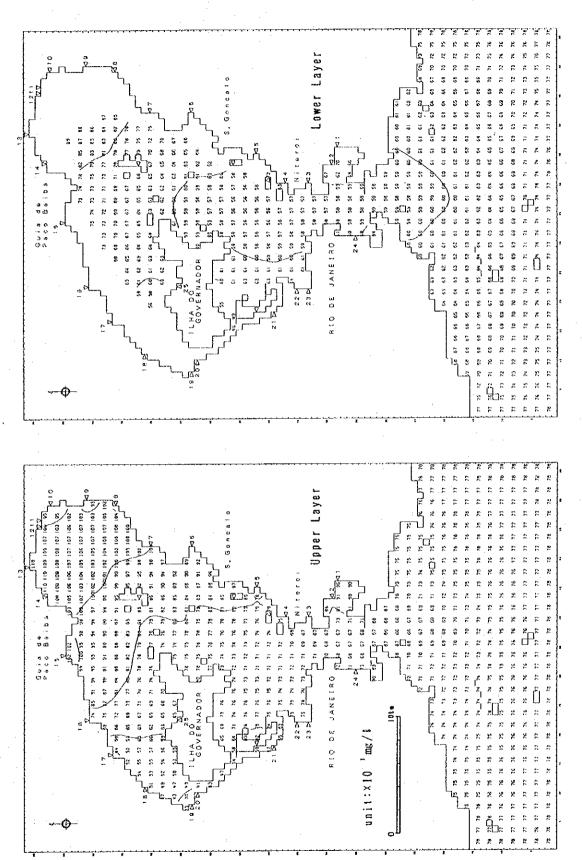
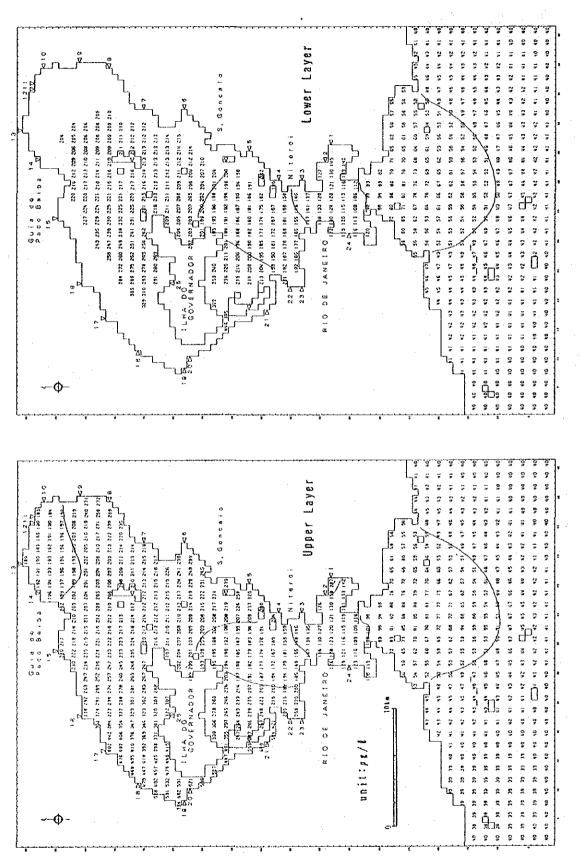


Fig. 5.3-3(1) Calculated Water Quality in Case 2 (IDB/OECF Project and Optional Sewage Treatment in 2010)



Calculated Water Quality in Case 2 (IDB/OECF Project and Optional Sewage Treatment in 2010) Fig. 5.3-3(2)



Calculated Water Quality in Case 2 (IDB/OECF Project and Optional Sewage Treatment in 2010) Fig. 5. 3-3(3)

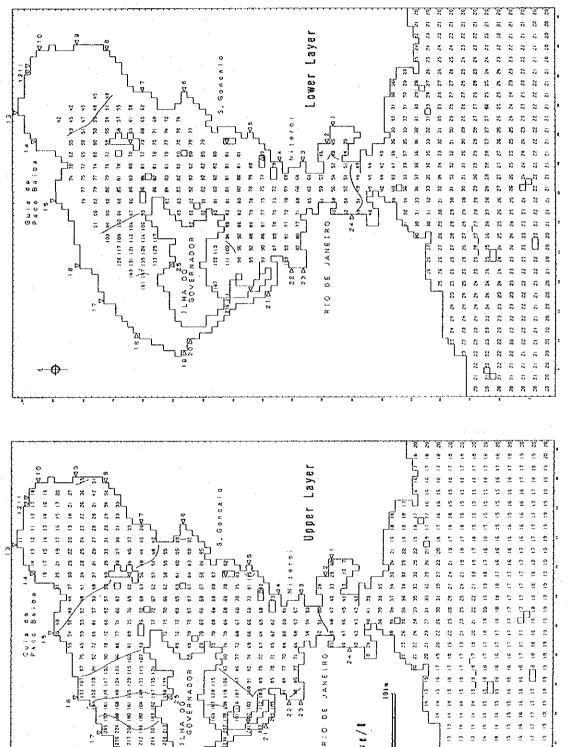
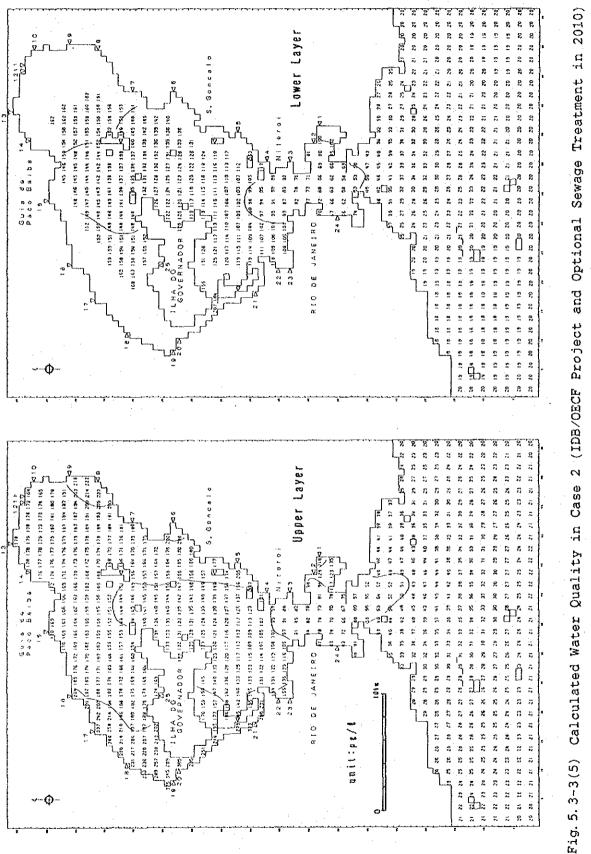
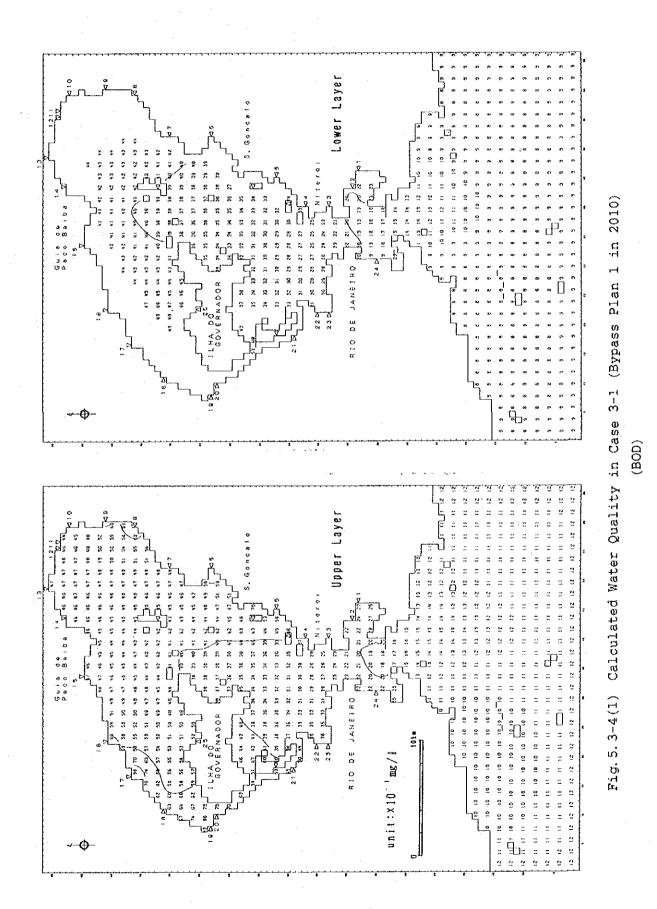


Fig. 5. 3-3(4) Calculated Water Quality in Case 2 (IDB/OECF Project and Optional Sewage Treatment in 2010)

19 17 15





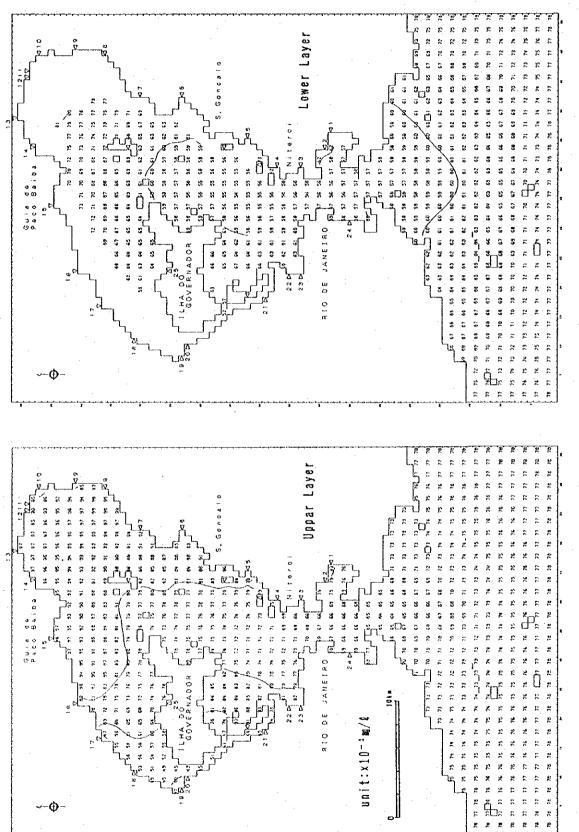


Fig. 5.3-4(2) Calculated Water Quality in Case 3-1 (Bypass Plan 1 in 2010)

(00)

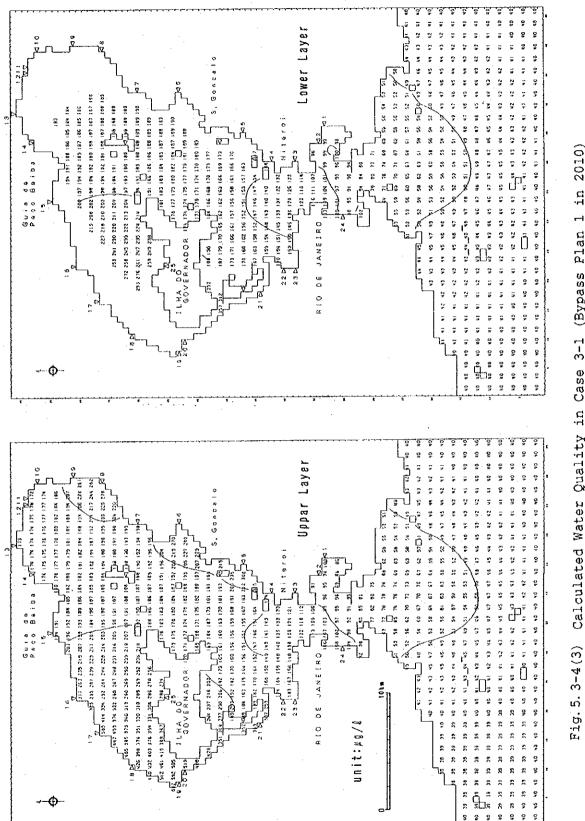
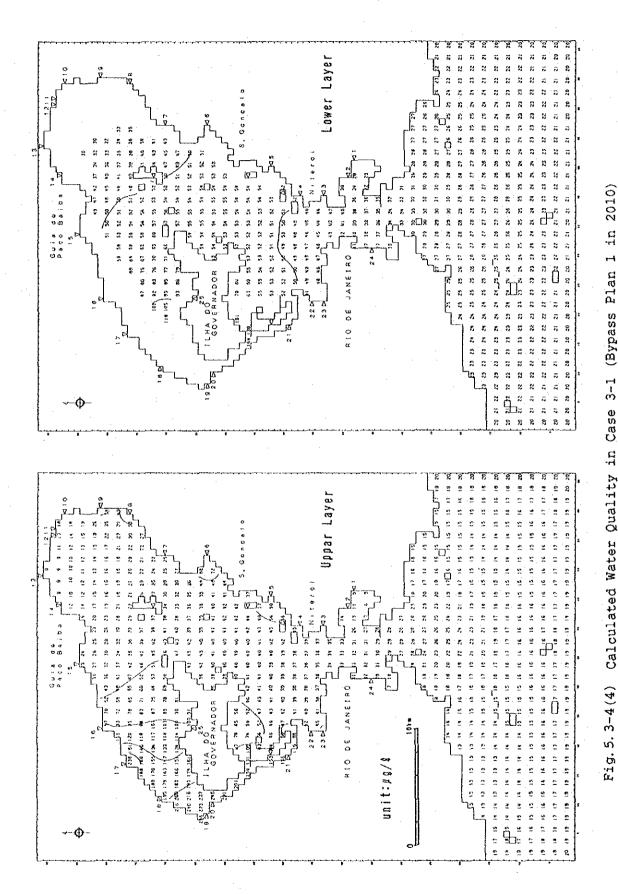


Fig. 5.3-4(3) Calculated Water Quality in Case 3-1 (Bypass Plan 1 in 2010)

(T-P)



5-30

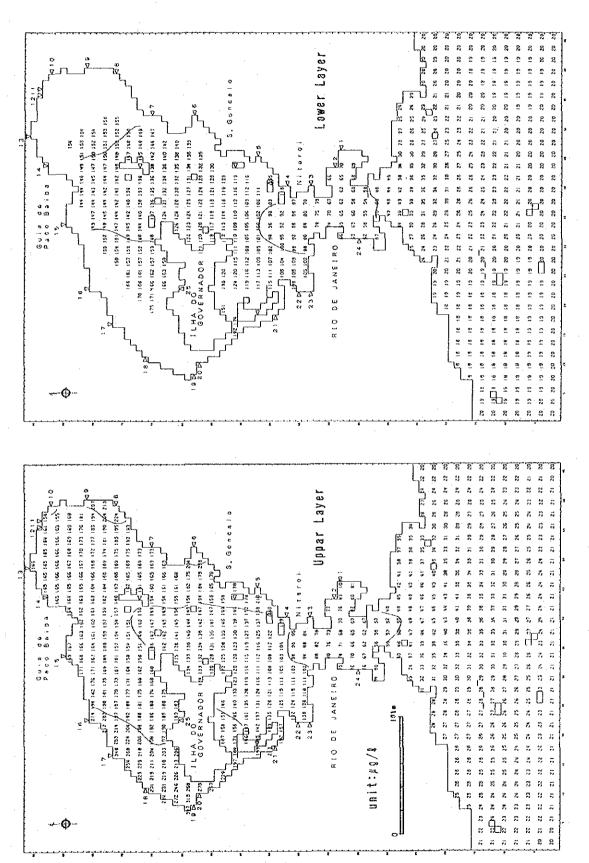


Fig. 5: 3-4(5) Calculated Water Quality in Case 3-1 (Bypass Plan 1 in 2010)

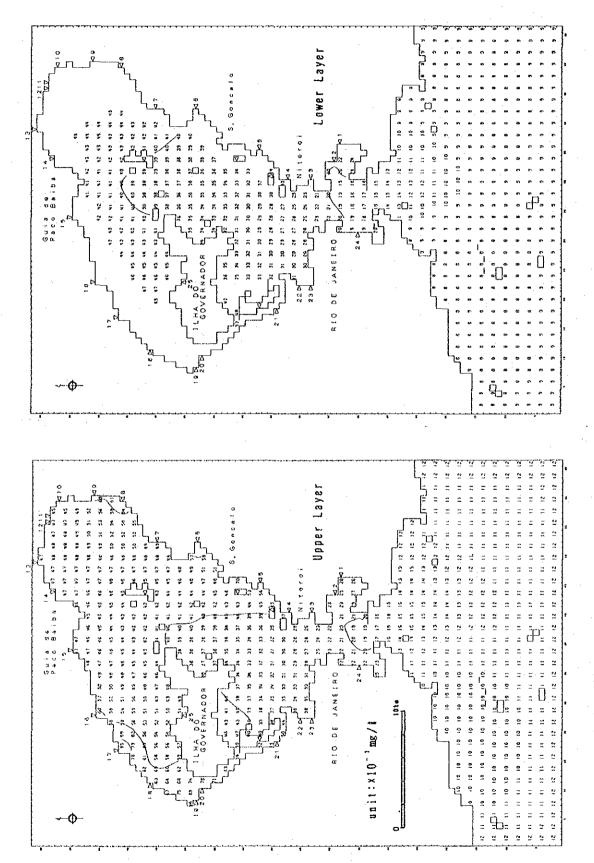
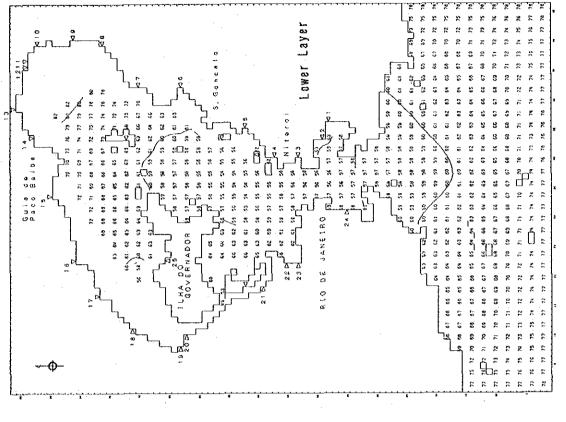


Fig. 5.3-5(1) Calculated Water Quality in Case 3-2 (Bypass Plan 2 in 2010) (BOD)



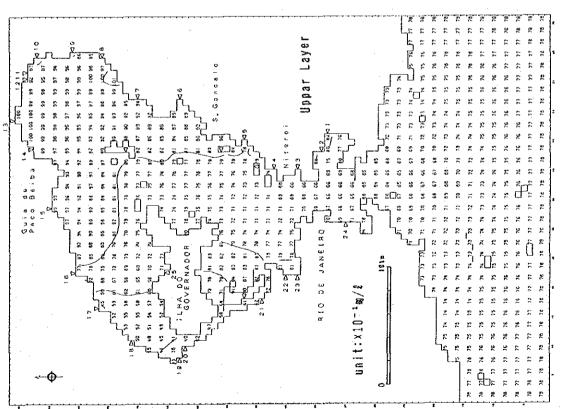
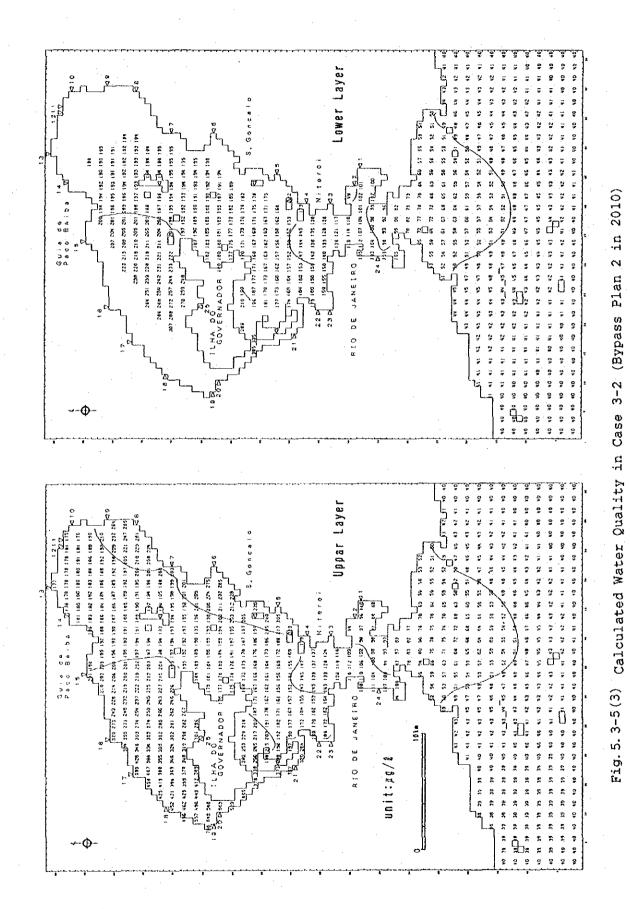
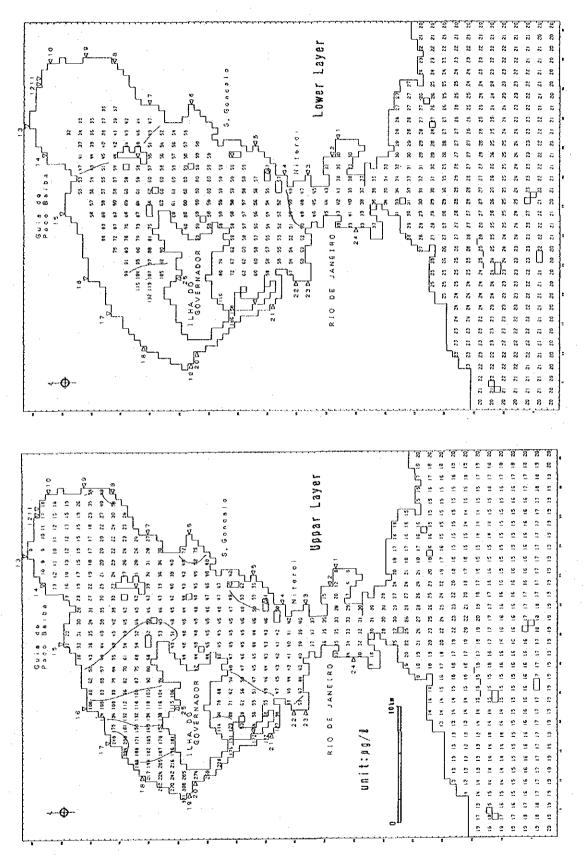


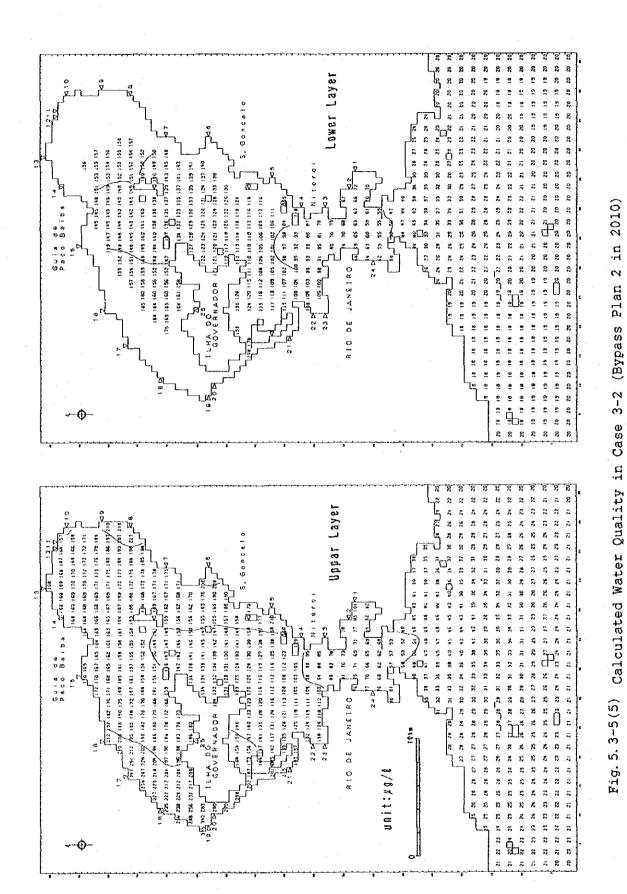
Fig. 5. 3-5(2) Calculated Water Quality in Case 3-2 (Bypass Plan 2 in 2010)



5-34



Calculated Water Quality in Case 3-2 (Bypass Plan 2 in 2010) Fig. 5. 3-5(4)



(0-P)

5-36

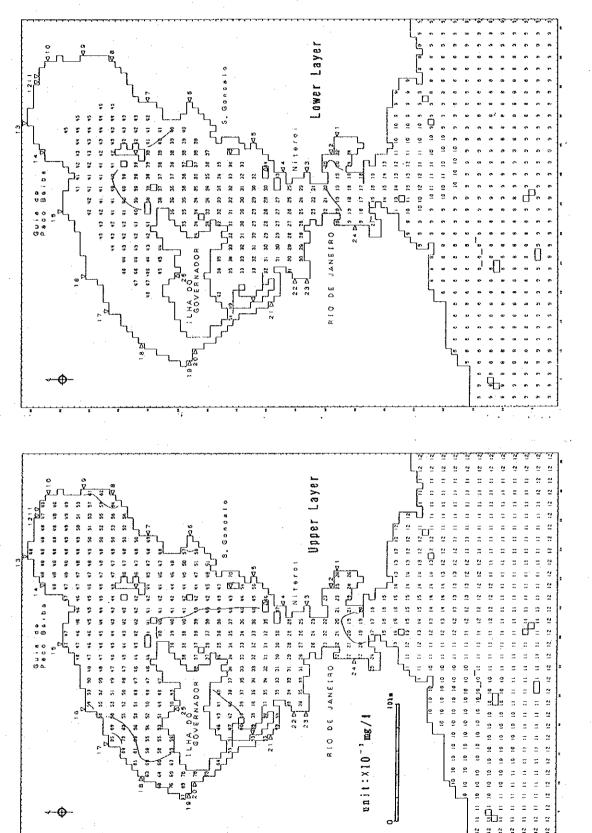


Fig. 5. 3-6(1) Calculated Water Quality in Case 3-3 (Bypass Plan 3 in 2010)

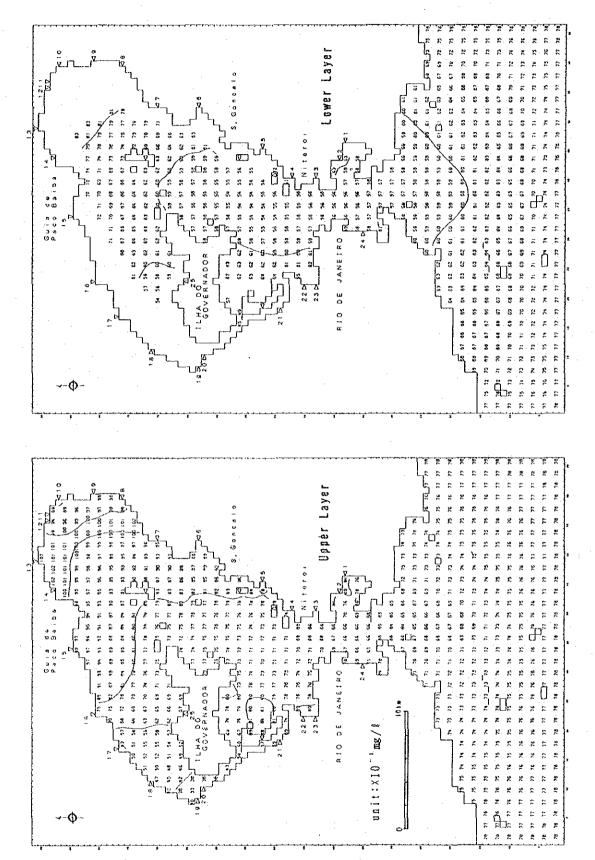
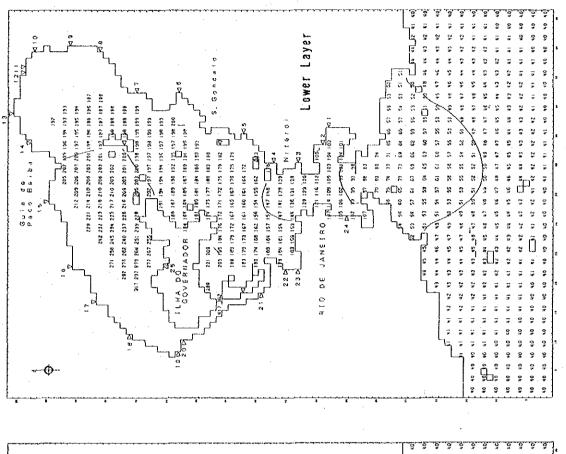


Fig. 5.3-6(2) Calculated Water Quality in Case 3-3 (Bypass Plan 3 in 2010)

9



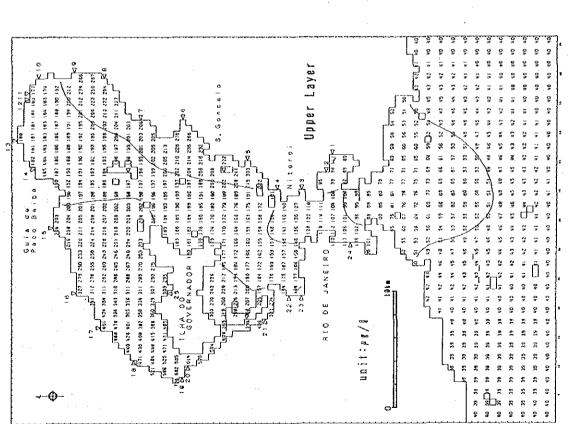


Fig. 5. 3-6(3) Calculated Water Quality in Case 3-3 (Bypass Plan 3 in 2010)

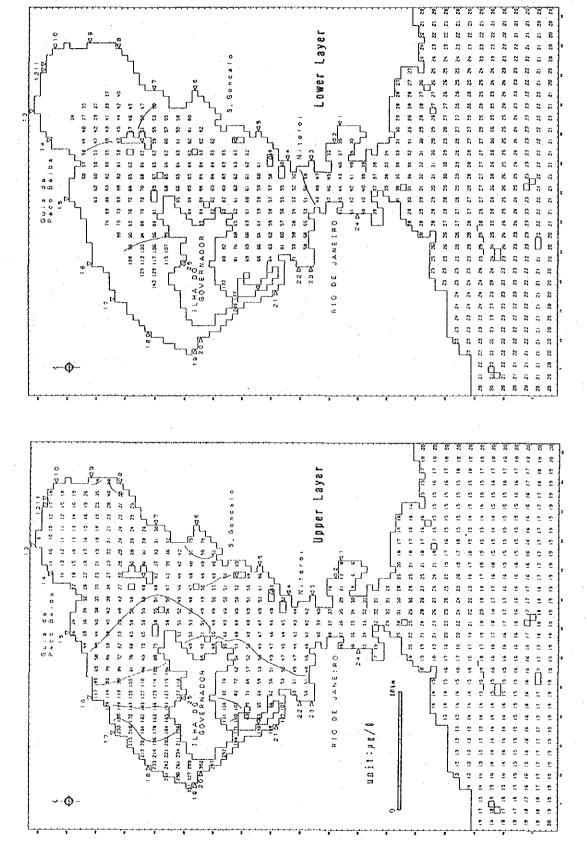
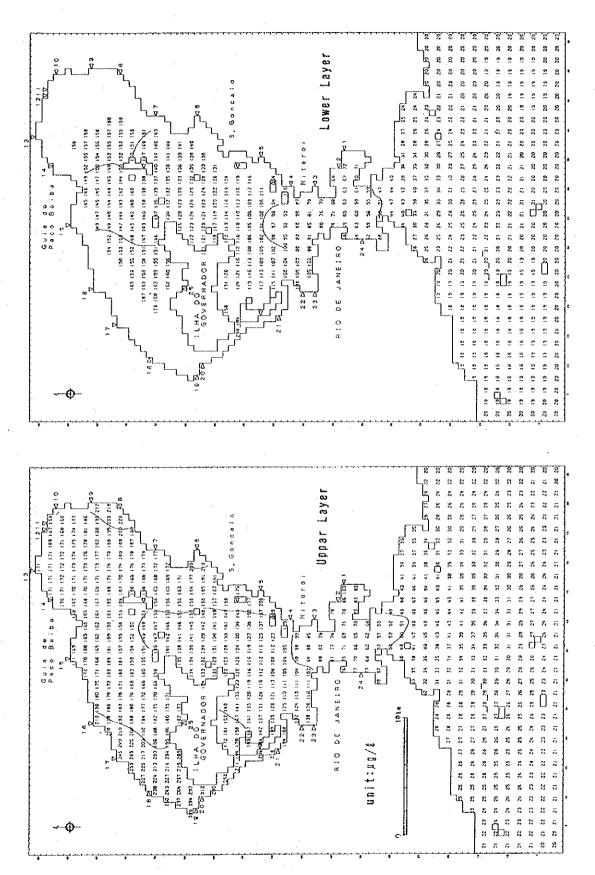


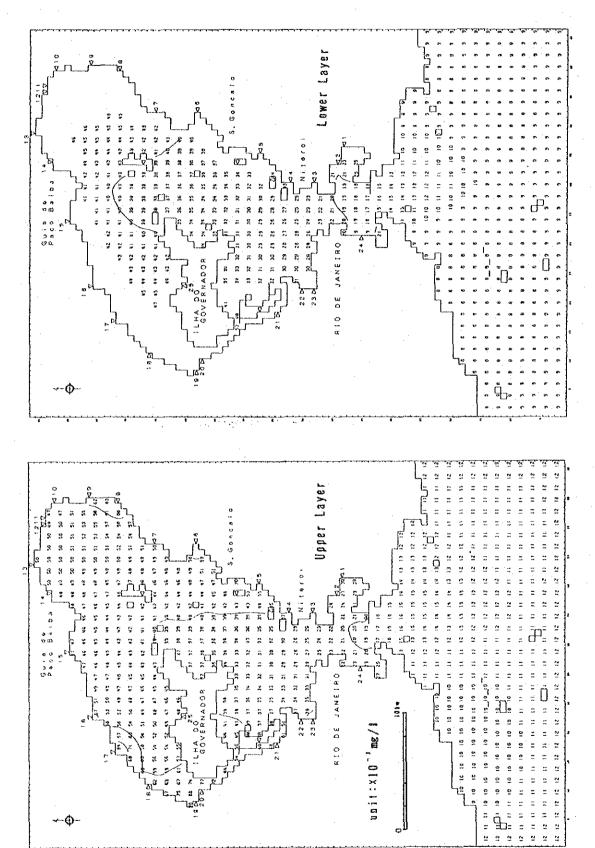
Fig. 5. 3-6(4) Calculated Water Quality in Case 3-3 (Bypass Plan 3 in 2010)

(PO4-P)



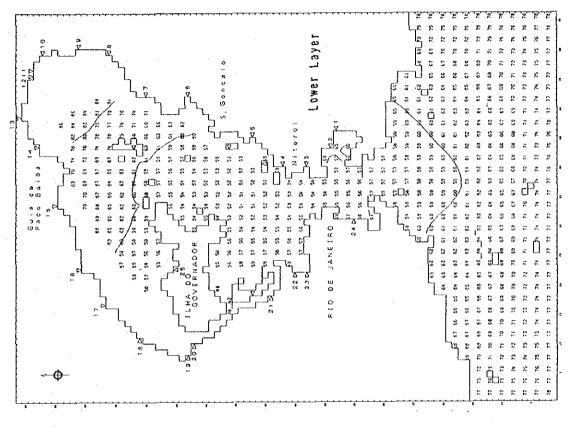
Calculated Water Quality in Case 3-3 (Bypass Plan 3 in 2010) Fig. 5.3-6(5)

(0-P)



Calculated Water Quality in Case 3-4 (Bypass Plan 4 in 2010) Fig. 5. 3-7(1)

(BOD)



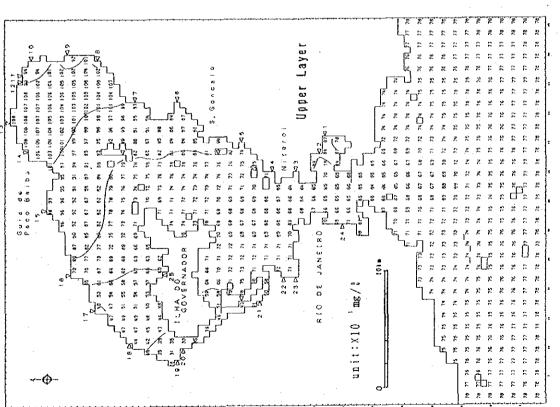
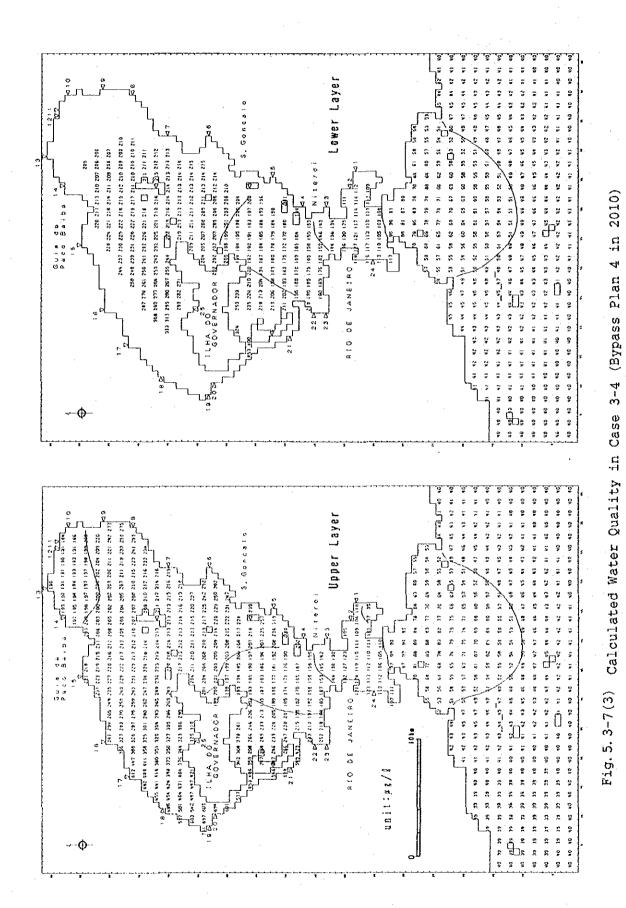
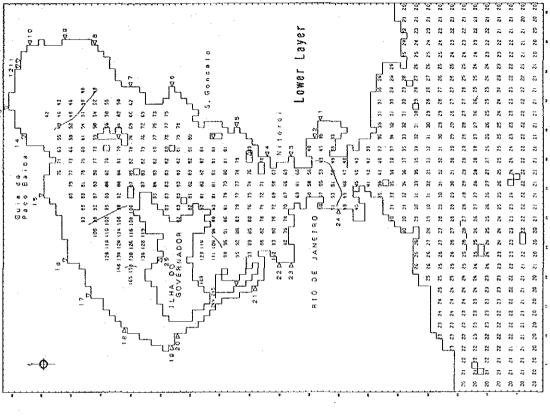


Fig. 5.3-7(2) Calculated Water Quality in Case 3-4 (Bypass Plan 4 in 2010) (00)



(T-P)

5-44



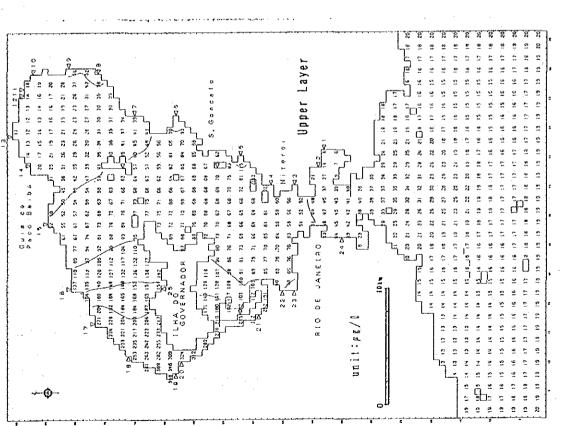


Fig. 5. 3-7(4) Calculated Water Quality in Case 3-4 (Bypass Plan 4 in 2010)

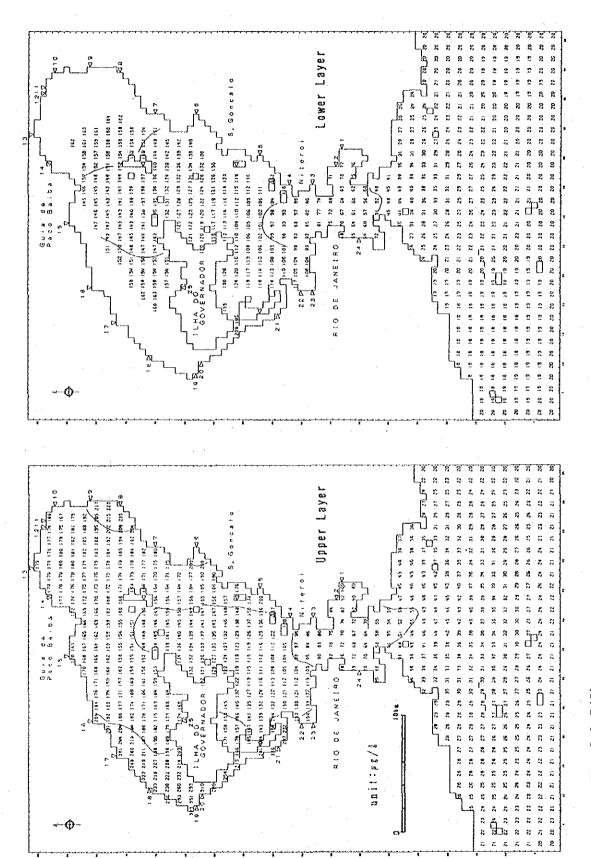
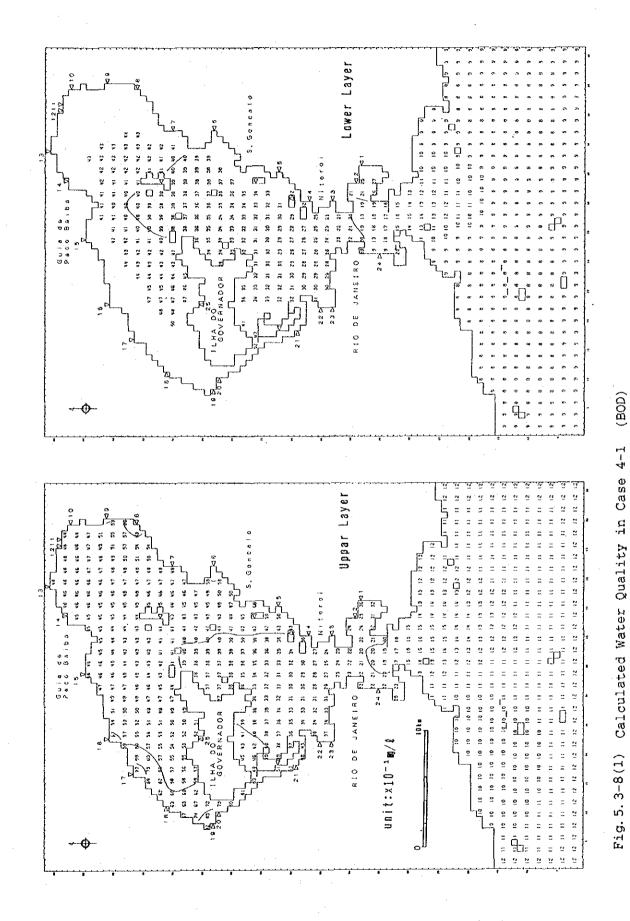
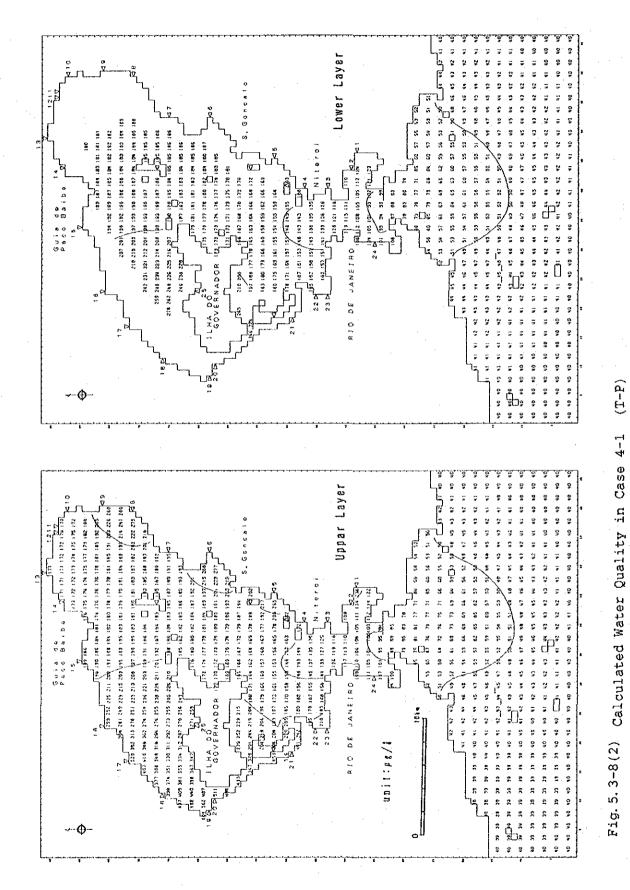


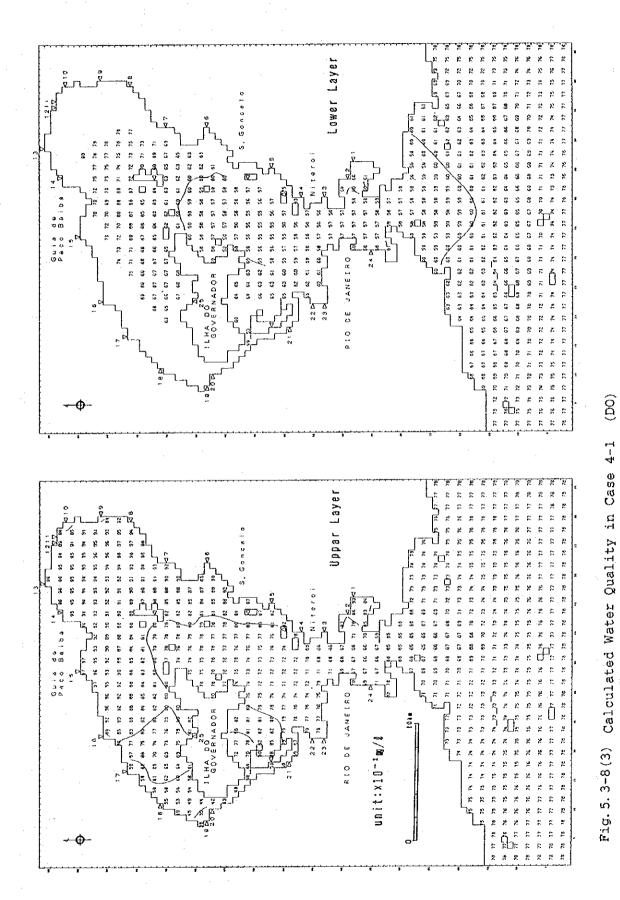
Fig. 5.3-7(5) Calculated Water Quality in Case 3-4 (Bypass Plan 4 in 2010) (O-P)



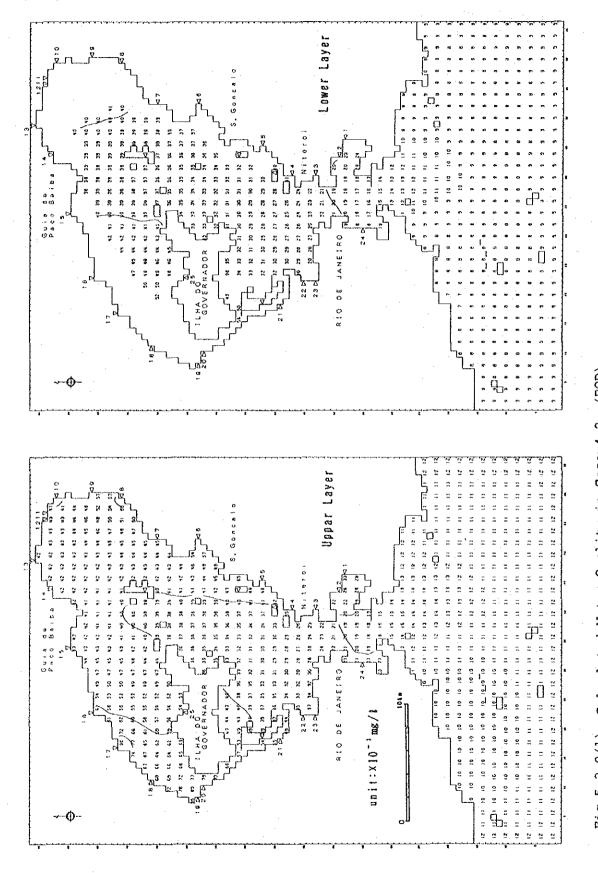
(20% Reducing T-P load from the object rivers of IDB/OECF program in 2010)



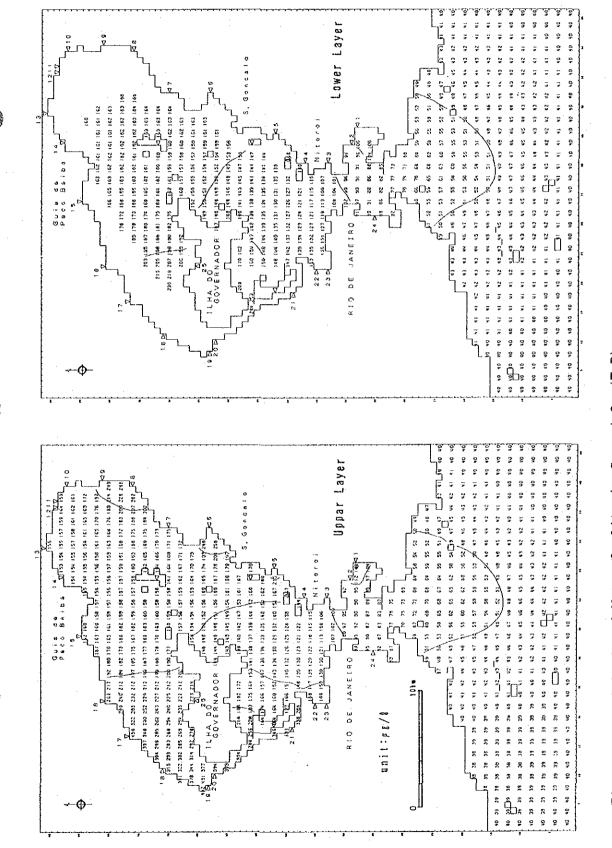
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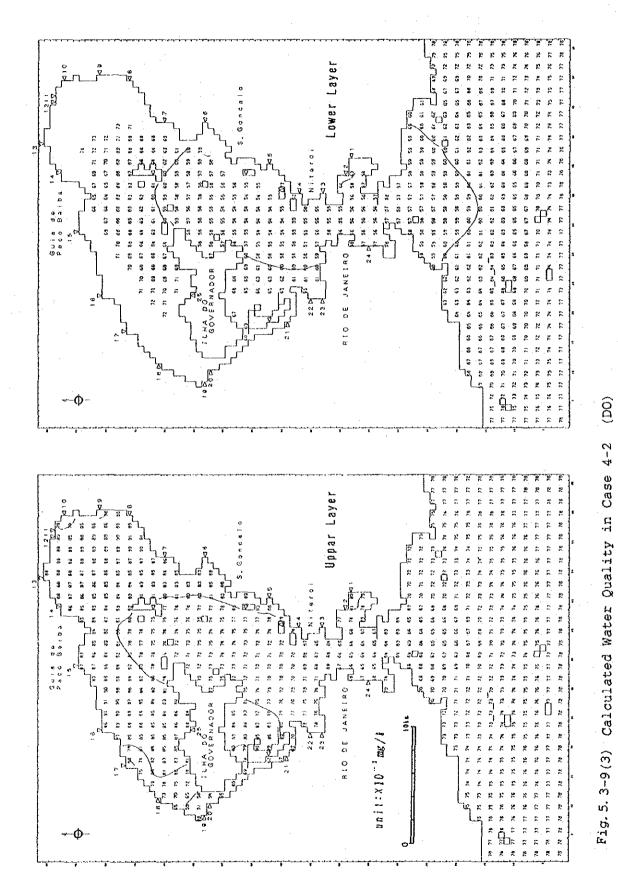
(20% Reducing T-P load from the object rivers of IDB/OECF program in 2010)



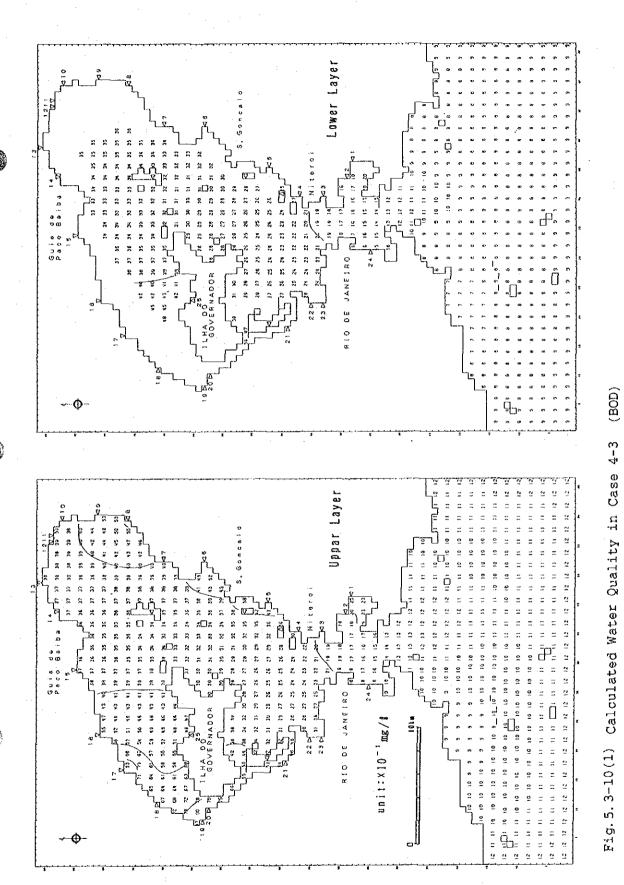
(40% Reducing T-P load from the object rivers of IDB/OECF program in 2010) (BOD) Fig. 5. 3-9(1) Calculated Water Quality in Case 4-2



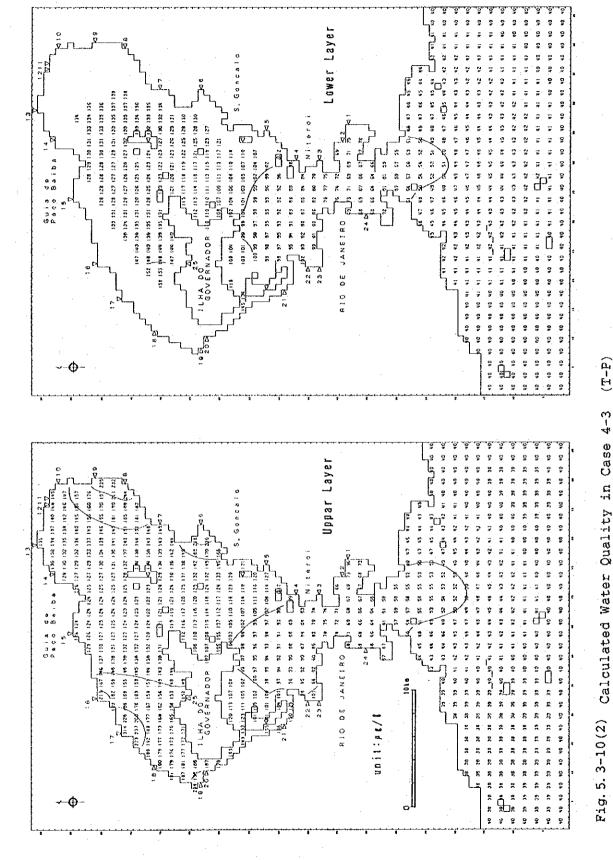
(40% Reducing T-P load from the object rivers of IDB/OECF program in 2010) (T-P)Fig. 5.3-9(2) Calculated Water Quality in Case 4-2



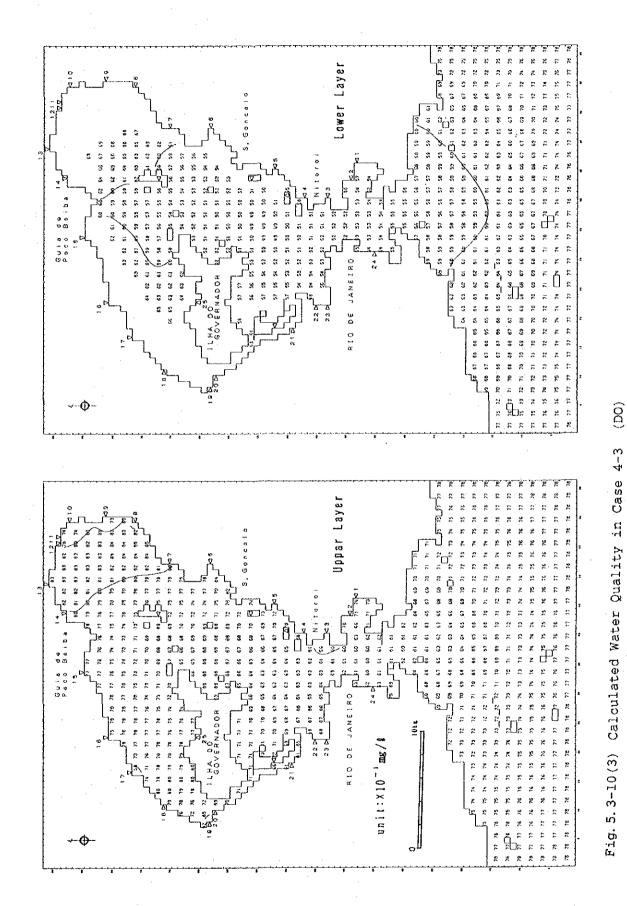
(40% Reducing T-P load from the object rivers of IDB/OECF program in 2010)



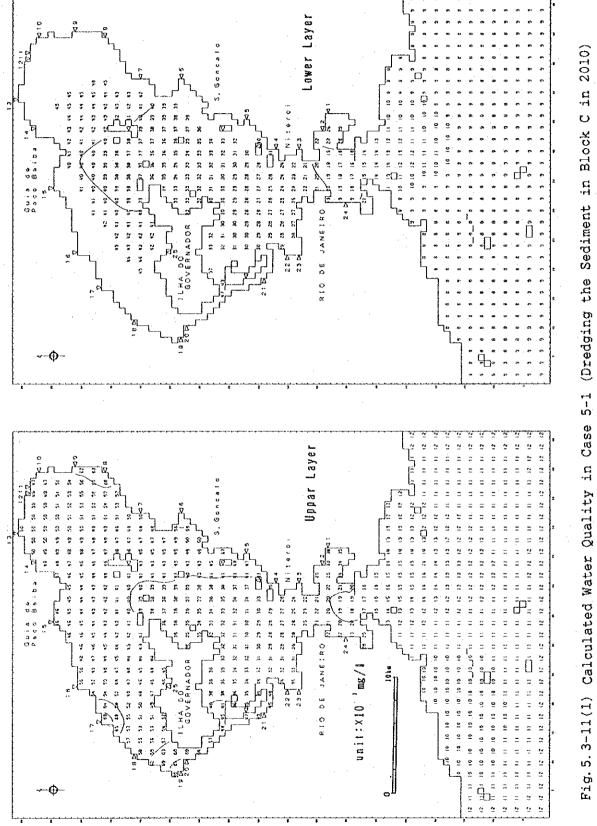
(80% Reducing T-P load from the object rivers of IDB/OECF program in 2010)



(80% Reducing T-P load from the object rivers of IDB/OECF program in 2010)



(80% Reducing T-P load from the object rivers of IDB/OECF program in 2010)



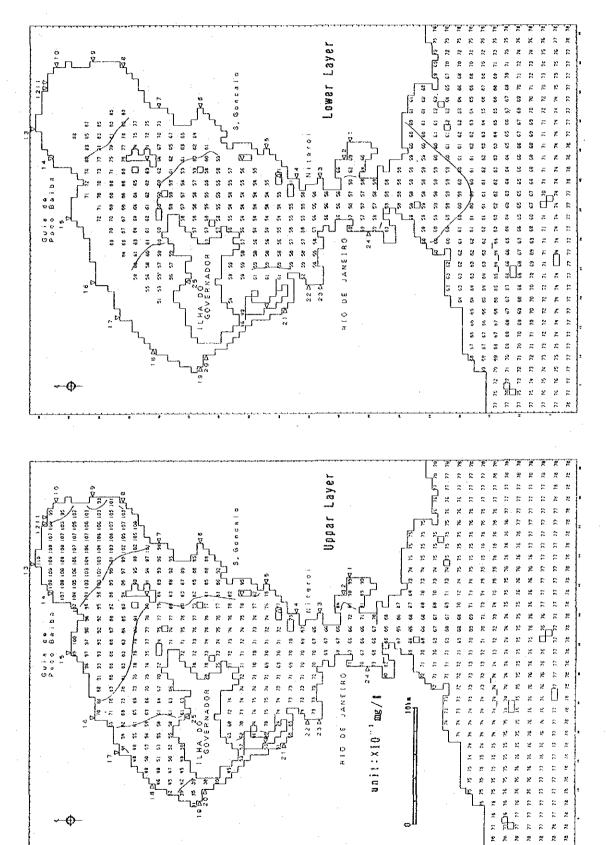


Fig. 5. 3-11(2) Calculated Water Quality in Case 5-1 (Dredging the Sediment in Block C in 2010) (<u>0</u>0

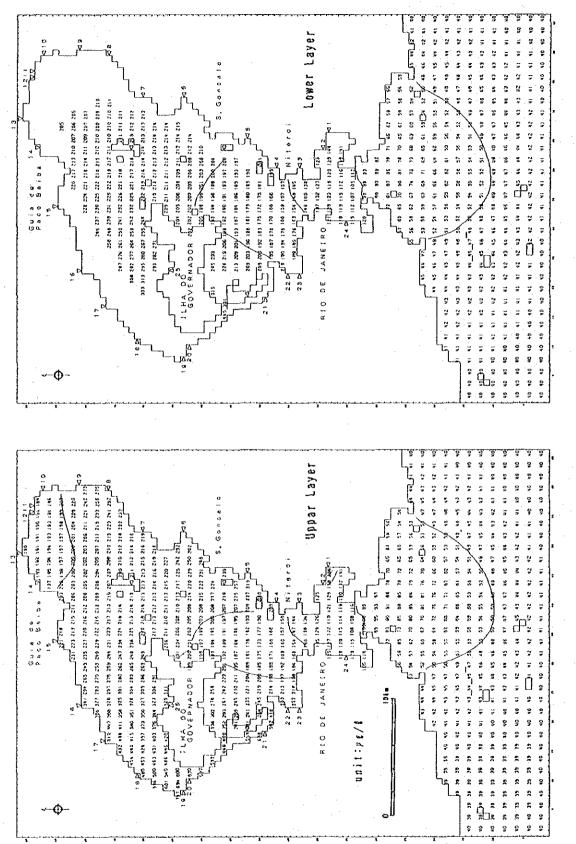


Fig. 5.3-11(3) Calculated Water Quality in Case 5-1 (Dredging the Sediment in Block C in 2010)

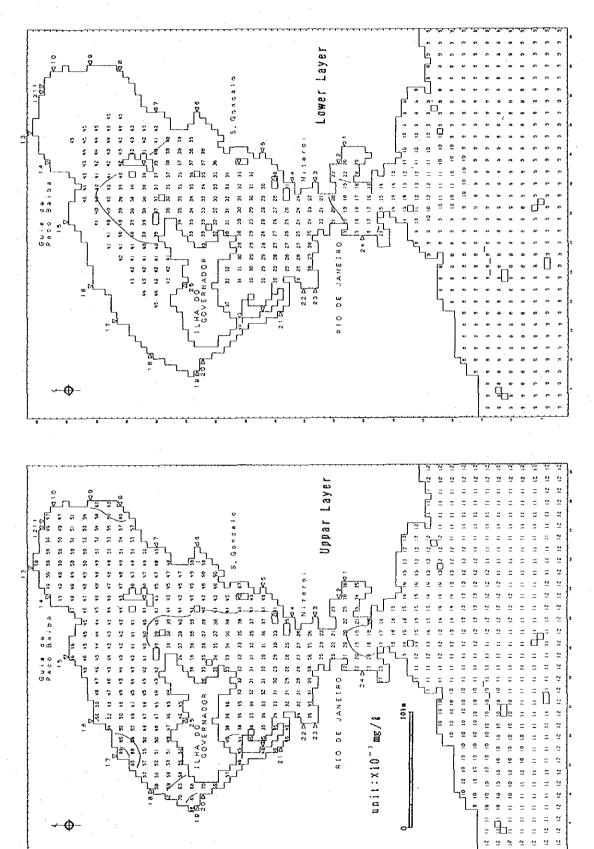


Fig. 5.3-12(1) Calculated Water Quality in Case 5-2 (Dredging the Sediment in Block D in 2010)