Chapter 11

COUNTERMEASURES AGAINST WATER POLLUTION BY ENGINEERING

11. COUNTERMEASURES AGAINST WATER POLLUTION BY ENGINEERING

11.1 Sewerage Construction in the Urbanized area

11.1.1 General

Domestic sewage is considered to be the main source of inflowing pollution load for the Billings Lake. As pollution loads to the Lake, there are 3 categories, that is, untreated sewage discharge (by sanitary sewer network), treated sewage discharge and direct discharge to river from each dwelling.

The population has been continuously increasing in the established urban area, which is major pollution load source in the Billings Lake basin. For this reason, load reduction (treatment of generated sewage) and move of loads (offsite treatment) must be taken into consideration. The offsite treatment has two sides of treatment in the basin and load transfer to outside of basin. Although transferring outside the basin is desirable in terms of reduction of the load, facility for transmission (pumping station and sewers) is necessary for its purpose.

In the ABC treatment plant (for each municipality except Sao Paulo) and Barueri sewage treatment plant (in Sao Paulo) of SABESP, they have enough treatment capacity for the entire basin and the sewer trunk lines to these treatment plants are under construction or already planned.

For this reason, sewage transmission to outside of basin is probable. However, construction plan is not completely decided yet.

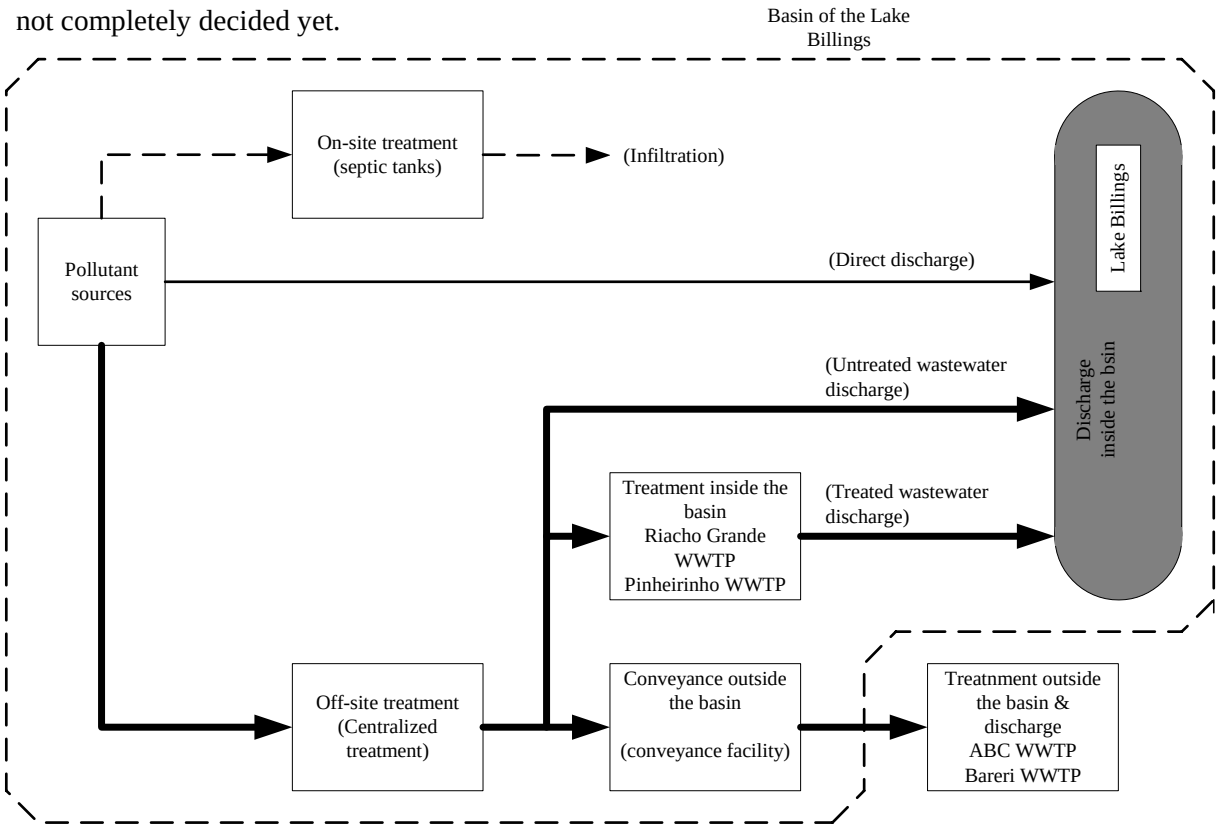


Figure 11.1.1 Flow sheet diagram of pollution load reduction

11.1.2 The existing sewerage plan and issues

The direction of the pollution load reduction plan of the existing sewerage and the implementation status is appointed. The outline of the plan is shown in **Table 11.1.1**.

Table 11.1.1 Outline of sewerage planning

Area		Enterprise	Project	Transport／Isolated Treatment	Targeted population	Completion
Ribeirao Pires, Rio Grande da Serra, Solvay Indupa	F	SABESP	Projeto Tietê	Transport to ABC STP[5)] Reversão ABC Trunk sewer 1	92,156 39,381	Junho 2006
SBC （The north Lake Billings basin）	A	SABESP	JICA	Transport to ABC STP (CT Couros) Trunk sewer 3	186,000	
São Paulo (Pedreira)	A	SABESP	Projeto Tietê	Transport to ABC STP (CT Pedreira) Trunk sewer 4	16,912	Under construction
São Paulo (Cocaia)	B	SABESP	Projeto Tietê	Transport to ABC STP (Cocaia force main) Trunk sewer 5	226,248	Under construction
São Paulo (Grajaú)	C	SABESP	Projeto Tietê	Transport to ABC STP (CT Caulm) Trunk sewer 6	26,510	Under construction
SBC	D	SABESP	JICA	Isolated treatment Riacho Grande STP	4,000	
SBC	D	SABESP	**JICA**	Transport to ABC STP (Pinherinho STP）	2,252	
Sant André	E	SEMASA	Projeto Tietê	Transport to ABC STP CT Guarará left bank Trunk sewer 2	15,350	2012
Sant André (Parque Andreense, etc)	D	SEMASA	Programa Mananciais	Isolated treatment	7,736	－
Diadema	A	SANED	Programa Mananciais	CT Couros, etc	120,000	－
Diadema	A	SANED	SANED	EEE Eldorado	(70,753)[4)]	2002 Till CTCouros
Total					736,545	

Notes : No indicated completion date for trunk sewers is unknown at present.

1) The management of the sewerage system in Diadema is SANED.
2) Wastewater in the Billings Lake basin of Diadema is transported to out of its basin by El Dorado lift pumping station. There is the Couros trunk sewer project in Programa Mananciais of The World Bank with exception of SBC's project.
3) Programa Mananciais was approved by COFIEX in May of 2006.
4) 70,753 persons are included in 120,000 persons of Programa Mananciais.
5) STP : Abbreviation for sewage treatment plant

The population concentration status in the basin in 2025 is shown in **Figure 11.2.2**. It is unevenly distributed in six areas and total population for the area is assumed to be about 1,300,000 by six locations of this A-F as shown in this figure. This forms about 93% of all the basin population in 2025. The estimate of sewage in 2025 of six areas is 207,000m^3/day.

<Sewerage facility construction plan>

Although construction schedule of trunk lines for the Parelheiros area (northwest end, Colonia crater) in Sao Paulo is unknown, after the completion of the trunk line to the direction of Ribeirao Pires (under construction in 2006), the trunk line to the Parelheiros area shall be set to work.

Issues from the analysis of current status of the existing sewerage are as follows;

(1) Although the trunk line of SABESP covers the area and population which is close to the projection, subject area/population/sewage are not specific.

(2) Prior to the planning of Couros trunk line, study on frame of Alvarenga area must be made.

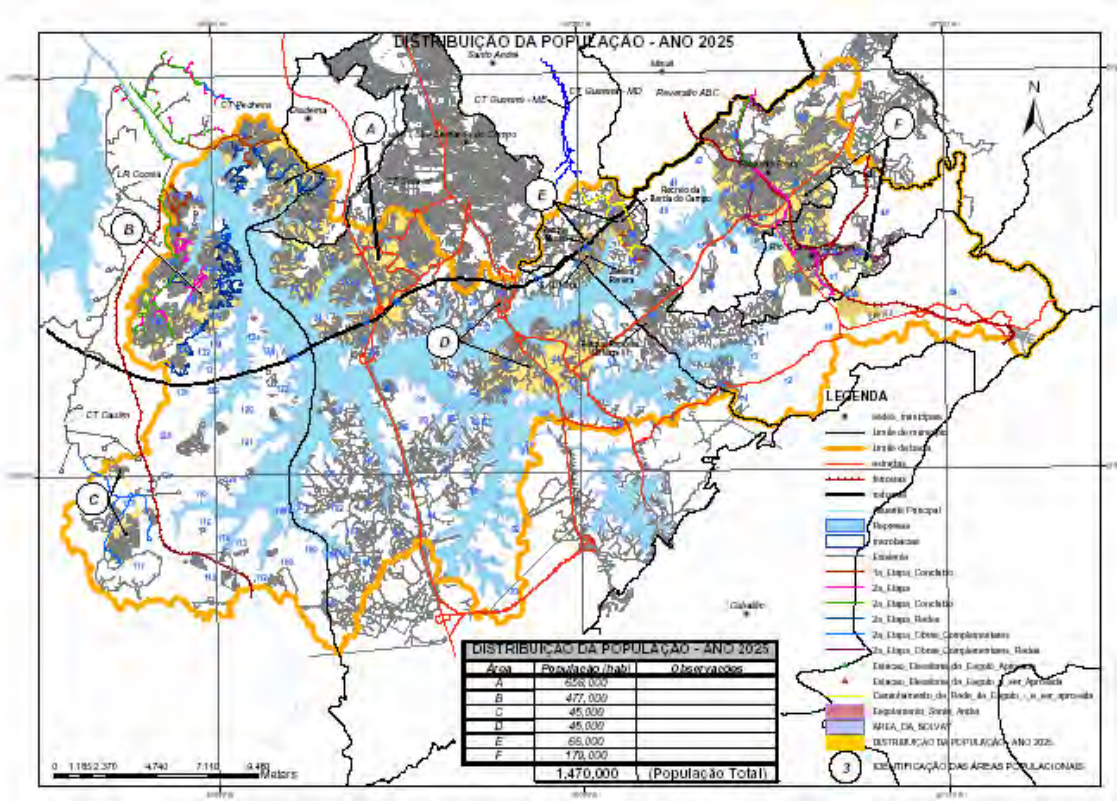


Figure 11.1.2 Densely populated district of the Billings Lake basin (2025)

11.1.3 Sewerage Plans for Urban Area in Northern Part

As for the sewerage system in northern part of the Billings Lake, sewage transfer to the ABC sewage treatment plant is already determined in the master plan of SABESP in 2000 to 2020. Due to this reason, there is no independent plan of sewerage plan in the Pat-Prosanear .

Sewage generated in the urban areas of Alvarenga and the Lavras in the northern Billings Lake shall be collected to transmit out of the basin by pumping station in this plan as well. This sewage shall be flowed into the trunk line of the Couros which will be connected to ABC STP in this project. Construction of the Couros trunk line, the semi- trunk line and service pipeline and public sewer pit shall be included

(1) Subject zone for urban-area sewer network

Basins of the Couros river and Tamanduatei river are the subject areas for the plan. The entire zone for planning of sewer network is shown in **Figure 11.1.3**. The sewage collection zone of the Couros sewer trunk line based on existing sewers is shown in **Figure 11.1.4**.

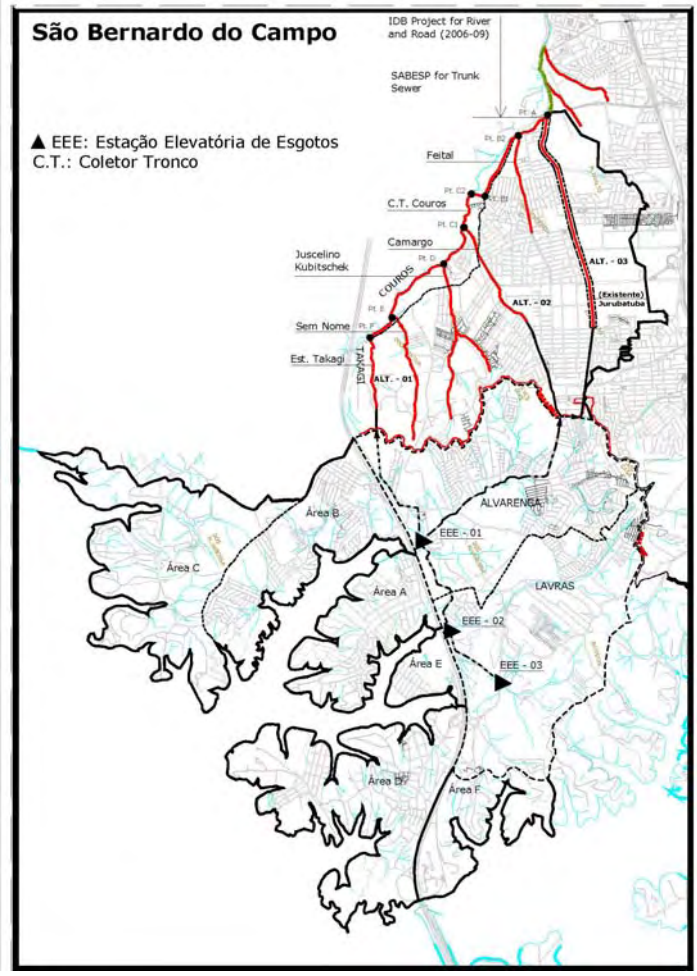
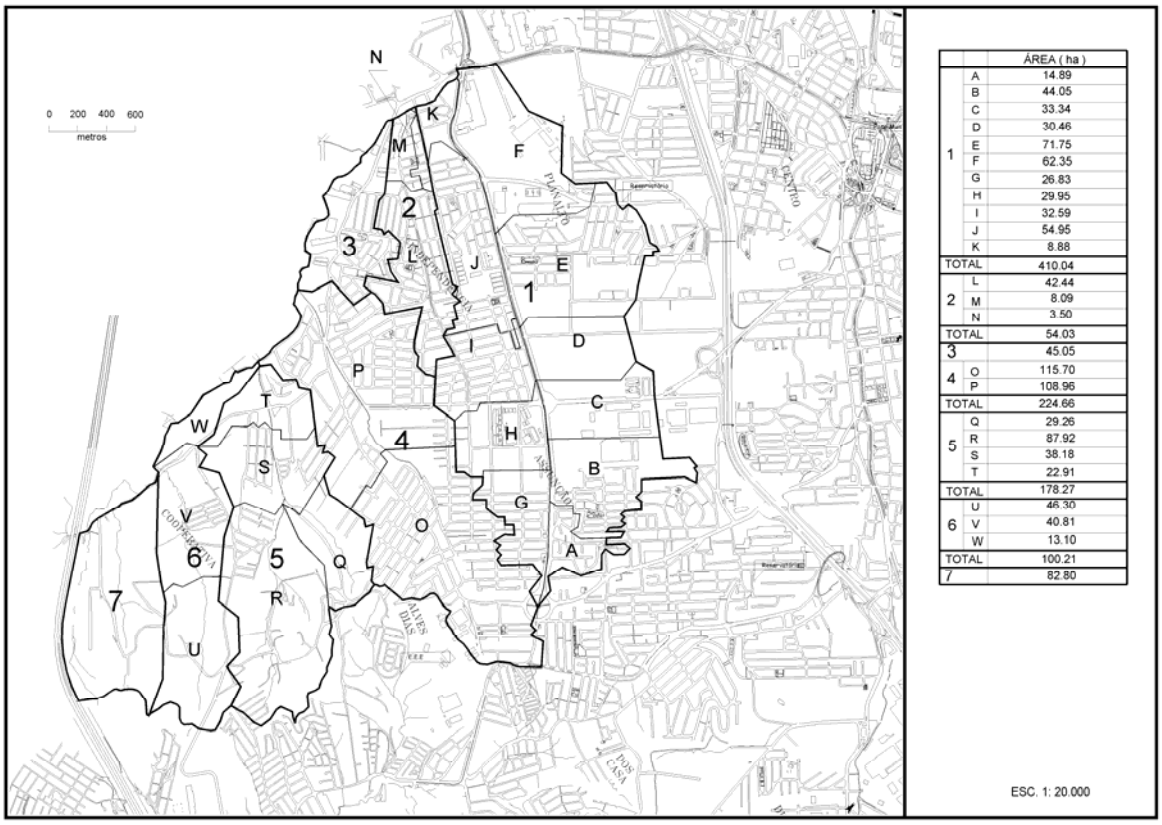


Figure11.1.3 Couros river basin sewage trunk line plan



		ÁREA (ha)
1	A	14.89
	B	44.05
	C	33.34
	D	30.46
	E	71.75
	F	62.35
	G	26.83
	H	29.95
	I	32.59
	J	54.95
	K	8.88
TOTAL		410.04
2	L	42.44
	M	8.09
	N	3.50
TOTAL		54.03
3		45.05
4	O	115.70
	P	108.96
TOTAL		224.66
5	Q	29.26
	R	87.92
	S	38.18
	T	22.91
TOTAL		178.27
6	U	46.30
	V	40.81
	W	13.10
TOTAL		100.21
7		82.80

Figure 11.1.4 SBC Couros trunk line service area

(2) Population projection and sewage flowrate

Population projection in the zone for sewerage and the flowrate are shown below

Table 11.1.2 Population projection and sewage flowrate unit(m^3/day)

Classification	Item	2005	2015	2015
Population Projection	Couros	88,600	97,400	109,300
	Other than Couros	244,822	272,332	295,331
Sewage Flowrate Projection	Couros	29,000	32,600	371,000
	Other than Couros	61,800	71,700	818,000

Sewage flowrate: Daily maximum

11.2 Sewerage Construction for communities scattered

11.2.1 Outline

(1) Fundamentals

Sewerage plans are confirmed in some established urban areas with population concentration in the Billings lake basin. On the other hand, there are some scattered communities away from urban area in the basin. Sewerage plan shall be made for the area as follows;

① Area without fixed sewerage plan

② Area, formation of urban area confirmed from the geographical information

③ Area with population concentration is confirmed from other information.

④ Area with sewerage facility (sewage treatment plant or sewers).

However, since collective treatment becomes uneconomical, the following areas shall be excluded.

① Areas between small colonies shall be excluded for sewerage planning area, since houses are scattered along the road with low population density and they have already septic tank.

② Private membership club

③ Area which is not legalized

The communities scattered in the Billings lake basin was extracted under the conditions. The outline is shown in **Table11.2.1** and the location/distribution is shown in **Figure11.2.1**.

Table 11.2.1 Outline of scattered community

No	Area	Mncplty	Basin	Population 2025	Area (ha)	Density (Pop/ha)	Sewage in 2025(m3/day)
1	Vale verde	SP	127	4,800	93.0	52	768
2	Rancho de Conacao	SP	126	100	21.3	5	16
3	Parada 57	SP	114	4,500	37.4	120	720
4	Silveira	SP	118	18,600	78.7	236	2,976
5	Colonia	SP	117	26,500	169.6	156	4,240
6	Nucleo Santa Cruz	SBC	97	4,100	23.8	172	640
7	Pedra Branca	SBC	93	400	93.4	5	64
8	Taquacetuba	SBC	99	200	34.3	6	32
9	Ⅵ Centenario	SBC	91	300	28.4	11	43
10	Jardin Jussara	SBC	30	14,700	73.9	199	2,352
11	Jardin Tupao	SBC	65	2,200	31.5	70	336
12	Riacho Grande	SBC	62	14,300	162.2	88	2,288
13	Estoril/Virgenha	SBC	60	2,200	37.9	58	352
14	Capelinha	SBC	61	5,900	76.2	77	784
15	Jardin Caicara	RP	58	6,200	66.7	93	992
16	Parque Amelia	RGS	52	5,100	152.6	33	816
Total				110,100	1,222.9		17,419

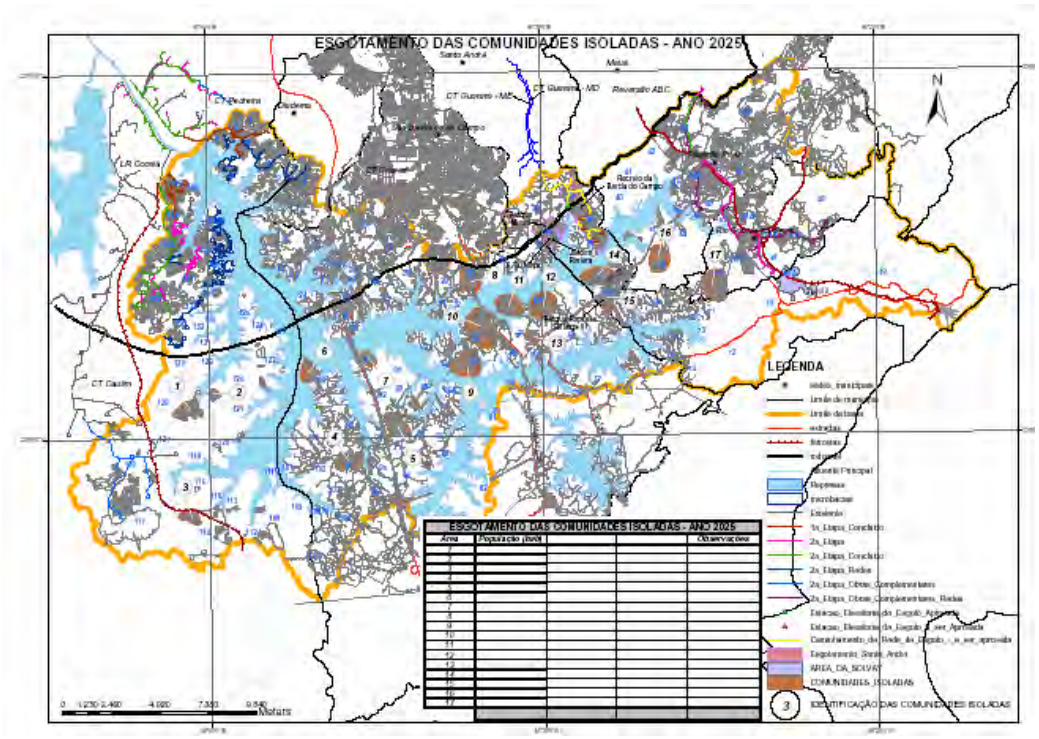


Figure 11.2.1 Distribution of scatterd community

(2) Issues of scattered communities

① Measures for load reduction to these areas shall be planned to determine whether sewage transfer, independent treatment, or on-site treatment should be adopted. Construction of Independent sewage treatment plant is recommended in Santa Cruz area in SBC which is the densely inhabited area (small basin97), small basin30, Capelinha area (small basin61), etc. In independent treatment, by regulation against the quality of final effluent, advanced treatment shall be required. In determining the treatment system, examination of construction cost, maintenance cost and maintenance nature need to be inquired.

② For the area around existing Riacho Grande sewage treatment plant (SBC), circumference urbanized zone needs to be taken in. Since treatment capacity of present sewage treatment plant is limited, expansion and improvement of facility is required. It needs to have nutrient removal capability in order to cope with the instructed conditions of final effluent by CETESB.

③ Since the quality of final effluent is less than the water quality requirement by CETESB, sewage transfer or system improvement is required for existing Pinheirinho sewage treatment plant in Alvarenga.

11.2.2 Sewerage Plan in the scattered community

(1) Outline of examination cases

The dispersion community is distributed from Ribeirao Pires over Sao Paulo almost linearly in the direction of east and west, as shown in **Figure11.2.1**. These 16 dispersion communities will have population of 110,100 in 2025. The Colonia crater area at the westernmost end belongs to the zone of Barueri sewage treatment plant. Trunk line sewers are now under construction in Ribeirao Pires at the easternmost end. It belongs to the zone of ABC sewage treatment plant. The middle zone of these two zones belongs to neither, and population density is low and communities are scattered. Sewerage service areas in this zone are Riacho Grande and Santa Cruz. In Santa Cruz area, sewage treatment plant is not built but untreated raw sewage is discharged to Pedra Branca arm.

Six cases of sewage treatment and sewage transfer for the subject area are shown in the **Table11.2.2**. About these dispersion communities,

Table11.2.2 Alternatives of sewerage construction for scattered communities

Alternatives	Description of Sewerage construction
Case 1（Sewage transfer for entire communities）	Sewage transfer (Abolition of Riacho-Grande sewage treatment plant) to out of basin boundary for the whole quantity.
Case 2（2sewage treatment plant＋sewage transfer）	Riacho Grande sewage treatment plant continuance, independent treatment for Jussara, sewage transfer for the rest
Case 3（3sewage treatment plant＋sewage transfer）	Independent treatment for Riacho Grande, Jussara and Santacruz. Sewage transfer for the rest
Case 4（1sewage treatment plant＋sewage transfer）	Integration of Riacho Grande sewage treatment plant to Jussara, sewage transfer for the rest
Case 5（6sewage treatment plant）	Independent treatment at 6 sites.
Case 6（2sewage treatment plant＋onsite treatment）	Riacho Grande sewage treatment plant continuance. Santa cruz independent treatment. Onsite treatment for the rest.(septic tank）

Examination of construction cost and maintenance cost was performed about these. The fixed conditions are as follows.

<Fixed conditions on examination>

① Sewerage system is existing Riacho Grande area, and the Colonia crater area is planned as Barueri sewerage system. In the examination of dispersed community, these 2areas shall be included.

② Branch sewers construction in areas shall be included to examination. Minimum diameter of branch sewers is set to 200mm in accordance with the facility standard of SABESP.

③ Integration of dispersed community in the sewerage planning is taken into consideration if needed, and the method of integration shall be based on manhole pumping station or pumping station. The power output was calculated by actual head and friction loss.

④ The sewage treatment system was determined as oxidation ditch system with the coagulant feeding. This is because of the requirement for water quality instructed by CETESB and economical and maintenance.

＜CASE-1：Entire sewage transfer>

This is the case of whole sewage transfer to the out side of the basin. Riacho Grande sewage treatment plant shall be abolished. 16 pumping stations are planned to construct.

Sewage of Santa Cruz area shall be transferred to the Barueri system with diameter 200 mm and extension of 15.5 km. Sewage of other area such as Riacho Grande area and Jussara shall be transferred to Meninos trunk line with the diameter of 500mm and extension of 13km.

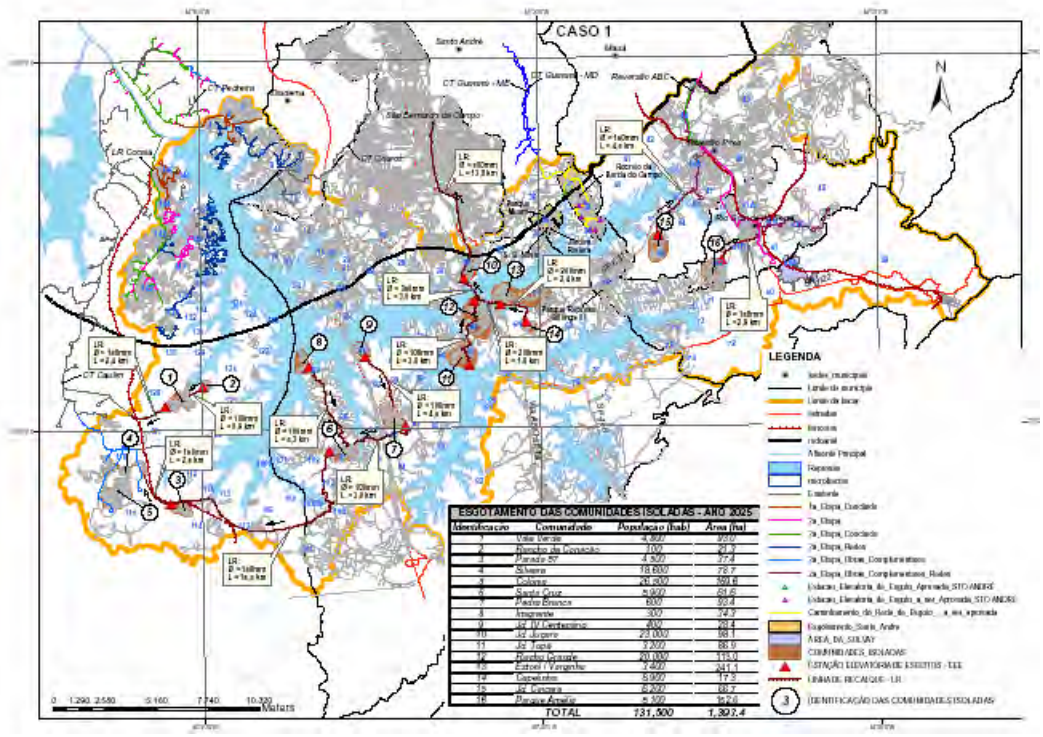


Figure11.2.2 Plan of CASE-1

<CASE-2：2sewage treatment plant＋sewage transfer>

Since sewage transfer to Meninos trunk line in Case 1 is considered to be difficult, Jussara area is planned as independent treatment. 14 pumping stations are planned in this plan. Two sewage treatment plants are also planned. Riacho Grande STP shall be converted to advanced treatment. Other sewage shall be transferred to outside of the basin.

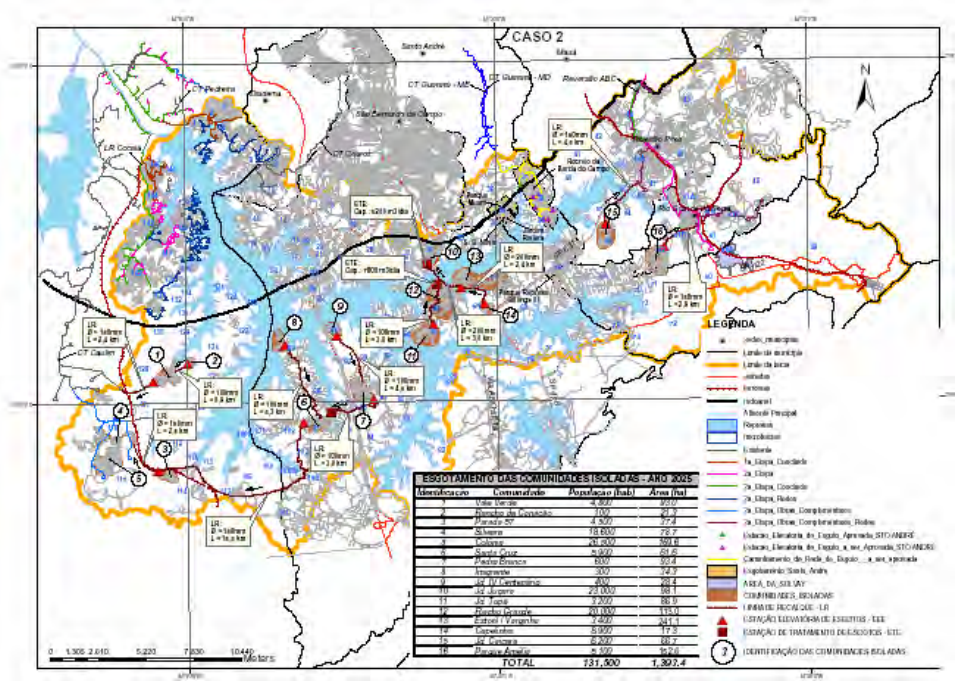


Figure11.2.3 Plan of CASE-2

<CASE-3：3sewage treatment plant＋sewage transfer>

Advanced treatment plant in Santa Cruz area is added to Case 2 with 13 PS and 3 STPs.

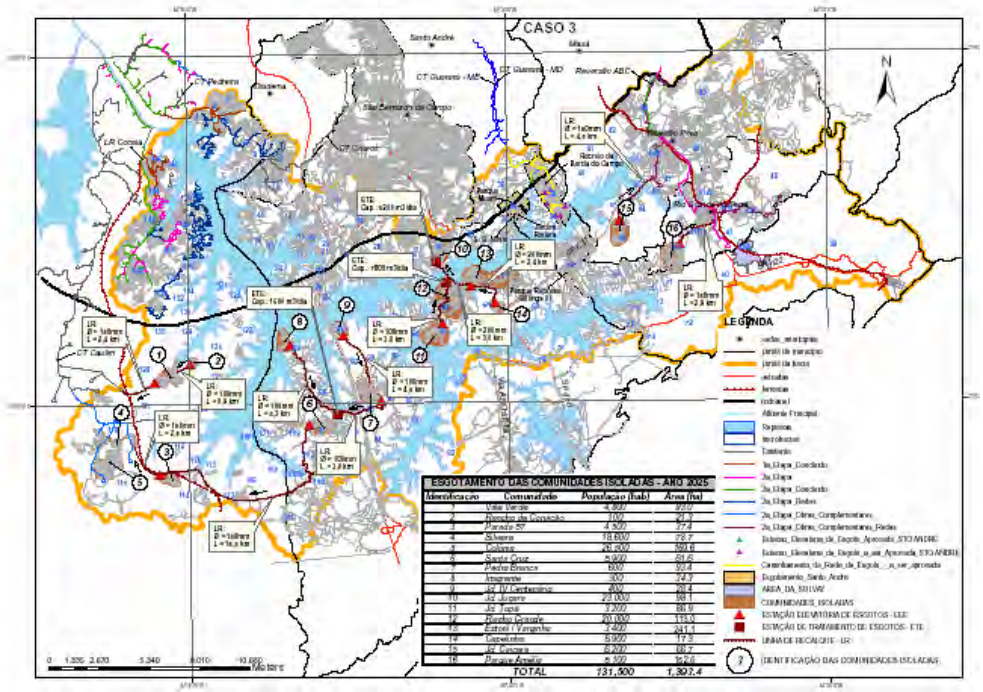


Figure11.2.4 Plan of CASE-3

<CASE-4：1sewage treatment plant＋sewage transfer>

Sewage of Riacho Grande area and Jussara area shall be collected to Jussara area for advanced

treatment. 15 pumping stations and one sewage treatment plant are planned. Existing Riacho Grande STP shall be abolished. Santa Cruz area will be transferred to Barueri by pressure pipeline.

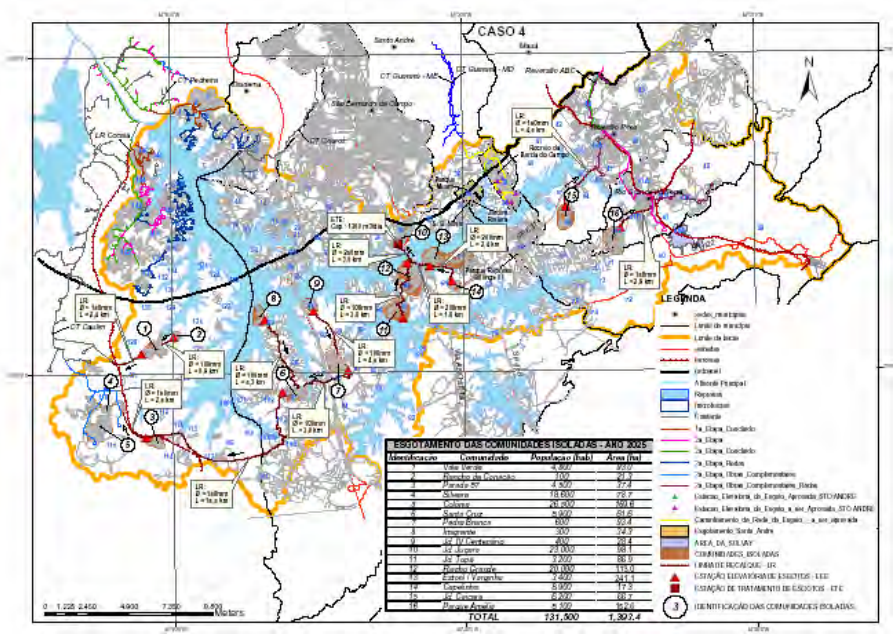


Figure11.2.5 Plan of CASE-4

<CASE-5：5sewage treatment plant>

5 close clustered areas are treated together by independent advanced STP. Ten pumping stations are planned. Generation of sludge shall be approximately 3.6 t/day.

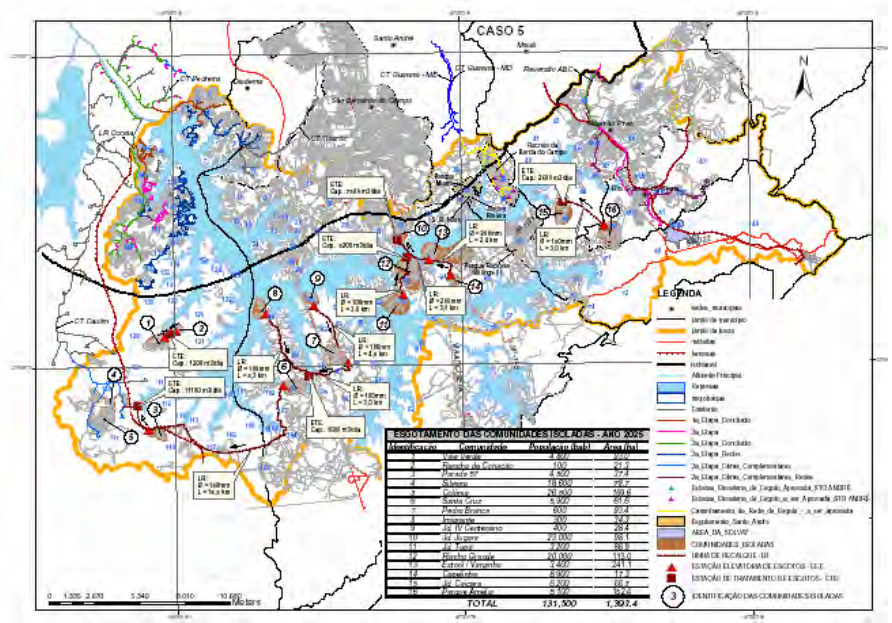


Figure11.2.6 Plan of CASE-5

<CASE-6 : 1sewage treatment plant+septic tanks for outside of sewerage area>

No sewerage construction shall be planned as present condition except for established Riacho Grande area and its circumference, and Santa Cruz area. (Septic tank utilization)

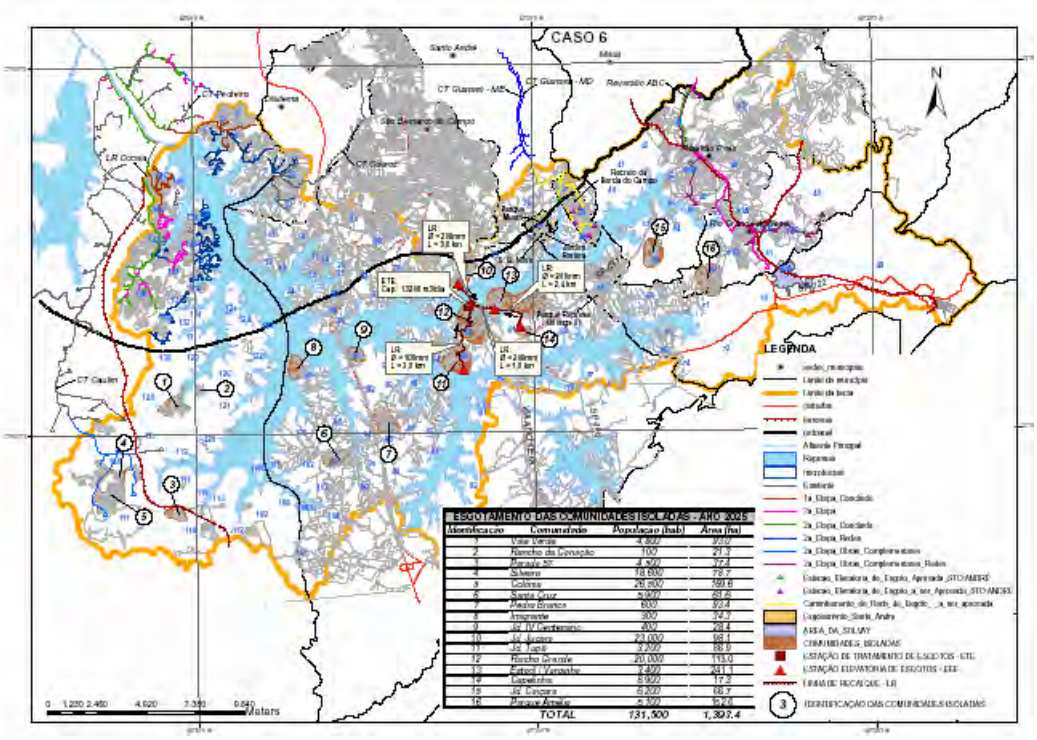


Figure11.2.7 Plan of CASE-6

(2) The result of each case

The result of examination of construction and maintenance cost is shown in **Table11.2.9**.

Table 11.2.9 Result of examination of economical efficiency

Division	Item	Unit	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6	Remarks
			Whole Sewage transferred	2 STP	3 STP	1 STP	5 STP	2 STP	
Rate of Construction	Population	Population	110,100	110,100	110,100	110,100	110,100	88,500	
	Rate of Sewerage Service	%	100	100	100	100	100	79	
Sewage Flowrate	Daily Maximum	m3/day	24,597	24,597	24,597	24,597	24,597	19,541	
Construction Cost	Branch Sewer	R$	17,051,696	17,051,696	17,051,696	17,051,696	17,051,696	3,493,136	
	Trunk Sewer	R$	18,999,600	15,875,600	11,473,600	15,023,600	11,473,600	3,714,571	
	Pumping Station	R$	10,392,229	2,479,391	2,348,648	4,479,391	348,648	174,324	
	Sewage Treatment Plant	R$	0	9,328,248	13,081,848	9,328,248	20,210,000	11,029,000	
	Sludge Treatment Facility	R$	0	6,348,000	6,113,400	5,423,400	11,750,000	5,061,000	
	Total	R$	46,443,525	51,082,935	50,069,192	51,306,335	60,833,944	23,472,031	
	Rank	-	2	3	5	4	6	1	
Maintenance /Operation Cost	Pumping Station	R$/yr	218,592	233,960	220,712	300,730	159,241	5,251	
	Sewage Treatment Plant	R$/yr	0	1,523,520	850,301	607,421	2,156,000	650,000	
	Total	R$/yr	218,592	1,757,480	1,071,012	908,150	2,315,241	655,251	
	Rank	-	1	5	4	3	6	2	

① Construction plan of case 6, that is building sewage treatment plant in Riacho Grande and Santa Cruz with septic tank use for the scattered area, is the most economical plan. Sewage of the Riacho Grande area including Boa Vista, Capelinha, Jussara and Areian shall be transferred to Riacho Grande sewage treatment plant (QDM=7100m^3/d) for advanced treatment. Santa Cruz sewage treatment plant (QDM=1000m^3/d) shall treat sewage from Santa Cruz area.

② Although the case 1 is most economical in terms of maintenance cost, case 6 is more advantageous due to its low construction cost.

③ CASE6 still continues septic tank use in scattered area, but the sewerage service ratio reaches 83%, which is adequate for improvement of lake water quality and groundwater preservation.

④ Construction and maintenance cost for CASE2 to CASE5 is very high and disadvantageous. Moreover, transportation of generated sludge by sewage treatment becomes economical burden due to its distance from existing sewage treatment plant such as Barueri and ABC STP.

⑤ In Santa Cruz area, since sewers had been constructed already and the lot for the sewage treatment plant is secured, there will not be many troubles over construction of sewerage facility.

(2) Consideration of the scattered small residential areas in future projection

Scenario in the future projection will be based on analysis of these distributed small residential areas in the future. Two scenarios are prepared, that is scenario 1 following the projection of prime report and scenario 2 with altered population increase rate examined by SBC city. The outline is shown below. Projections are the same for the two till 2015 taking values by prime report, and scenario 1 uses the same increase rate with prime report while scenario 2 uses examined population increase rate made by SBC city.

Table11.2.10 Projection scenario in sewerage planning

	Year	Event	Treatment of dispersed small residential area sewerage facility
Scenario 1	2000	Past	
	2005	Present	
	2010	The solvay trunk line of SABESP is completed and SABESP has started the sewage treatment of Ribeirao-Pires and Ribeirao Pires.	The same with present
	2015	With no new construction of a sewage facility -	The same with present
	2020	With no new construction of a sewage facility -	The same with present
	2025	With no new construction of a sewage facility -	The same with present
Scenario 2	2000	Past	
	2005	Present	
	2010	The solvay trunk line of SABESP is completed and SABESP has started the sewage treatment of Ribeirao-Pires and Ribeirao Pires.	The same with present

	2015	The Alvarenga and Cocaia becomes sewerage service area.	Sewage treatment zone expansion in Riacho Grande area. Sewage treatment starts in Santa Cruz area.
	2020	Improvement of sanitary facilities and the rate of sewage treatment	
	2025	Improvement of sanitary facilities and the rate of sewage treatment	

11.3 Improvement of Sanitary Facilities

The sanitary facilities that need urgent improvements are the ones with direct discharging in the lake and sewage discharge from sewers without treatment as is the case in favela. According to the law, sewage must be drained to the sewer in the sewerage or treated by law-abiding septic tank. In the scattered areas where sewerage construction is not economically viable, it is needed to employ septic tank or whole storage and pumping up system of community sewage.

Besides, due to the development of new urban areas in a dispersed way, areas without sewage treatment plant facilities of sewer treatment are considered to increase. Sewage treatment in such areas should be performed by septic tanks. Septic tanks are still necessary sanitary facilities even from now and they should grow in number.

Effluent is infiltrated to the under ground and treated through soils. There are hazards of polluting groundwater by infiltration of effluent and safe disposal when the condition is not suitable for the case. Supposing that the use of septic tanks should grow, pollution of the underground water must be monitored in terms of pollution of lake water.

As regards the final disposal of the sludge from septic tank, register system to enable accomplishing management of the entities entrusted of transporting and disposal of the sludge from septic tanks.

The installation and improvement of the domestic sanitary facilities is basically a problem of residents. It should be reinforced through the administrative guidance and Environmental Education as well as the incentive to the installation and maintenance of the facilities with the effort to avoid expansion of the irregular residential areas.

11.4 Water-Permeable Paving Road

11.4.1 Current status and issues

As it was presented in **Chapter 10.1**, due to the population growth, it won't be possible to avoid expansion of growth of impermeable areas. Surface run off is considered to increase more than 20% after the development. In such way, erosion should grow, as well as garbage wash out

dragged to the water and floods in high population density area. Characteristic of soil in this area has high risk causing infertile due to wash away of fertile surface by rainfall as it was mentioned in the **Chapter 1**. To prevent such inconvenient event, it is necessary to use such structure for the development as follows;

① Facility to control surface run off of rain fall and pollution from the roads and street;

② Facility to cultivate underground waters.

The measures are presented below:

(1) Permeable pavements

In places where the surfaces suffer with erosion, after protecting the surface layer, permeable pavements should be constructed to reduce the surface run off and to protect the underground water. In SBC, use of permeable paving in the roads inside of the area of the basin has been conducted and its use tends to grow.

Besides, the area shows several locations with steep inclinations with problems of stability of the slope, which is not good condition for the permeable pavement. In such case, it will be studied to use of regulating tank to control flooding.

The permeability of 10 mm/h shall be taken as target value for the facilities.

According to the result of the analysis on the precipitation data, 10 mm/h rainfall shows probability of 97% for the total rain fall. As the number of days of precipitation a year is 177 days, the frequency of surface run off can be reduced to about 5 days per year when the subject roads are paved by the specification.

(2) Facilities for flooding protection

1) Subject Areas

It will be applied in the neighborhoods with high population density like Alvarenga and Cocaia. They are shown in the **Table 11.4.1** in terms of small basin number and areas of public roads. 1 to 26 correspond to the neighborhood in Alvarenga and 135 to 146 correspond to the neighborhood in Cocaia. The extension of public roads reaches approximately 753 km and the area approximately 10.1 km^2.

Table 11.4.1 Small-basins and their road status

Micro Basin	Municipality	Existing Condition			
		Road Length (m)	Paved Road Area (m2)	Unpaved Road Area (m2)	Total Area (m2)
1	São Paulo	12,040.95	132,674.17	5,559.00	138,233.17
2	São Paulo	19,606.90	153,806.97	51,521.48	205,328.45
3	São Paulo	11,709.88	61,895.88	60,534.86	122,430.74
4	São Paulo	46,575.92	183,299.45	251,143.27	434,442.72
5	São Paulo	9,705.70	79,948.10	34,259.13	114,207.23
6	São Paulo	50,752.35	213,098.27	282,232.68	495,330.95
7	São Paulo	929.46	129.69	6,511.28	6,640.97
8	São Paulo	21,207.56	70,497.73	154,691.91	225,189.64
9	São Paulo/Diadema	36,651.42	362,592.37	49,336.78	411,929.15
10	Diadema	25,150.58	203,070.99	91,213.56	294,284.54
11	Diadema/SBC	15,379.64	67,130.81	82,944.95	150,075.76
13	SBC	548.98	0.00	2,195.92	2,195.92
14	Diadema/SBC	9,334.04	98,611.40	37,069.84	135,681.24
15	SBC	65,724.80	713,348.40	524,452.31	1,237,800.71
16	SBC	6,971.93	20,833.83	42,062.28	62,896.11
17	SBC	1,005.61	1,055.52	8,124.31	9,179.83
18	SBC	7,564.74	24,329.24	55,794.78	80,124.02
19	SBC	24,495.75	357,661.45	46,378.57	404,040.02
20	SBC	1,800.09	134,665.41	1,190.07	135,855.48
21	SBC	989.18	69,398.40	2,465.16	71,863.56
22	SBC	17,000.00	130,392.40	165,750.18	296,142.58
23	SBC	20,347.67	254,673.50	263,640.19	518,313.69
24	SBC	393.68	0.00	5,117.84	5,117.84
25	SBC	8,093.33	111,378.86	133,346.62	244,725.48
26	SBC	12,001.98	52,558.01	246,328.16	298,886.17
135	São Paulo	5,133.53	53,950.70	3,765.16	57,715.86
136	São Paulo	16,622.20	226,287.90	7,804.52	234,092.42
137	São Paulo	17,998.52	118,389.32	58,158.04	176,547.36
138	São Paulo	10,708.53	42,834.12	42,834.12	85,668.24
139	São Paulo	14,713.23	94,269.02	39,755.72	134,024.74
140	São Paulo	45,195.93	730,446.36	19,944.08	750,390.44
141	São Paulo	22,507.40	250,805.94	15,379.04	266,184.98
142	São Paulo	96,127.62	827,343.68	138,292.72	965,636.40
143	São Paulo	35,802.97	328,259.82	36,998.76	365,258.58
144	São Paulo	28,609.82	496,742.77	6,005.72	502,748.49
145	São Paulo	3,288.49	27,132.96	7,566.96	34,699.92
146	São Paulo	30,729.20	374,974.68	11,578.80	386,553.48
	Total	753,419.58	7,068,488.12	2,991,948.76	10,060,436.88

(2) Extension and area of the permeable pavement

Regarding this, basic unit value for the existing roads was examined with the data of Alvarenga, the values below were obtained from the data of the small basins 13 to 24 in Alvarenga.

Table 11.4.2 Relationship between the extensions of public roads and areas (Alvarenga 13 to 24)

Item	Unit	Description	Observation
Area	km^2	22.60	
Length of Public Roads	km	156	
Area of Public Roads	km^2	2.96	
Medium width of the Roads	m	18.97	2.96/156
Ratio of Area of Roads/ Area	km^2/km^2	0.1310	2.96/22.6

(3) Approximate BOQ and cost estimate of the civil work

Table 11.4.3 shows the estimated area of permeable pavement and construction cost. For an extension of 502.3km, the area of pavement is of 465ha. The use of the permeable pavement used in Brazil was adopted and its rate is R$100/$m^2$. With that, the cost of the work would be of R$465 million.

As the areas of dense population have 25% of roads, with the introduction of permeable pavement, the points of total drainage decrease to 75% when.

However, as the permeable pavement can cause land slide or break down of steep slope, it is necessary to be careful about the suitability. This permeable effect decreases with the clogging of their pores, it is necessary to maintain the permeability by cleaning with water jet. In case this maintenance with jets of water is executed, according to the experimental result in Brazil, it is reported that the permeability reduces 60% in 5,5 years. However, this is the case of rainfall intensity of 150 mm/h and that, even after the decrease, there is capacity of 60 mm/h (150 x [1-0.6]). This permeability even after the decrease is 10-1 cm/s, which is permeable enough for the condition of this study.

(4) Effect of the permeable pavement

1) Effect of pollution load decrease

Area: 465ha/0.131 = 3,549.6ha 0.131: share of roads

Unitary load of the surface: 146 kg BOD / there is / year of residential area for class of low income (according to CETESB)

Load of the current surface: 400 g BOD / there is / day

After the ecological asphalt: 300 g BOD / there is / day

Volume of reduced load: 3549.6 x (0.400-0.300) kg BOD /ha/ day =354.96 kg BOD / day

Therefore, the equivalent effect is considered to be 355 kg BOD / day.

Table 11.4.3 Cost of the permeable pavement application in Alvarenga / Cocaia

Micro Basin	Municipality	Existing Road Length(m)	Permeable Pavement(m2)	Construction Cost(R$)	Remarks
1	Sao Paulo	12,040.95	120,410	12,040,950	
2	Sao Paulo	19,606.90	196,069	19,606,900	
4	Sao Paulo	46,575.92	465,759	46,575,920	
5	Sao Paulo	9,705.70	97,057	9,705,700	
6	Sao Paulo	50,752.35	507,524	50,752,350	
7	Sao Paulo	929.46	9,295	929,460	
8	Sao Paulo/Diadema	21,207.56	212,076	21,207,560	
9	Diadema	36,651.42	366,514	36,651,420	
14	SBC	9,334.04	93,340	9,334,040	
16	SBC	6,971.93	69,719	6,971,930	
18	SBC	7,564.74	75,647	7,564,740	
19	SBC	24,495.75	24,496	2,449,575	
20	SBC	1,800.09	18,001	1,800,090	
21	SBC	989.18	9,892	989,180	
23	SBC	20,347.67	203,477	20,347,670	
25	SBC	8,093.33	80,933	8,093,330	
26	SBC	12,001.98	12,002	1,200,198	
97	SBC	4,400.00	4,400	440,000	
135	Sao Paulo	5,133.53	51,335	5,133,530	
136	Sao Paulo	16,622.20	166,222	16,622,200	
137	Sao Paulo	17,998.52	179,985	17,998,520	
138	Sao Paulo	10,708.53	107,085	10,708,530	
139	Sao Paulo	14,713.23	147,132	14,713,230	
140	Sao Paulo	45,195.53	451,955	45,195,530	
143	Sao Paulo	35,802.97	358,030	35,802,970	
144	Sao Paulo	28,609.82	286,098	28,609,820	
145	Sao Paulo	3,288.49	32,885	3,288,490	
146	Sao Paulo	30,729.20	307,292	30,729,200	
Total		502,270.99	4,654,630	465,463,033	

11.5 Parks and green areas

(1) Construction of parks and green areas

This project has objectives for control of the surface run off and cultivation of underground water by parks and green areas. Improvement of the deforested areas and vacant lots to green tract of land is planned. Secondary effect such as preserving water side and creation of small stream shall be aimed as well.

The site of the project shall be such places as: (1) permeability needed (2) to be a place with possibility of a certain amount of area with no legal problems (3) to be close to the water, where the

residents can feel the good effects of the measures of sewerage and others (4) to be a place of easy access for the population

(2) Effect of the construction of parks

The effect of installation of parks can be observed in the run-off coefficient. In the deforested lands, the coefficient is from 0.1 to 0.3 and it is from 0.05 to 0.25 for the parks, decreasing the flowrate up to 83% at the most (index of drainage from 0.3 to 0.05).

Goals of the project	1.Control the flowrate caused by rain 2.Cultivation of under ground water
Secondary effects	1.Preservation of the natural condition of the cities and improvement of the urban landscape 2.Construction of the water amenity space of the lake 3.Recreational field 4.Refuge at disaster, Stop the spread of fire 5.Base for reconstruction, etc.

(3) Subject area

The areas with park projects are excerpted from **Table 3.4.3**.

Table 11.5.1 Project of parks in the Billings Lake

Area	Name of park	Area (m^2)	Land use		Area for construction (m2)
			Classification	%	
Sao Bernardo do Campo	1. Parque Alvarenga	21,121	Terreno de mato	100	21,121
Sao Paulo (Area Ademar)	2. Parque Mar Paulista	216,000	Terreno de mato Florestas secundárias, etc.	62 38	133,920
	3. Parque dos Bandeirantes	260,000	Terreno de mato Florestas secundárias	4 96	10,400
	4. Parque Sete Campos	84,000	Floresta secundária	100	-
	5. Parque do Aterro de Itatinga	255,000	Terreno de mato	100	255,000
	6. Parque Apurá	482,000	Terreno de mato Florestas secundárias, etc.	7 93	33,740
	7. Parque da Pedreira	326,000	Terreno de mato Florestas secundárias, etc.	33 67	107,580
Diadema	8. Jardim dos Eucalipto	4,461	Solo desmatado Florestas secundárias, etc.	10 90	446
	9. Parque Eldorado	99,166	Solo desmatado Outros	50 50	49,583
	10. Santa Fé 11. Parque Sul 12. Eldorado Camargo	2,980,000	Floresta mista Área construída	99 1	-

1) The areas intended goes the facilities, excluding the ones that already have determined uses.

(4) Cost estimates of the work

The cost of the work esteemed goes the facilities described in the **Table 11.5.1** presented in **Table11.5.2**.

Table 11.5.2 Cost of the work for construction of parks

Area	Parks	Area for the construction (m2)	Cost of the work (R$)
Sao Bernardo do Campo	1.Parque Alvarenga	21.121	633.630
Sao Paulo (Area Ademar)	2. Parque Mar Paulista	133.920	4.017.600
	3. Parque dos Bandeirantes	10.400	312.000
	4. Parque Sete Campos	-	-
	5. Parque do Aterro de Itatinga	255.000	7.650.000
	6. Parque Apurá	33.740	1.012.200
	7. Parque da Pedreira	107.580	3.227.400
Diadema	8. Jardim dos Eucalipto	1.784	13.380
	9. Parque Eldorado	99.166	1.487.490
	10. Santa Fé 11. Parque Sul 12. Eldorado Camargo	-	-

11.6 Measures for the purification of rivers and channels

(1) Situation of the water quality in the rivers and the channels

About half of the population is connected to the sewerage system in the Billings Basin. However majority of the sewage are spilled in the channels or directly to the Lake. Used toilet papers are disposed separately with the garbage. Selective collection of the garbage has been conducted and the recycling of materials has been moving forward.

As for water quality of the rivers, the worst values are observed in the tributaries close to Pedreira Dam, where they reach levels from 300 to 400 mg-BOD/L. Even Ribeirao Pires, in the basin of the Arm of Rio Grande, presents close values to 100 mg/L. It is evident that the improvement of water quality is necessary in such courses of water. Its causes are the direct discharge to the rivers.

On the other hand, water quality of the tributaries in the area of the isolated communities, where the demographic density is smaller, it is much better in comparison with mentioned above. It is not necessary to purify the rivers directly.

(2) Current status of water quality of the rivers

The characteristic of the rivers of the Billings Lake is short length small basin area. The distance between the lake water and the boundary of the basin (excluding Rio Grande) is about 5km. Especially, the length of the rivers in the west are short. Rainfall run-off occurs short after rain fall because of small basin area, steep slope of rivers and channels. For example, in Jardim Laura the

channel has a slope of 10‰ and run-off coefficient is beyond 80%. For this reason the current of the small river in the area is usually small, but the flow of the current increases suddenly in the rain. The most extensive river is Rio Grande with only about 15 km.

Most of the rivers of urban area have small basins, and the weight of the pollution made by human is much larger than that of natural origin as observed in the water quality presented in (1).

(3) Characteristics of rain fall

It was verified that the precipitation is characterized by short period rains with great intensity. (Annual precipitation is about 1500 mm with the number of days in a year is 177 days).

(4) Conclusion

The pollution of the rivers of urban (Cocaia, Alvarenga, Ribeirao Pires) area is serious with similar concentrations to raw sewage. Considering that water in the Billings Lake is used as drinking water source, first priority should be placed to transfer the pollution load to outside of the basin or to treat properly. The facilities for direct treatment of river water are supplemental for the purification of river water.

11.7 Plan of measures for specific sources of pollution

11.7.1 Colonia crater

1) Current status and the problems

In the vicinity of Grajau of Sao Paulo, a big swamp exists with about 4km of diameter. It is reported that it was made by a meteorite fall about 36 million years. Any direct proof of the meteorite has not been discovered yet, but through the exploration by seismic waves many indirect proofs have been confirmed. It exists in upstream of a Rio Vermelho in which blackish water out flow is observed. The swamp is surrounded by crater edge of about 120m height.

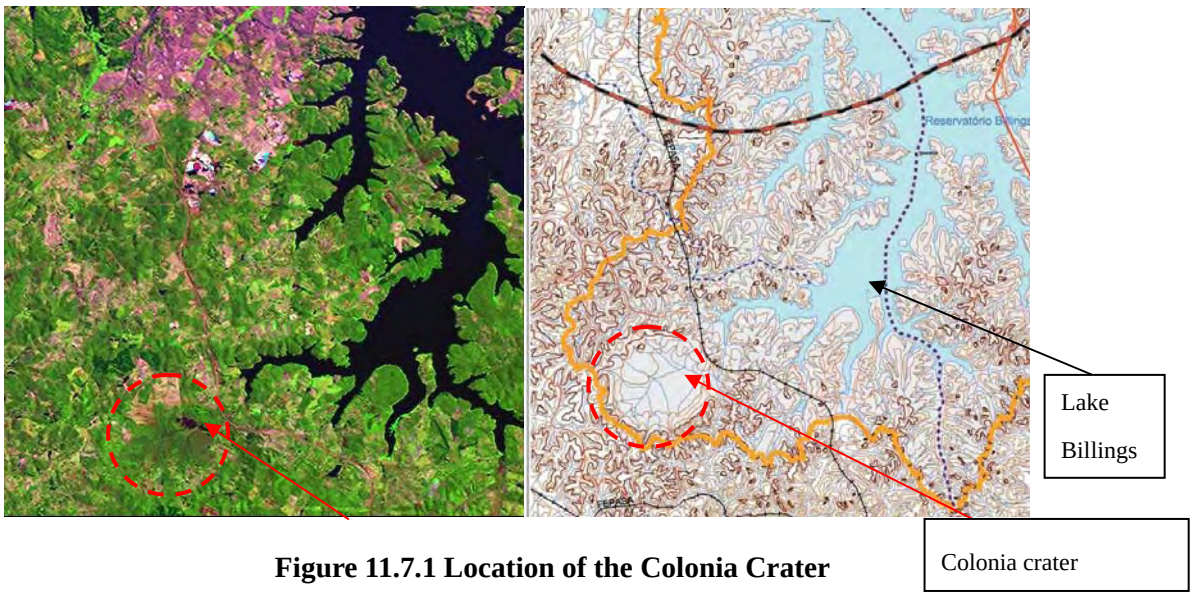


Figure 11.7.1 Location of the Colonia Crater

(Circles and arrows indicate the same place)

It is known that the maximum depth of that crater to the bed rock is about 400m, it is filled with about 2 billion m^3 sediment of the tertiary and quaternary period. (alluvium, mud, remains of vegetables) (See **Figure 11.7.2**.) Probably it had been one of the lakes in that area for long time and even before of the human appearance the lake had been buried by sediment and vegetable matter. The consolidation of sediment in the crater has not been finished and practically the whole area is marshy with no bearing capacity for the structure.

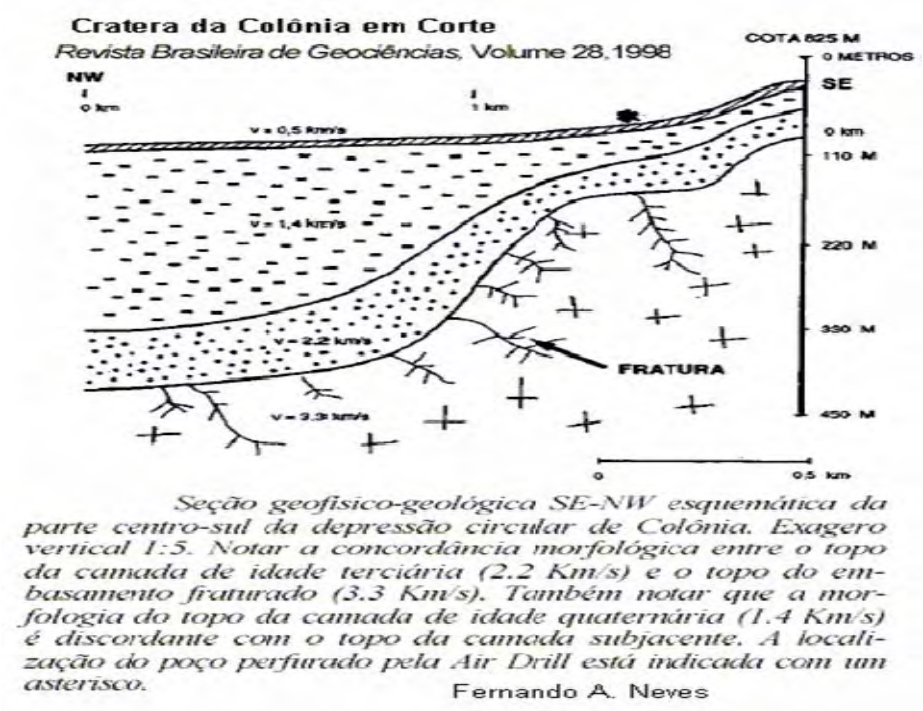


Figure 11.7.2 Section of Crater

(Universidade de São Paulo, Claudio Riccomini, SIGEP, http://www.unb.br/ig/sigep/sitio116/sitio116.pdf)

From the swamp, there is a continuous flow of dark colored water. It consists of high concentration of insoluble COD above 50mg/L and, on the contrary, low concentration of BOD. As for water quality, see the data of the measurement of the point R-6.

Coloration is considered to be a distinctive characteristic of the humus and leaching from the sediments inside of the crater. Instead of its impressive color, water containing humus has several favorable functions on the ecosystem. In Rio Negro in the Amazonian Basin, similar condition is observed.

In the location of the swamp where the ground is in better conditions in terms of foundation, population in the area is already 14,000. The water from the crater has low concentration of BOD, nitrate nitrogen and coliform, though raw sewage is being discharged to the swamp. (However, that of the concentration of the ammonia nitrogen and phosphorus is high.) The whole area of the crater has problems of bearing capacity and humidity, construction of buildings is not suitable in general.

2) Issues and measures

It is necessary to construct sewerage system to avoid direct discharge of the sewage to the swamp. As for insoluble COD of high concentration, there is no treatment need. However, in the use of the water for drinking, care should be paid for location of pumping up and treatment process. Humus (as the humic acid) may generate trihalo-methane through the treatment with the chlorine.

As a result of the analysis of the water quality, insoluble COD is considered to be of leachate of humic acid from the sediment in the crater. Reason of low concentration of BOD is probably due to biodegradable nature of the COD matters.

11.7.2 Old dumping site of Alvarenga

1) Current status and the issues

Old dumping site of Alvarenga is located in the neighborhood of Alvarenga, on the boundary between Sao Bernardo do Campo and Diadema. It began operation in 1973 and it was closed in 1987 for order of the Justice.

Location: Surrounded part of the **Photo 11.7.1**

Area: about 75ha

Direction of run-off of rain fall: Direction of the arrow in the figure

Type of waste: domestic waste, industrial residues, including hospital waste

Total volume covered with earth: about 2,400,000t (see **Table 11.7.1**)

Table 11.7.1 Historical data of the sanitary dumping site

Year	Volume of Disposal (t)
1973～74	129,600
1975	144,000
1976	201,600
1977	244,800
1978	259,200
1979	259,200
1980	259,200
1981	259,200
1982	259,200
1983	259,200
1984～86	129,200
Total	2,404,400

Photo 11.7.1 Existing old dumping site of Alvarenga

The current situation of the sanitary dumping site is as follows;

- Vegetation has been recovering and even high trees can be observed.
- Waste has been partially exposed by collapse of the steep slope and subsidence.

- Drainage for the area is inadequate making muddy area in the site. Existing drainage ditches are covered with dirt and bushes.
- Leachate has been leaking from the side of the site. Also water quality of the leachate has not been accomplished.
- There are vertical gas releasing pipes installed in several points for emission of methane gas, but seemingly generation of gas is not observed.
- Impermeable sheets were not constructed in the bottom to avoid leakage to the underground.

In sanitary dumping site, stability and safety are significant to evaluate existing condition of the facility. When judging the current situation based on the information above, result can be summarized as in the **Table 11.7.2**.

Wastes are considered to be stabilized judging from the elapsed time after close and manner of gas generation, but as various defects are remarkable and original safety measures were incomplete, additional plan for improvement should be taken for future effective use. Consequently, it is necessary to do detailed research in the basic design stage.

Table 11.7.2 Analysis and Evaluation of the Current Status of Old dumping site of Alvarenga

	Item	Current situation	Remarks
1	Scale	Large scale with more than 10ha.	
2	Stability of the slopes	Need to confirm safety's level.	Many strong slopes exist.
3	Consolidation of the waste	Subsidence is considered to have been ceased.	
4	Scattering of wastes	Scattering of wastes are remarkable due to exposure.	
5	Prevention against fire and explosion	Generation of gas seems to be ceased.	There is no fire from the gas releasing well.
6	Measures against the odor	It depends on the state of the cover earth.	No extreme odor.
7	Measures against the inundation	Measures were not adopted.	
8	Measures against the leak of leachate to underground	Measures were not adopted.	
9	Stabilization of the wastes	The level of wastes stability is considered high.	25 years has passed after close.
10	Illegal occupation	Observed.	
11	Type of wastes	All the type of wastes are buried.	
General evaluation		The stability of the wastes are high, but improvement of the current situation to control the site in an appropriate way.	

2) Methods of improvement

Starting from the results of the analysis of the current situation, the following improvement measures are suggested.

1. New construction of earth covers
2. New construction of drainage facilities
3. New construction of maintenance facilities and utilities (Retaining walls, roads and fences, etc.)
4. New construction of facilities for leachate

. Network of collectors

. Reservoir for the leachate to send it to sewage treatment plant

The effective use of this area shall be started when its safety is confirmed. Land use shall be limited to green area, park or athletic field, since subsidence will continue very slowly.

11.8 Measure for the sludge deposited at the bottom of the lake

The sludge at the bottom is distributed through the whole area of the Billings Lake and its volume reaches 52 million m^3 (about 7% of the capacity of the lake). The environmental impact against the water quality of the lake is considered to be very big and continue long time. Volume of sludge is considered to be increasing due to the growth of algae by nutrient salt and raw sewage inflow. Thus, it is necessary to transfer the load by raw sewage inflow, remove nutritious salts and removal of sludge.

For this point of view, the measure against the deposited sludge is extremely important. However, due to the extension of the water surface, the huge amount of sludge and the difficulty of removal work, extraordinary time shall be needed to remove sludge for the whole lake.

Generation of great amount of methane gas and bad smell in Alvarenga and occurrence of algal bloom in the Taquacetuba arm even during the winter has already become daily problem for the surroundings of the lake and water. Urgency of sludge removal in such areas is becoming larger.

The scale and the cost of the necessary works of the removal of sludge for these two areas are shown below. (Dredger with sludge pumps and trucks for transportation) Subject area is only 7 km^2 out of total surface 108 km^2, however the cost is 480 million Real. (About 25 billion yens)

Table 11.8.1 Removal of the sludge and cost of the works

Area of water surface	Area (ha)	Cost of the works (R$)	Remarks
Alvarenga 1 (Alvarenga 2411)	45		< drainage >
Alvarenga 2 (próximo a 2411)	60		Boat with pumps for drainage
Alvarenga 3 (Grota Funda)	105		< transport on the lake >
Alvarenga 4 (Pereira)	60		Transport boat
Alvarenga 5 (Lavras)	120		< land transport >
Cocaia	160		Truck
Bororé	80		
Taquacetuba	75		< volume of the sludge>
Total	**705**	**480,000,000**	**About 3,500,000 m^3**

Although the cost of the necessary works for this 7 km^2 overwhelms the total cost of other works, the effect of this work is limited to only 6% of total area. Moreover, since this work does not produce tangible profit to government and people, any collecting charge for this work cannot be expected. It will be necessary to minimize the dredging area for the way of cost effective.

11.9 Aeration of the water in the Lake (Direct Purification)

In case the aeration is adopted for direct improvement of water quality in the lake, mechanical aerator shall be most suitable in efficiency. However, it will need a number of aerators even the subject area is limited and it also requires electrical power. Therefore, this method must be applied to some limited area for the specific purpose. Further, possibility to reduce BOD through this method is very small and it is not possible to eliminate the nutritious salts.

Applicable location for aerators in this project is surroundings of Pedreira Dam. As example, the aeration around the dam is presented in A12.9.1. This example is for the improvement of extremely restricted area in the proximities of the dam. Under the circumstances of reverse pumping up at the Pedreira Dam as the occasion demands, its importance is not high due to pollution loads carried in by pumping up.

11.10 Purification by aquatic plant

The purification by aquatic plants is usually applied to sewage treatment for low concentration or diluted polluted water to complement the treatment of the water. Therefore, it is necessary to avoid the places where raw sewage is discharging without treatment in the Lake Billings, such as Alvarenga. Swamp with reed for this purpose must be shallow (approximately 0.6m) for their growth and its treatment is summarized to sedimentation, filtration and absorption. Although the Billings Lake has a lot of arms, wide and shallow arms which enables this treatment are few with the depth increasing suddenly according to the distance from the shore. This is the reason big reeds

population cannot be seen much in the Billings Lake. In order to conduct this treatment in the Billings Lake, it will be necessary to reclaim arms to make broad reed field in necessary mouth of arms.

For example, when this treatment is applied to Alvarenga area, reclamation of 20 ha shall be needed to treat sewage of 10,000m^3/day. The system shall include sedimentation basin, a set of reed shallow ponds. Periodical removal of anaerobic sludge from sedimentation basin, harvest of reeds and prevention of mosquito must be conducted to avoid their harm. Mosquitoes are the great cause of Dengue fever in Brazil.

Finally, the water surface is territory of EMAE and construction of such facility obviously decreases the volume of the Lake.

As an alternative for the reeds, water hyacinth can be a candidate for this method. They are observed in the Billings Lake. Water hyacinth is native of South America with fast growth nature and absorption capability of nitrogen and phosphorus. Because of its floating growth, cultivation and harvest are easy and it has high value as biomass resource. Removal of nitrogen and phosphorus of the lake can be greatly expected.

However, due to high growth rate, they may occupy the water surface very easily dispersing for the wide area. They will block the solar rays causing deficiency of oxygen and bring worsening the water quality. If the grown water hyacinth are not collected and eliminated, its dead body will deteriorate water making absorbed nutrients go back to the water.

Application of experimental facility using water hyacinth for purification of the water is recommended to confirm the capacity of absorption of nutritious salts and its defects for maintenance and control of growth of mosquito.

11.11 Construction of the Environmental Protection Center

11.11.1 Center of Environmental Experience/Study of the Billings Lake

(1) Preamble and Objective

- The Billings Lake is important source of drinking water for the population of ABC area. It is also important source of water supply of Great Sao Paulo with water supplies to Guarapiranga.
- The Billings Lake also provides multiple uses not only for SBC, but for 870 thousand inhabitants of the basin. Additionally, it is important reserved green area with rich biodiversity.

- However, in the last years with increase of pollutant loads as sewage, especially with the progress of the eutrophication, algal broom occurred frequently, threatening the use as source of drinking water.
- As measure for preservation of the quality of water of the Billings Lake, the implementation of the system of sanitary sewerage is an urgent measure.
- However, from the point of view of long period, it would be impossible to assure the preservation of the quality of water of Billings in the future without environmental protection awareness among the inhabitants of the basin, even with the implementation of the system of sewerage.
- Consequently, SBC considers that for improvement of the quality of water of the Billings and creation of good environmental, as well as its sewerage construction and environmental education of the residents, is an important measure.
- In order to execute that environmental education, the Center of Environmental Experience/study of the Billigs Lake shall be constructed.
- The fundamental education shall be conducted to school children by Flotation (motorboats) School and Circulating (bus) School. They would learn significance and importance of the Billings Lake through experiences in indoors/outdoors.
- The existence of those activities would increase the awareness in SBC about environmental preservation. It would also contribute to formation of the dedicated people for the Environment.
- The Center will promote the integration of the 6 municipalities of the Basin, and it will also work as a support for environmental preservation with functions of exchanging opinion and information.
- On the other hand, it will also have the function of information depot on the environment of the Billings Lake.
- It will also work as place for study and meeting of NGO and partnerships of the activities of the municipalities.
- It will also be able to play the part of support center for preservation of lakes and swamps of Brazil, with function to concentrate and store national and international information.
- Together with the implementation of the sewerage system, the construction of center of environmental experience and study for the environmental education shall be made.
- The motto is “once in a lifetime, all the residents study the environment in Billings.”

(2) Principle of Center of Study and Environmental Experimentation of the Billings Lake

1) Functions in relation to environmental education

- Knowledge learning on the system including training outdoors, training that links with the practice, teachers' preparation and local leaderships, support to the leaderships.
- Learning and experience on the Lake, flotation school by boats and landing school by bus for activities of preservation of the environment.

2) Related functions of information and its exchange

- Exchange of information and opinions with the municipalities, researchers and research institutions
- Collection, organization and spreading information (Home Page, library implementation)
- Relationship with researches and movements for preservation of lakes and national /international

3) Functions about relationship with municipality's activity and supports.

- Relationships with NGOs for environment protection

4) Functions related to studies, researches and technological development.

- Storage of scientific knowledge.

(3) Concept of the Facilities

- Exhibition rooms
- Lobby for exhibition of exchanges
- Multi-use Hall
- Facilities of lodgings
- Workshop room for experiences
- Monitoring room
- Orientation counter
- Salon room for exchanging information
- Meeting room
- Library
- Copier/ printer room
- Motorboats for field study (for flotation school), bus (for circulating school)

11.11.2 Center of Water Quality Monitoring

(1) Current situation as for the monitoring

1) Meteorological and hydrological

The meteorological and hydrological condition of the Billings Lake is monitored by EMAE, DAEE and IAG-USP. The water level and the volume of water of the Billings Lake are monitored by EMAE, water level and volume of water of the arm of Rio Grande by SABESP, pumped up flowrate and water quality of the treatment plant, Rio Grande and Ribeirao Pires by SABESP and EE Pedreira by EMAE.. Flowrate of the rivers is only measured in Campo Grande and in Rio Grande, but a standardized database doesn't exist nor there is spreading of those data.

2) Monitoring of the water quality of the lakes and swamps

Quality of water is monitored monthly by CETESB in 6 points. However, monitoring is made only for horizontal distribution on the water surface of the lake. Still, CETESB has been monitoring some parameters automatically through the 3 observation buoys (3 points). However, monitoring is not being made in any arms with serious pollution.

In the case of the arm of Rio Grande, just as in the case of the Billings Lake, water quality is also monitored monthly in 3 points by CETESB only for the horizontal distribution on the surface of the lake. These collected data are presented by CETESB as an annual report and published in Website.

3) Monitoring of water quality of the rivers

More than twenty rivers and channels are flowing into the Billings Lake and in the arm of Rio Grande. In Rio Ribeirao Pires and Rio Grande, the quality of water is monitored. In spite of that, the flow is measured only in the point of Rio Grande. SABESP monitors the water quality of Rio Grande regularly to preserve its quality in the points of water intake.

4) Monitoring of the industrial discharge

Industries and companies in the basin are registered, and they are forced to report the flowrate and the water quality of the own discharges. CETESB has been controlling appropriately. Chemical industry Solvey, located in the basin of Rio Grande, occasionally it had caused serious environmental accidents.

(2) Plan of monitoring of water quality and hydrological data

1) Basic concept

Water quality of the lakes and of a part of the rivers, industries and companies in the Billings Lake's basin and of the arm of Rio Grande has been monitored. But, (1) monitoring of water quality of the reservoirs has just been made only for horizontal distribution of the limited major points of its

course. (2) Points of the arm with pollution are not monitored. (3) Independent rivers and channels flowing into the lake have not been monitored.

CETESB monitors water quality in 4 points in the Billings Lake, 2 in the arm of Rio Grande and 2 in the inflowing rivers, 8 monitoring points in total. As for the quality of the sediment, there are 1 point in the Billings Lake and 2 in Rio Grande, in total of 3 monitoring points.

However, due to the difficulties of CETESB to deal with all the water quality data in the state, the Center of Water Quality monitoring shall be founded. This Center will cover the whole area of the Billings Lake basin and Rio Grande through integrated administration by all the cities involved in the basin. For the time being, it will be administered by Sao Bernardo do Campo. The basic policy is as follows;

a) Sustainable Monitoring

Since sustainability is essential for a monitoring project, monitoring points and the items for measurement should be limited to the necessary minimum level. Automatic system of measurement won't be adopted since its maintenance cost is expensive.

b) Flexible Monitoring System

As the hydrological atmosphere drastically changes with the meteorological and hydrological condition, the measurements and collections of samples in the arms will be seasonally accomplished, 4 times a year. The municipal district of Sao Bernardo do Campo will take charge of the planning and integration of the monitoring; however, due to the limited number of members of the team, the extension of the research area, broad cooperation will be requested for sampling and measurements of samplings.

c) Gradual improvement of the institutions and equipments

The expenses and the execution of the analyses will be under the responsibility of the municipal district of Sao Bernardo do Campo. However, as for the most specialized analyses, they will be sent to institutes of federal researches or universities that possess techniques and structure for the analysis.

d) Opening the data to the public

The data obtained by the Center of monitoring of water quality will be organized and stored in a database and published in the homepage of the Center of Environmental Existence, so that they can be used by related organs and others.

e) Revising the monitoring method

Due to the need to use the most effective system of monitoring to the variation of the area, of the variation of the pollution level and of the volume of load, of the measurement instruments and

analysis, the monitoring method needs to be reviewed periodically.

2) System of monitoring of the Billings Lake and Rio Grande

Considering the basic politics described above and the acquired experience during the monitoring accomplished during one year by the present study, monitoring in the lake should be accomplished by the following specifications:

a) Items to be monitored

The items to be monitored are: water quality, quality of sediment, aquatic animal and plants, meteorological and hydrological conditions. The number of items should be gradually expanded, in agreement with the order of priorities presented in the **Table 11.11.1**. To understand the organic substances in decomposition, an index of organic carbon will be adopted, in other words, the Total Organic Carbon (TOC), as a new indicator to observe the entrance and exit of the substances.

b) Monitoring Points

The monitoring of water quality and sediment will be executed in the 15 suitable points shown in the **Figure 11.11.1**. Distribution of water quality, the state of use of the water, the points of release of loads, etc. shall be made clear.

Meteorological and hydrological monitoring in the existing 6 points in the **Figure 11.1.1** will be continued without missing. As the Center of Administration of water quality will be administered by the municipal district of Sao Bernardo do Campo, the area included by the monitoring will be limited to the municipal district.

c) Frequency of the monitoring

The basic items of water quality will be monitored four times a year; however, as for the other items, they will be monitored twice of a year, depending on the suitable priority level in the **Table 11.11.1**.

d) Regime of the monitoring

The collection of the samples and analysis of the data, they will be accomplished by Sao Bernardo do Campo, with the support of the involved

3) System of monitoring of the rivers

System of monitoring of the rivers shall be executed according to the specifications below:

Table 11.11.1 Priority of the monitoring items

Priority	Items	Parameter
A (maximum priority)	Flow and quality of the water	Flow, transparency, color of the water, temperature of the water, salinity, pH, DBO, DQO, COT, OD, N-T, NH_4-N, NO_2-N, NO_3-N, P-T, PO_4-P, TSS, Chlorophyll her, coliform
	Meteorological and hidrological	Temperature, precipitation, conditions of the wind (sense and speed), level of the water
B	Quality of the water	Odor, oil, flotation garbage, electric conductivity, level of contamination, Cd, Pb, Cr+6, Ass, Ni, Zn, Hg, The, CN
	Quality of the sediment	Color of sediment, odor, pH, ORP, DQO, S-T, N-T, P-T, Ignition - loss
	Aquatic life	Population numbers for phytoplankton, zooplankcton
C	Quality of the water	Pesticides
	Quality of the sediment	Cd, Pb, Cr+6, Ass, Ni, Zn, Hg, The, CN, pesticides

a) Items to be monitored

The items to be monitored are volume and quality of water.

b) Monitoring Points

Monitoring of volume and quality of water will be executed in the 20 points marked in the **Figure 11.11.2**.

c) Frequency of the monitoring

As the major rivers are relatively big and show large variation in the data, the monitoring in the 20 points will be accomplished four times a year.

d) Monitoring Method

Sao Bernardo do Campo and all the municipalities participating this project are responsible for the measurement, collection and analysis of the samples.

4) Measurement instruments and analysis

The samples collected will be analyzed in the Water Quality Administration Center. The Center shall be equipped with necessary minimum instruments of the **Table 11.11.2** and **11.11.3**.

Table 11.11.2 Instruments for analysis to be installed

Objective	Instruments	Water quality indices
Flow Rate	Magnetic Flow meter	2 sets.
Depth	Echo sounder	1 set
	Auto-analyzer TOC	1 set, total organic carbon
	Vacuum pump for filtering sample of water	2 sets, determination of Chl-a
	Fluorimeter	1 set, determination of Chl-a
	Radioactive scintillation counter	1 set, measurement of C14
	Spectrofotometer: UV - visible	1 set, analysis of PO_4-P, NO_2-N, NH_4-N
Analysis of the mud of the bottom	CHNS Analyzer	1 set, analysis of C, N, S in the sediment
Analysis of heavy metals	Analyzing Spectrofotometer of atomic absorption	1 set, analysis of heavy metals
	Mercury analyzer with fluorescence detector / generator	1 set, analysis of Hg
	System of Chromatograph of Ions	1 set, determination of Cr, CN
	Microwave oven Digestor	1 set, metal analysis in aquatic organisms

Table 11.11.3 Measurement Instruments to be installed

Measurement instruments	Amount
1) disk of Secchi	2
2) pH meter	2
3) Turbidity	2
4) Water Sampler	2
5) Mud Sampler	2

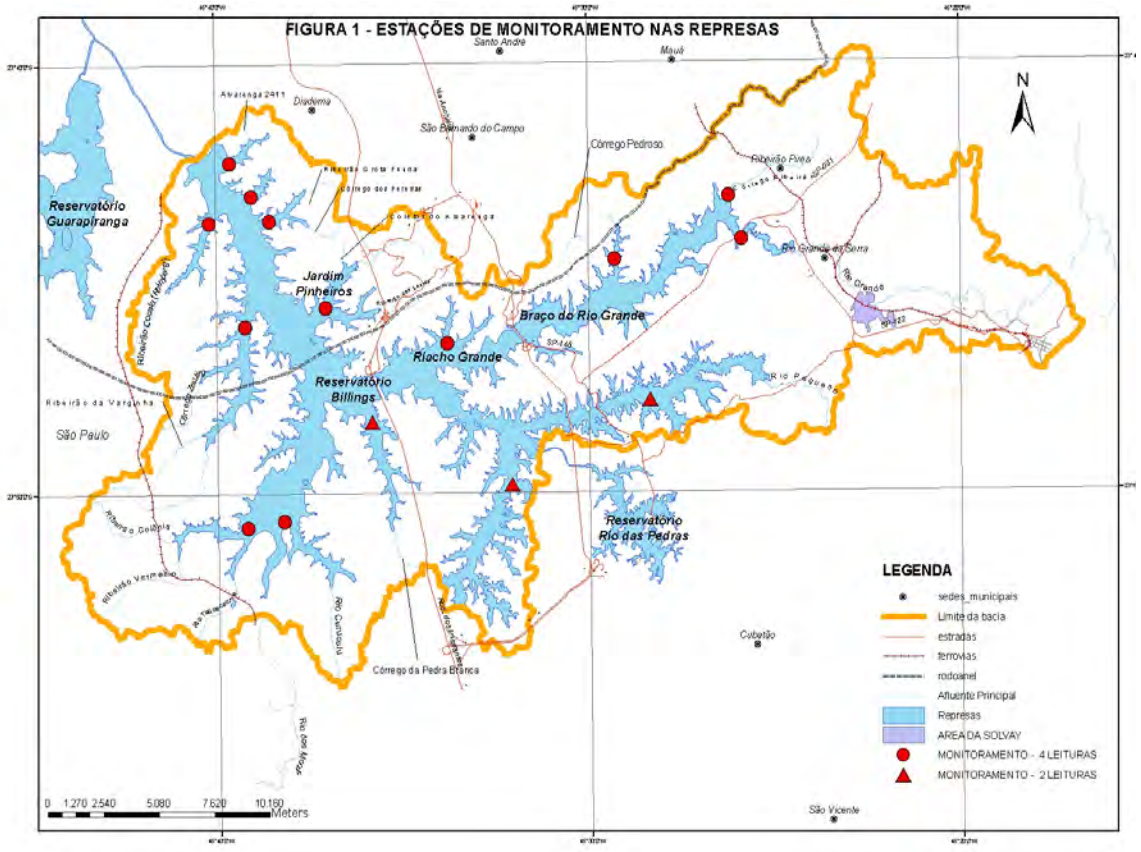


Figure 11.11.1 Monitoring Points in the arms

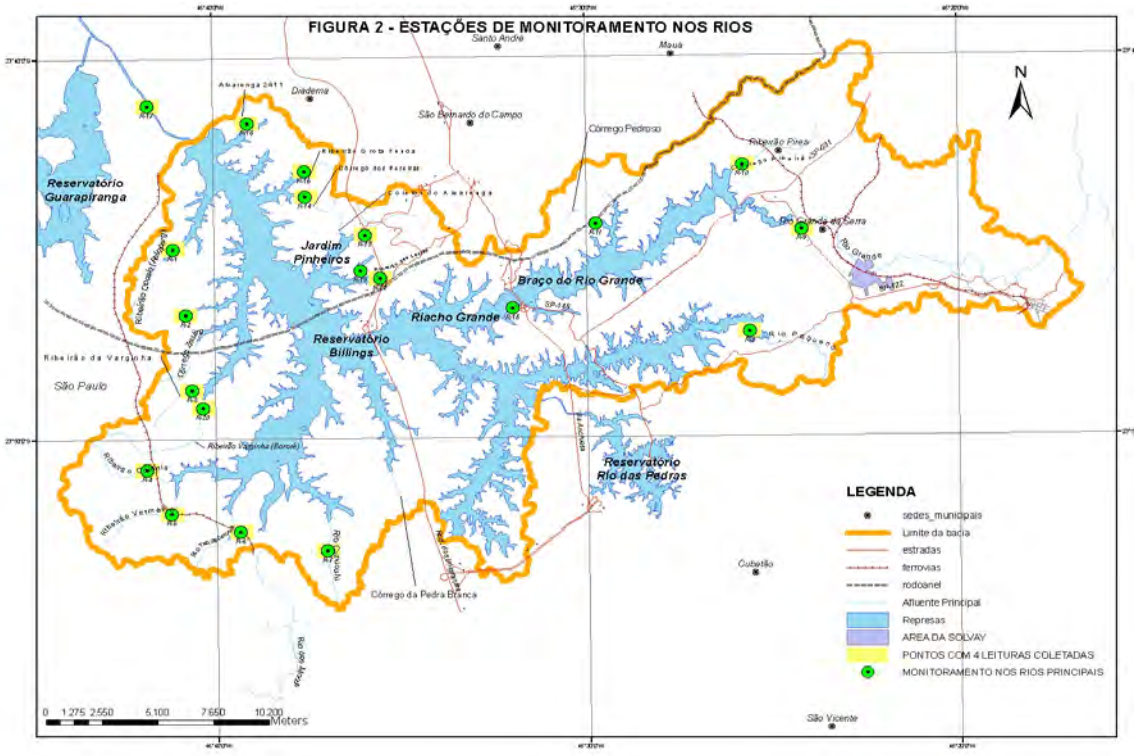


Figure 11.11.2 Monitoring points of rivers

Chapter 12

PUBLIC ENLIGHTENMENT AND ENVIRONMENTAL EDUCATION

12. PUBLIC ENLIGHTENMENT AND ENVIRONMENTAL EDUCATION

12.1 Current State on Environmental Education in Relevant Authorities

(1) National Policy on Environmental Education

The national program on environmental education (*PRONEA*: *Programa Nacional de Educação Ambienta*) was established in Brazil in 1994, and it was decided that the establishment on a national environmental education policy is conducted by MMA in collaboration with IBAMA. After that, in 1997, the first national conference on environmental education was held in the capital city of Brasilia.

The national policy on environmental education was announced to public on the following subjects;

- Environmental education and sustainable development
- Principles on environmental education
- Environmental education in various actors such as administrative bodies (related to capacity building), manufacturing industries, communities and citizens
- Environmental education, public policy, national program on environmental education (*PRONEA*) and its relevance to urban planning, water resource, agriculture, science and technology
- Formulation of ethical education and citizenship

A conference on national program of environmental education was held in MMA in 1999, and based on the conference the federal law 9,795/99 the national program on environmental education was enacted in the same year.

Above law declared that the national obligation is to implement environmental education in the field of school education and develop human resources deepening the understanding for environmental conservation in civic society, business enterprises, commercial enterprises and governmental institutions. The law also regulates that the federal government can create environmental education organs in state level and that authorize them to establish environmental education programs, basic and the priority policies at state level in accordance with the national policy.

The basic principles of Law 9,795/99 are as follows;

> Article 1: Environmental education is indispensable for individuals and corporate bodies in the process of building social value, knowledge, capacity and attitudes in order not only to protect environment but also to maintain their healthy lives.

Article 4: The principle of environmental education is "humanism, comprehensive, democratic and participatory".

Article 5: The goal of environmental education is to intend to understand the environment ecologically, psychologically, legally, socially, economically, culturally, ethically, multilaterally, pluralistically and comprehensively.

The ordnance (*Decreto Lei*) 10,172/01 concerning national education policy also regulates the necessity of environmental education. The ordnance was enacted in 2001 in the Federal congress which was originated from the problem of the shortage of specialists in the field of environmental education. The ordnance regulates that the systematization of education and its open system of receiving education is indispensable in order to conduct the continuous social learning and that environmental education is necessary to learn social environment and inequity. The ordnance also regulates that the curriculum course for building environmental knowledge shall be included in higher education.

(2) Environmental Education by Sao Paulo State

In Sao Paulo state, the state decree 30,555 (*Decreto 30,555/89*) was established in 1989, and the environmental coordination body (CEAM: *Coordenadoria de Educação Ambienta*l) was created as an inter-agency of SMA for the purpose of the development of environmental education and its enhancement. Based on the decree, CEAM, as an advisory body for establishing the regional program on environmental education, undertook the role of promoting mutual communication among state, municipality and NGO groups in implementing the environmental education program, their assistance and enlightenment activity for enhancing public awareness for environmental protection for the ultimate purpose of sustainable development.

CEAM established the program on environmental education center in 1996 which assists environmental education activity in regional level. The state decree 42,798 (*Decreto 42,798/98*) was enacted in 1998 and the provision on the creation of regional environmental education center in regional level was realized in legal system. Above decree regulated that the regional environmental education center shall fulfil the requirements in Agenda 21, establish, implement and coordinate the regional environmental education projects in regional level and conduct the training for teachers, civil servants and NOG groups who are engaging in environmental education.

SMA was reorganized in 2003 based on state decree 47,604 (*Decreto 47,604/03*), and the former CEAM was disorganized into the coordination department of strategic environmental

plan and environmental education (CPLEA: *Coordenadoria de Planejamento Ambiental Estratégico e Educação Ambiental*) and the department of environmental education (DEA: *Departamento de Educação Ambiental*) of CPLEA's subordinate agency were created. The role of establishing the policy and strategy on environmental education in regional level, management, establishment of program and its guidance were delegated to CPLEA and DEA from former CEAM.

About 15 staffs are currently involved in DEA as of 2005 in their activities of the research works on environmental education, its methodology study, preparation of education materials and printed materials. The most important function of DEA is to promote the education for human resource engaging in environmental education, to conduct monitoring and evaluation for the environmental education projects.

Currently, sufficient budget is not allocated to environmental education sector in state level compared to other sectors of economical and industrial development. In most cases, the environmental education programs / projects in water and sanitation sector are financed by the State Water Resource Fund (FEHIDRO: *Fundo Estadual de Recursos Hidricos*).

The environmental education programs / projects which were conducted by Sao Paulo state are shown in **Table 12.1.1**. As shown in **Table 12.1.1**, SMA's operation on environmental education programs / projects extends in the wide areas from the training of NGO groups, financing support to them to utilizing their capabilities in state level.

Table 12.1.1 Environmental Education Programs / Projects by Sao Paulo State

Name of Program / Project	Year	Implementation Agency	Outline	Good Practice
Operação Litoral Vivo (Operation for Alive Coast)	1996 ～ 1998	CETESB, CEAM and SMA	• Enlightenment campaign for cleansing coast areas in Sao Paulo made for the target of 5.5 Million tourists visiting the coats of and 2.5 million local residents by distributing pamphlets and plastic bag for garbage collection. • Total of 4,500 staffs composing of SMA staffs, municipality staffs, external contractors and volunteers were involved in the campaign in 1997 • 69 teams were formulated for the implementation of the project. SMA assisted municipality staff's nominating works of above contractors and their training.	• The campaign was highly supported by the volunteer groups. • The partnership with public networks including teachers in school education field was created and the campaign results were introduced into the curriculum in the school education. • According to the interview survey conducted by SMA in 1998 summer, 67 % of the tourist visitors the coasts and the local residents built an awareness that the coasts was cleaned up compared to the previous state, and 93 % of them recognized the campaign.
Program on regional environmental education program	1998 ～	CEAM	• The program is to create the regional center on environmental education and expand the regional centers. • The ultimate goal of the program is to promote environmental education in regional level and enhance the capacity of the teachers, government technical officers and NGO groups.	• Each regional center could prepare the training materials on environmental education for the problems specific to the region in collaboration with CEAM
Programa de Apoio às ONGs (*PROAONG*)	2003 ～	CPLEA	• The program is to provide the subsidy to the NGO groups who intend to conduct the activities in environmental conservation based on the partnership with SMA.	• The program is open to the groups who have interests in the field of environment, and it targets mainly the teachers who are conducting primary, secondary education, the staffs in environmental department in business enterprises and union persons.

(3) Environmental Education by SBC City

SBC city put the environmental education as an important tool which can settle the environmental, social issues and improve the quality of civic life. Its policy on environmental education is that a process for changing individuals and society is necessary for public projects and the environmental education is to bring the citizens the understanding on the necessity of environmental improvement.

The environmental education in SBC city is mainly conducted by Housing and Environment

Bureau (SHAMA: *Secretaria de Habitação e Meio Ambiente*) and Education and Cultural Bureau (SEC: *Secretaria de Educação e Cultura*). SHAMA mainly conducts the public enlightenment in community level, while SEC conducts the environmental education in the field of school education.

SHAMA conducts the public enlightenment in irregular and squatter residential areas for the purpose of implementation of appropriate land use for water source conservation in Billings Lake basin, the public campaign toward segregation and garbage recycle and the environmental restoration of *Mata Atlantica* (Atlantic mountains).

Some of the environmental education programs conducted by SHAMA are "*Bairros Ecológicos*" and "*Lixo e Cidadania*", which are shown in **Table 12.1.2**.

"*Bairros Ecológicos*" is a public enlightenment campaign on appropriate land use and the importance of water which aimes at the environmental conservation for the environmental restoration, urban planning and water source through community participation. In the program, the creation of green space in individual houses and permeable pavement near the residential areas were implemented in community level.

"*Lixo e Cidadania*" is the public enlightenment program targeting the scavengers dwelling in Alvarenga district in SBC city which has a former open dumping site located at Alvarenga district in SBC city. The program was formed by the finance support of UNICEF and Canadian NGO, which is to train and encourage the scavengers who is currently depending on the garbage collection to earn their livings through garbage recycling,

Table 12.1.2 Environmental Education Programs / Projects by SBC City

Name of Program / Project	Year	Implementation Agency	Outline	Good Practice
"*Bairros Ecológicos*"	N/A	SBC City	The public enlightenment on appropriate land use and the importance of water, which aimes at the environmental conservation for the environmental restoration, urban planning and water source through community participation.	The program was to promote the community participation for environmental conservation and resulted in the activity of environmental conservation on their initiative.
"*Lixo e Cidadania*"	1997 ～ 2001	SBC City	The program is to provide independence for the scavengers of earning their livings by garbage recycling who had depended on the garbage (target scavengers: 92 households and 372 persons in Alvarenga district).	Public enlightenment program for provide independence for the scavengers of earning their livings. The program was implemented through the technical support by Sao Paulo University.

SEC who is charge in the environmental education in the field of school education, and SEC conducts the environmental education in schools dealing with water issue, reuse of domestic garbage (kitchen garbage), general environment, energy saving, reduction of slid waste and use of recycled paper.

The priority subject in SEC's environmental education is shown as below;

- Water: Its importance and the education toward the reduction of water consumption
- Re-use of kitchen garbage: The education that the kitchen garbage can be changed into organic fertilizer and it can produce vegetables in garden spot.
- General environment: Nature conservation of *Mata Atlantica*, water pollution in Billings Lake, importance on protection of flora and fauna species under endangered state
- Understanding on energy saving
- Importance on reduction of generation amount of solid waste
- Recycling of used paper and production of recycled paper

In addition, a public environmental education center named *Chácara Silvestre* located in northeast part of SBC. However, only the photographs of the settlers in old times of SBC city and the cultural assets are exhibited there and major activities using the center have not been conducted there.

(4) Environmental Education in SABESP

SABESP, the water and sewerage company, conducts the social action projects for environment-related works, community improvement and environment education.

As for environment education projects, SABESP conducts various projects on water and environment in public enlightenment. The education guidance program is one of the education projects, and through the program SABESP conducts the support for the teachers participating in after-school activities.

SABESP has a huge organization structure with its employees exceeding 17,735, and its environment education is conducted independently in each operation unit. As for the operation and management in ABC regions including SBC city, the South Unit of water and sewerage in Sao Paulo Metropolitan Region conducts the planning, its implementation and management for education programs. SABESP obligates the employees to attend the training on environment education for exceeding 60 hours a year, and it intend to promote environmental education throughout company.

SABESP's emphasis on environmental education is put on its implementation of different types of education targeting children, adults, corporations and irregular residential areas, etc. As for the issue of water stealing and nonpayment for water tariff collection, the regional staffs of SABESP generally have connection pipes with the residents and conduct public enlightenment through consultations in most cases.

"*Futurágua*", "*Caracol*" and "*Gota Borralheira*" project were carried out by SABESP for environment education projects in the field of school educations. **Table 12.1.3** shows the outlines of above projects. "Futurágua" project was intended to educate 1st to 8th school children of primary schools, and its major object is to bring them the understanding on SABESP's business activity. The object of "*Caracol*" project is to introduce the knowledge on environment / sanitation into the field of education, and to enlighten the importance of water and environmental conservation.

Table 12.1.3 Environmental Education Programs / Projects by SABESP

Name of Program / Project	Year	Implementation Agency	Outline	Good Practice
"*Futurágua*" [1)] project	2001 ～ 2002	SABESP	• The SABESP's staffs visits the schools once a week for 2 months and educated the school children on the importance of water by displaying videos. • In laboratory, they educate the school children on the formation of water, component and water quality analysis.	• According to SABESP, the project brought the education effect not to children but also to the adults, since the details of the project had already been explained to the schools teachers and the parents beforehand.
"*Caracol*" project	2000 ～ 2001	SABESP	• The object of the project is to introduce the knowledge on environmental education in school education related to water and environmental conservation. • The target of the project is the schoolchildren in 1- 4 grades of the primary schools.	• The project introduced the method of "learning by playing". • According to SABESP, the school children could learn social problems by being stimulated with each other.
"*Gota Borralheira*"[2)] project	2000 ～ 2002	SABESP	• The object of the project is to enlighten the residents on the cycle of water, sewage treatment, garbage treatment and water related diseases. • The project is to promote of changes in the consciousness of the residents and its ultimate goal is to bring the change in the daily life and attitude of the residents.	• The project used the methods of the learning at classrooms, illustrated books and comic books. • Therefore, the project had effect on the schoolchildren in low grades of the primary schools.

Notes:
1) "*Futurágua*" is the word combined with "*Futuro*" (future) and "*Água*"(water) in Portuguese.
2) The word of "Cinderella" is "*Gata Borralheira*" in Portuguese, "*Gata*"was replaced with "*Gota*" (water drop), which means that wastewater and sewage can be changed into clean water.

12.2 Problems related to Environmental Education

The implementation of environmental education is legally regulated, and it is the obligation of the administrative agency for environmental conservation. Actually, various educations are currently implemented by state government, municipalities and the public utility organization such as SABESP. Also, the capabilities of NGO groups are applied in field level.

However, the following issues are pointed out;

- The strategy for long-term, midterm and short-term vision on environmental education is not identified
- The environmental education is implemented independently at each agencies, and it does not bring the exchange nor shearing of mutual information
- The budget allocation for environmental education is not prioritized compared to those for infrastructure development. Therefore, the efficient, the prompt response and long-term continuous operation including using NGO groups cannot be made especially in municipalities
- From the standpoint of water environment improvement of Billings Lake, there is no symbolic facility for environmental education center which can provide the actual training on such knowledge to the basin residents
- The number of staffs engaging in environmental education and their relevant facilities are limited in municipal level, and especially there is a limitation of their capabilities in implementing the public enlightenment education in community.

12.3 Current State on Public Awareness for Environmental / Sanitation and Its Problems

(1) Current State on Public Awareness

The results of the public awareness survey conducted in the JICA study for the Billings basin residents are shown in **Table 12.1.4**. **Table 12.1.4** shows that most of the basin residents are low in income and education level, and most of them engage in manual labor or some engage in some fixed commercial / service business. The ownership or the possession of the basin residents' dwelling land is not clear, and most of the houses are assumed to be built by the illegal development of residential lots or illegal occupation. Most of the residents are not aware that the sewage treatment facilities can contribute to the prevention of the water pollution of the lake. Large portion of the basin residents (more than 60 % of the respondent to the survey) is not willing to pay for the additional water tariff collection after the completion of the proposed sewerage projects. Most of them recognize the water pollution of Billings Lake, and most of the reasons are the untreated waste water effluent causing the lake water pollution. However, very few are aware that irregular dwelling or illegal land use is the cause of such pollution. On the one hand, as for the environmental / sanitation issue including

water pollution, most of them are aware that they need to participate in the community activities in some way.

Table 12.1.4 Results of Analysis on Public Awareness Survey

Survey Item	Results of Analysis
Socio-economy Situation	Most residents are in low income level (low-income or poverty class) (about 71 % of the respondents to the survey)
Education level of householder	Most of the residents (about 55 % of the respondents to the survey) take only primary education, and the 40 % takes secondary or higher education. And only 5.6 % graduates the university course.
Type of occupation	Most of the residents do physical works or engaged in some fixed commercial / service business.
Ownership form of dwelling	The ownership or the possession of the basin residents' dwelling land is not clear, and the dwelling houses are likely to be built by themselves. The houses of 23 % of the respondents are located in the high density of residential areas, where the irregular housing is progressing. Almost all respondents (99 %) furnish toilets or showers.
Situation on public service	The public service of water and electricity supply, garbage collection is provided in the basin area. And about 65 % of the respondents have the connection to existing public sewerage service. 35 % of the respondents discharge their domestic wastewater (kitchen, lavatory and laundry wastewater) directly to the adjacent drain ditch.
Public awareness for sewerage or wastewater and their treatment	Most of the respondents are not aware of the treatment situation after the connection with existing sewer, and they recognize that the crude sewage is directly discharged into rivers and the lake.
Necessity of community or resident participation in environmental issues	Most of the basin residents (71 % of respondents) are aware that the public or community participation is necessary in relation to environmental conservation.
Necessity of community or resident participation in public service	Most of the basin residents (50 % of respondents) are aware that the public or community participation is necessary in relation to public service.
Public awareness on water pollution of Billings Lake	Most of the basin residents (92 % of respondents) are aware of the environmental pollution of Billings Lake, and most of them point out the garbage sediments and odor issue. Few of the respondents are aware that industrial wastewater and irregular residential areas of illegal housing areas cause the water pollution of Billings Lake, while most of them recognize that garbage or plastic dumping, untreated sewage causes such pollution.
Necessity of measures by residents' action or administrative body's measures for water pollution prevention or environmental improvement	Most of the residents (over 75 % of respondents) are aware that re-use of garbage, increase of green space, development of sewerage facilities and the resettlement of the residents dwelling at dangerous areas are necessary as direct actions or measures for environmental improvement.
Willing to pay for water tariff	Most of the residents (60 % of respondents) are not willing to pay for the additional water tariff collection after the completion of sewerage facility. Most of the reasons are the raise of the water tariff. Some residents have the skeptical views on how the water tariff is used. The remaining respondents (40 % pf total respondents) agree with the additional tariff collection.

(2) Problems related to Public Awareness on Environment / Sanitation

Table 12.1.5 shows the current problems on the basin residents' awareness on the environment / sanitation which were analyzed from the public awareness survey targeting the basin residents. The basin residents are low in socio-economic situation (income) and education level, and it is quite unlikely that they have the scientific knowledge related to

environment-related issues of water pollution and its treatment. And, it is a critical problem for the residents that they are not aware of the inappropriate land use including irregular residential areas causing water pollution. In addition, as for the residents' skeptical view on how the additional tariff collection is used by the project proponent, it is estimated that there is a shortage of the mutual communication between the residents and the public utility organization, or a shortage of accountability from the project proponents to the residents.

Table 12.1.5 Problems related to Basin Residents' Awareness on Environment / Sanitation

Type of Problems	Details of Problems
Low income and education level	Most of the residents are low in income and education level, do not have sufficient knowledge on sewage treatment process and environment / sanitation.
Insufficient recognition for legal housing or irregular land use	Most of the residents recognize that the treated sewage currently causes the water pollution of Billings Lake. However, very few residents recognize that legal housing or irregular land use cause water pollution.
Not willing to pay for water tariff	Most of the residents are not willing to pay for the water tariff collection by the reason of their low income level and the increase of water tariff. Some residents are not willing to pay since they have skeptical view how such tariff is used.
Not good communication between basin residents and public utility organization	Communication between basin residents and public utility organization is unlikely to work out well as shown in the survey result that some residents have skeptical view how such tariff is used by the public organization.

12.4 Master Plan on Public Enlightenment and Environment Education

(1) Approach Method

The master plan on the environmental education for the environmental improvement in Billings Lake basin should be established from two different viewpoints, namely, an environmental education in the field of school education and a public enlightenment in community level. The current situation causing water pollution greatly differs from those of Japan as already mentioned previously that the basin residents are low in income and education level, not willing to pay for the water tariff after the development of the future projects and that inappropriate land use is progressing in its conservation area for water source. Therefore, the special situation should be taken into consideration for the establishment of the master plan for above public enlightenment and environmental education.

The basic approach and its development policy for the establishing the master plan on environmental education is shown as below.

1) Regional Differences on Pollution Load

The pollution load is currently higher in the western parts of Billings Lake basin and Riberon Pires with its high density of population. On the contrary, these figures are comparatively lower

in the rural areas of the southern lakeside compared to above high populated areas. Therefore, for the captioned development, the north-west part of Billings Lake basin (north-west part of SBC city, Diadema, South-east part of Sao Paulo city and Riberon Pires city area) should be prioritized regionally.

2) Education by Development of Environmental Protection Center

Environment education in the field of school education is legally obligated to administrative agencies and its activity is actually implemented to considerably large degree in the field including using printed materials. However, the education through on-the-job training is not widespread yet. Therefore, it is recommended that an environmental protection center equipped with the facilities shown in **Table 12.1.6** should be developed in SBC city which is located in the central part of Billings Lake basin. At the center, the basin residents will be able to grasp the understanding and learn by experience on the environmental issues focusing on water pollution. Through the center, parents and children will be able to experience on-site training and the basin residents will enhance their environmental / sanitation knowledge from their low education level. Adjacent to the center, a water quality analysis center equipped with water quality analyzer that can do water quality analysis will be developed in parallel.

Table 12.1.6 Outline of Proposed Environment Education Center

Item	Outline
Location	Land owned to SBC city（Lakeside area of Billings lake is recommended, *Estoril* park, for instance）
Major facilities	• Exhibition room (model display of Billings Lake, history of Billings Lake, flora / fauna in Mata Atlantica, model display of water supply and sewage treatment process) • On-site training room (On-site learning on water quality analysis by using water analysis kit) • Library (Information search room by using computer) • Water quality analysis center (water quality analyzer, computer) • Conference room

3) Low Income Level of Basin Residents

The income level of the basin residents is currently low according to the results of public awareness survey. Therefore, the enlightenment strategy for earning their lives continuously is necessary as well as the conservation of the lake basin. The public enlightenment for the garbage recycling including valuable resources by using the capability of NGO groups is recommended.

4) Low Willingness to Pay

According to the public awareness survey, most of the basin residents (about 60 % of the survey respondents) are not willing to pay for the additional water tariff to be charged after

the facility development of sewage treatment. Most of them have skeptical view for what purpose the additional tariff collection is used. No implementation of connection of house connection pipes with the sewer pipes and no payment by residents will cause adverse impact on not only sanitary issues but also on business operation. Therefore, the steady public enlightenment in community such as the public consultation, distribution of printed materials and the implementation of campaign is recommended.

5) Irregular Land Use

According to the public awareness survey, most of the houses in the lake basin are assumed to be built by illegal development of residential lots or illegal intrusion. Most houses of the survey respondents are located in the areas of high density housing areas where irregular housing land development is currently progressive. On the contrary, few survey respondents are aware that such irregular residential areas are causing the lake water pollution. Therefore, the step-by-step activity for public enlightenment for appropriate land use and the legal / regulatory compliance is necessary by each municipality. By the same way as mentioned in above, the implementation of event or campaign, distribution of printed materials and public consultation in community base are recommended.

6) Lack of Communication among Public Agencies on Environmental Education

The environmental education is actually implemented by state, municipal governments and SABESP. However, the information on each activity seems to be incoherent and lack of mutual communications. The shearing of the information on mutual operation activities on environmental education, their methodology and good practice, etc. is necessary. Therefore, it is necessary to hold periodical workshops on environmental education, to build information network system by using internet, to shear each information and reflect to each activity of environmental education.

7) Capacity Building of Municipalities

The actual state is that the number of staffs engaging in environmental education is few and the budget allocation of its operation is not prioritized compared to infrastructure development. Especially, the public enlightenment in irregular residential areas in Billings Lake basin is important for environmental conservation for reduction of sewage and domestic wastewater. For that reason, the step-by-step activity for public enlightenment by each municipality is necessary. In order to achieve such enlightenment, the capacity building for the increase of the staffs for establishing strategies and project / program management, development of relevant facilities and implementation of periodical training is recommended.

8) High Willingness to Participation in Activity for Environmental Improvement

According to the public awareness survey, large number of basin residents recognizes of the necessity of community's or public's participation in environmental issues, which shows high willingness of the basin residents' to participate in the environmental improvement activities. Therefore, the cleaning activities of lakes and rivers by the community's initiatives and public participation are recommended based on the municipality's public enlightenment.

(2) Implementation Program for Environmental Education Project

1) Implementation Schedule

The schedule aimed at the target year of 2025 on the proposed environmental education based on above mentioned conditions is shown in **Table 12.1.7**. The projects for environmental education and the public enlightenment for basin residents' willing to pay should be developed by considering the facility development of sewerage projects, while others shall commence in 2007.

Table 12.1.7 Overall Implementation Schedule on Public Enlightenment and Environmental Education Projects

No.	Name of Project	Year																		
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1	Environmental Education Center Development Project (SBC City)																			
2	Environmental Education by using Environmental Education Center																			
3	Public Enlightenment for Sustainable Garbage Recycling																			
4	Public Enlightenment for Willing to Pay or connection to Sewer Pipes																			
5	Public Enlightenment for Appropriate Land Use																			
6	Workshops on Environmental Education																			
7	Development of Information Network for Environmental Education																			
8	Capacity Building of Municipalities on Environmental Education																			
9	Public Enlightenment for Participatory Projects for Cleaning of Billings Lake and Surrounding Rivers																			

12.5 Possible Software Measures

Many listed as software measures is concerned with the daily life style or action of the stakeholders such as the people, schools, NGOs, agricultural associations, housing estate developers, etc., or rely on their cooperation or voluntary activities. Therefore, the formation of a system, not as the project, that is able to maintain such activities is a problem. Public enlightenment and environmental education, construction of the Environmental Centre for Experimental Study, and formation of the Association of "Clean the Lake Billings" proposed in relation to the establishment of organizational and institutional systems are all concerned with this.

Although some of software measures have already conducted at present, it is advised that all will be developed as the basin-wide movement without waiting for the completion of projects proposed.

(1) Concerned with the life style/business style of the people/entrepreneurs

- Proper use of groundwater
- Reduction of water consumption
- Reduction of pollutant loads by domestic wastewater generated at the kitchen, etc.

Out of pollutant loads, that from domestic wastewater has the biggest contribution at present and increasing tendency in the future due to the increase of population in the basin. It still takes much time to complete the provision of a sewerage system in the basin. For this reason, it is necessary to reduce the pollutant load generated in the basin. However, as the pollutant loads derived from industrial and livestock wastewater have been already not in a problem level, the main target is domestic wastewater. Since the pollutant loads are calculated by the following equation, the basis is "No Discharge, No Pollution" for wastewater.

[Pollutant loads] = [Concentration of wastewater] x [Wastewater flow generated]

As this may require the people to change the life style, it is recommended to enlighten the people repeatedly through a variety of channels such as public relation to the people, works on communities, school education (from children to families) and so on.

(2) Concerned with the participation in the activities for the basin environment improvement

- Restoration of natural forest

The restoration of natural forest that was lost during the World War II has been fruitful, but

the current problem depends on how such forest will be protected from the wave of urbanization and extended in the future

- Cleaning of the lakeside

- Cleaning of the streams

The garbage spread along the lakeside and riverside is visually unpleasant and causes heavy damage to the lake and streams, all the more in case that it is used for a water source. The lake and streams are used for a dumping site of garbage in some cases and the garbage placed on somewhere is washed out by the stormwater during rainfall in other cases. The both cases are apt to occur at the area where a garbage truck has no access over there. In such an area, it is effective to work on the people through community association.

- Removal of water bloom and algae

The SABESP has been forced to remove the water bloom and algae in the Rio Grande Arm for operation and maintenance of the intake works and water treatment plant. Even though they die in the lake, as they become a new internal pollutant source in the lake, it is the best way to remove them from the lake as the SABESP has conducted.

(3) Concerned with legal compliance or administrative guide

- Proper land use

It is important to require the housing estate developers for the strict compliance with the law, and to monitor and regulate what they have done actually, not so as to increase the sub-normal houses any more. The order of improvement for illegal building should be issued in the earliest time, before they have the floor with a progress of building on the loose.

- Improvement of fertilizer application

- Soil erosion from firms

In the basin of the Lake Billings, the firms are found in the basin of Borore Arm and Taquacetuba Arm where vineyards and Chrismas tree plantations are managed in a small-scale. As the fertilizer applied to those crops has a fear to be washed out together with soil, the farmers should take measures for such soil erosion, especially at the slope. As there is an intake works of the SABESP in the Taquacetuba Arm, it is recommended to work on actively the farmers for proper fertilizer application and minimization of naked land.

Chapter 13

SUMARRY OF M/P

13 SUMMARY OF M/P

13.1 Background

13.1.1 Brief History of the Lake Billings

The Lake Billings is the reservoir constructed for power generation at Henry Borden Power Plant by dropping water over the Ridge of Coastal Mountains. From the beginning, the pumping of water from the Tiete River, which runs through Sao Paulo, to the Lake Billings through the Pinheiros River has been conducted to supplement a lack of natural runoff therein. This has another purpose to alleviate the occurrence of flood in Sao Paulo. The Rio Grand Water Treatment Plant of the SABESP was commissioned in 1958 by taking water at the Rio Grande Arm for water supply. However, water pumped from the Tiete River has changed to polluted water which has caused the problems such as offensive odor, forming and algae growth. Due to this, the SABESP was constructed the weir beneath the Anchietta Highway across the Lake Billings and completely separate the Rio Grande Arm from the Lake Billings in 1982. The 1988 Constitution of the Sao Paulo State called for the proper measures not so as to bring polluted water to the Lake Billings within three years. As it was impossible to provide sewerage within such a period, it was made a condition to allow pumping of water from the Tiete River to the Lake Billings at the time when a river flow exceeded 160 m3/sec, or Sao Paulo enters on alert for flood.

The Lake Billings got a lead to improve water quality by this limitation of pumping, but the development of Greater Sao Paulo has already extended to the basin of the Lake Billings and the basin population has expanded from 110,000 in 1970 to 860,000 in 2000, or about eight times. Such domestic wastewater has been almost discharged into the Lake Billings without any treatment.

Apart from the intake from the Rio Grande Arm, the SABESP has commenced the pumping of water from the Taquacetuba Arm of the Lake Billings to the Lake Guarapiranga for water supply in 2000.

13.1.2 Situation of Water Pollution in the Lake Billings

The CETESB has monitored water quality at four points of the Lake Billings and two points of the Rio Grande Arm. **Table 13.1.1** shows the comparison of average water quality between 2005 and the past ten years (1995-2004) in both lakes.

- The improvement of water quality is observed between 2005 and the past ten years (1995-2004), or BOD_5 was improved at four points our of six points (4/6), NH_4-N at 4/6, TP at 6/6 and at Chl-a at 4/5, while NO_3-N was worsened at five points our of six points (5/6).

- The concentration of BOD_5 does not meet the environmental standards for Class 2 (≤ 5mg/L) at Pedreira Dam and the SABESP's intake points of the Taquacetuba Arm.
- The concentration of DO meets the environmental standards for Class 1 (≥6mg/L) at all monitoring points.
- The concentrations of NO_2-N and NO_3-N meets the environmental standards for Class 1 (≤ 1mg/L and ≤10mg/L, respectively) at all monitoring points.
- The concentration of TP meets the environmental standards for Class 2 (≤30μg/L) only at SABESP's intake points in the Rio Grande Arm.
- The TN/TP ratio of 29 to 49shows the existence of abundant nitrogenous component.
- The concentrations of TN and TP in the Lake Billings and t Rio Grande Arm indicate a high level of eutrophication.
- Based on the Vollenwider's eutrophication criteria for Chlorophyll-a, the situation of Pedreira Dam and the confluence with the Taquacetuba Arm and the SABESP's intake point at the Taquacetuba Arm is classified into the high level of eutrophication (>25μg/L) in which the water bloom is apt to occur.
- Since 2000, the occurrence of water bloom has been outstanding in the Rio Grande Arm.
- According to the bottom sediment estimation based on the thickness survey in the Lake Billings. The volumes of bottom sediment are 47 million m^3 at an average thickness of 51 cm in the Lake Billings and 5 million m^3 at 34 cm in the Rio Grande Arm.

Table 13.1.1 Water quality of the Lake Billings and Rio Grande Arm

Lake		Unit	Lake Billings				Rio Grande Arm	
			BILL02100	BILL02500	BILL02900	BITQ00100	RGDE02200	RGDE02900
			Pedreira Dam	Confluence with the Taquacetuba Arm	Summit Dam	SABESP's Intake pt.	Confluence with the Rio Grande	SABESP's Intake pt.
BOD_5	1995-2004	mg/L	7.5	4.9	4.4	6.3	5.1	3.4
	2005	mg/L	5.2	4.5	3.8	4.4	5.2	3.5
DO	1995-2004	mg/L	7.5	7.6	8.0	10.1	8.3	7.4
	2005	mg/L	7.5	8.77	8.7	9.9	8.6	7.5
NH_4-N	1995-2004	mg/L	0.26	0.11	0.09	0.12	0.74	0.26
	2005	mg/L	0.22	0.11	0.17	0.09	0.61	0.19
NO_2-N	2005	mg/L	0.12	0.05	0.01	0.03	0.05	0.04
NO_3-N	1995-2004	mg/L	0.98	0.64	0.48	0.36	0.73	0.53
	2005	mg/L	2.63	0.97	0.20	0.48	0.89	0.63
Kjd-N	2005	mg/L	1.64	1.18	0.95	1.31	1.38	0.59
TN	2005	mg/L	4.38	2.20	1.16	1.82	2.81	1.26
TP	1995-2004	mg/L	0.149	0.053	0.064	0.087	0.100	0.066
	2005	mg/L	0.090	0.052	0.040	0.053	0.058	0.027
Chl-a	1995-2004	µg/L	83.4	42.1	20.3	56.8		12.6
	2005	µg/L	67.8	41.3		52.5		7.0
TN/TP	2005		49	42	29	34	48	47

Source: CETESB, "Relatório de Qualidage das Águas Interiores no Estado São Paulo – 2005"

13.1.3 Situation of Pollutant Sources

The possible external pollutant sources other than domestic wastwater in the Lake Billings basin areindustrial wastewater, agricultural wastewater, livestock wastewater, pumping water and stormwater in addition to the internal pollutant source. The findings of the survey on pollutant sources are as follows.

- There are four small-scale wastewater treatment plants in in the Lake Billings basin at present. The treated populations are 2,300 at Pinheirinho (SBC), 7,700 at Riacho Grande (SBC), 52,400 at Ribeirao Pires and 8,700 in Rio Grande da Serra that totals to 71,100 against the total basin population of 865,900. That is to say, only 8% of the total population is served by sewerage in the basin (See **Table 13.1.2**). Furthermore, effluent from Pinheirinho and Ribeirao Pires Wastewater Treatment Plants does not meet the requirements of the CETESB.

- The CETESB, or the state regulatory agency for water quality strictly monitors effluent from the factories with the authority of operation stoppage. The factory is forced to install the wastewater treatment plant individually or convey all wastewater outside the basin after tentative storage. In its premise.
- The livestock industries that their existence was reported in “Billings 2000” have plunged into business closure or transfer. Therefore, it will not be a great threat in future
- In the agricultural field, there are no large-scale farms and crops which require large fertilizer.

Table 13.1.2 Sewerage coverage in the basin of the Lake Billings

Name of municipality	Agency	SEADE’s pop. projecion (2005)		Sewerage coverage		Sewerage coverage in the basin	
		Total	Urban	Conn. rate	Treatment rate	Basin population	Treated pop. in the basin
Sao Paulo	SABESP	10,744,060	9,934,108	93	66	469,041	
Diadema	SANED	380,838	380,838	80	0	59,804	
SBC	SABESP	768,592	756,021	84	3	188,181	10,000
Santo Andre	SEMASA	669,076	669,076	96	0	25,283	
Ribeirao pires	SABESP	115,195	115,195	65	70	86,470	52,413
Rio Grande da Serra	SABESP	41,041	41,041	25	85	34,225	8,721
						863,004	71,134

Note: The estimated served population for treatment are 2,300 at Pinheirinho WWTP and 7,700 at Riacho Grand in SBC.
All served population for treatment at Ribeirao Pires and Rio Grande da Serra WWTPs live in the basin of the Lake billings.

Due to the above-mentioned reasons, the pollutant sources in the basin of the Lake Billings are narrowed to domestic wastewater, storm water and pumping water in addition to the internal pollutant source.

The composition of generation and runoff pollutant loads are estimated as shown in **Figure 13.1.3**. The removal of the load by pumping water is considered to be difficult from by nature.

The load composition is domestic sewage: storm water = 20.094:2.560 = 89:11 in the Lake billings and 75:25 in the Rio Grande Arm. As for TN and TP, the percentage of domestic wastewater is slightly up from this, hence the measures for domestic wastewater is the greatest issue for water pollution control in the Lake Billings.

Table 13.1.3 Composition of BOD load in 2005

		Domestic sewage (ton/day)	Storm water (ton/day)	Pumping water (ton/day)	Internal pollutant source (ton/day)	Total (ton/day)
Lake Billings	Generation	43.500 (77.0)	2.560 (4.5)	10.417 (18.4)		56.477 (99.9)
	Effluent	20.094 (60.8)	2.560 (7.7)	10.417 (31.5)		33.071 (100.0)
Rio Grande Arm	Generation	10.003 (87.0)	1.492 (13.0)			11.495 (100.0)
	Effluent	4.581 (75.4)	1.492 (24.6)			6.073 (100.0)

Note: Figures in parenthesis shows the composition rate (%).

13.1.4 Current measures and their evaluation

The agencies concerned with the State of Sao Paul and basin-involved municipalities have extended the measures for basin environment improvement as described below.

(1) CETESB

The CETESB is the state regulatory agency of environment and responsible for regular water quality monitoring of the Lake Billings and regulates industrial wastewater strictly. The factories that discharge industrial wastewater in the basin of the Lake Billings install their own industrial wastewater treatment plant and dispose effluent through land application to minimize the discharge into the Lake Billings or store wastewater in the pond to convey outside the basin for treatment requesting the professional company.

(2) SABESP

The SABESP is the service provider for water supply and sewerage that the State Government of Sao Paulo is the major stockholder, and has a policy to convey all domestic wastewater generated in the basin of the Lake Billings, excluding the southern area of Sao Bernardo do Campo and Santo Andre, outside the basin for treatment at existing Barueri and ABC Wastewater Treatment Plants. The former receives domestic wastewater from Sao Paulo, while the latter from Diadema, Sao Bernardo do Campo, Santo Andre, Ribeirao Pires and Rio Grande da Serra. In line with this policy, the construction works of the trunk sewers and pumping stations are now going in Sao Paulo, Ribeirao Pires and Rio Grande da Serra. The trunk sewer to convey wastewater generated in Ribeirao Pires and Rio Grande da Serra outside the basin was planned to connect to Solvay Industry Co., the largest discharger of industrial wastewater in the basin by June 2006, but its construction work is suspended as of October 2006 due to the accident.

(3) Diadema

The Municipality of Diadema providing sewerage service independently completed the construction of Eldorado Pumping Station in the basin of the Lake Billings which has been already into operation to convey wastewater to the Couros River running along the boundary between Diadema and Sao Bernardo do Campo outside the basin.

(4) Santo Andre

The Municipality of Santo Andre also providing sewerage service independently similar to Diadema has proceeded with sewerage construction in the basin of the Lake Billings.

(5) Sao Bernardo do Campo

The SBC transferred water supply and sewerage services to the SABESP on January 2004 regulates the livestock industry in the basin of the Lake Billings and extends the Eco-town Movement involving the permeable pavement by the Municipality and permeable sidewalks by residents. In addition, the municipality has endeavored to maintain good housing estates through strict check of applications and tackled the regularization problem of sub-normal residential areas.

In addition to the above, the projects to be extended in the basin of the Lake Billings were elaborated based on the following observation and experience:

(1) As a whole of the Lake Billings basin, the treatment rate of wastewater is too low notwithstanding that the load by domestic wastewater is largest.

(2) In the basin of the Lake Billings, Sao Bernardo do Campo is most behind in sewerage construction for lack of the master plan for sewerage in comparison with those in other relevant municipalities..

(3) The present water quality monitoring by the CETESB and SABESP put a focus on the Central Channel from Pedreira Dam and Summit Dam or the intake point in the Taquacetuba Arm, and from the Ribeirao Pires to the intake point in the Rio Grande Arm, but not cover the arms and their streams of both lake. It should be noted that the water pollution status in those arms and streams reflects the problems involved in their basin with reality and affects resultantly on the condition in the Central Channel.

(4) The findings through the Environmental and Social Awareness Survey to the basin people are as follows:

- Less awareness for the lake pollution by themselves.
- Low awareness for willingness to pay for sewerage
- High awareness for people involvement in environmental improvement activities

(5) The findings in the effort for environmental improvement of the basin by the municipalities are as follows:

- No facility that becomes the core for practical lesson on environmental knowledge from the viewpoint of water quality improvement in the Lake Billings
- Lack of cooperation between relevant municipalities for environmental education
- Lack of capabilities in relevant municipalities for environmental education

(6) Taking into account the present endeavor for basin-environmental improvement, it is necessary to consider the project development so as to promote and supplement such endeavor.

(7) Based on the experiences in water quality conservation program for lakes and marshes in Japan, it is recommended to consider the basin-environmental improvement from the viewpoint of maintenance of sound hydrologic cycle (in both quantity and quality), ecological conservation, strengthening of linkage among water, human and green, and study and research.

<Reference: Water balance accompanied with wastewater conveyance outside the basin>

The water balance in the Lake Billings in 2005 is roughly as follows excluding groundwater due to the unknown:

<u>Inflow</u>		
Storm water runoff	19.98 m^3/s	(see **Table 7.3.5**)
Domestic wastewater	0.73 m^3/s	(see **Table 7.3.5**)
Pumping water	2.93 m^3/s	(see **Table 1.1.4**, average for 2001-2004)
Total (A)	23.64 m^3/s	
<u>Outflow</u>		
Intake for water supply	4.8 m^3/s	(from the Rio Grande Arm)
Intake for water supply	4.0 m^3/s	(from the Taquacetuba Arm)
Total (B)	8.7 m^3/s	
Balance (A) - (B)	14.94 m^3/s	(for power generation)

Accordingly, the percentage of a wastewater volume to the total inflow is only 3.1% (=0.73 / 23.64). A wastewater volume of 0.73 m^3/s is equivalent to 45.6% of the estimated total wastewater volume generated in the basin of 1.60 m^3/s (= 863,000 x 0.160 / 86,400).

When the basin population is increased to 1,393,000 in 2025, the estimated total wastewater volume generated in the basin of 3.22 m^3/s (= 1,393,000 x 0.200 / 86,400), out of which a runoff is 1.48 m^3/s (3.22 x 0.46 = 1.48 m^3/s). Even if this volume of 1.48 m^3/s is conveyed outside the basin, it is only 6.0% of the total runoff. Therefore, such an amount is not so great as to break the water balance and to give a threat on ecology.

13.2 Outline of Measures and their Appropriateness

Based on the studies on the present situation, policies and so on as stated in **13.1**, the possible measures considered necessary for improvement of water quality of the Lake Billings are shown in **Table 13.2.1**.

By sewerage construction, it is considered that almost incoming pollutant can be reduced, and in addition, further load reduction is possible through the implementation of other measures in **Table 13.2.1** integrally.

However, the pollutant load elution from 52,000,000 m^3 sediments piled in the lake bottom and pollutant load inflow by pumping the Tiete River water on alert for flood is postponed as the future problems. Dredging of sediments requires a huge construction cost and a long time, even though limiting sites for dredging. There are probably many obstructions for actual implementation.

The pumping of the Tiete River water is a necessary measure to mitigate and reduce the damage by flooding. For this reason, pollutant load inflow by pumping is unavoidable, until the Tiete River restores previous clean flow

Therefore, the basic policy of the project is to dilute nutrients continuously with incoming river water by thorough reduction of pollutant load derived from domestic wastewater. In addition, it is proposed to study a nutrient intake capacity by local suspended aquatic plants such as water hyacinth, etc. and to utilize its outcome for lowering a nutrient concentration. However, such aquatic plant has not only an advantage but also a disadvantage, it should be implemented based on the sufficient study results. It is recommended to research various aquatic plants using a pilot plant for lake purification by aquatic plants for application to water quality improvement.

Table 13.2.1 Objectives and considerations of the projects proposed in the Master Plan

	Objectives			Considerations
	Water Quality improvement (BOD reduction)	Restoration of water volume (groundwater recharge)	Others	
Sewerage construction in urban areas	55,209 kg/day[1)]	—	—	
Sewerage construction in isolated communities	2,093 kg/ day[2)]	—	—	Phosphorous removable Spread and management of septic tanks and thorough infiltration disposal of their effluent in other areas
Environmental centre for experimental study	—	—	Provision of the place for experimental study Education of leaders in eco-towns Support to civic activities for basin environment improvement Dispatch of environmental information	
Water quality management centre	—	—	Water quality monitoring Development of lake purification technology	Water quality monitoring is not done at arms and rivers at present.
Permeable pavement	355 kg/day (see **11.4**)	3,677,000 m^3/yr[6)]	Protection of unpaved roads from soil erosion Improvement of living environment	Regulation by state law Requirement in regularization of sub-normal residential areas SBC calls the people to join ”Eco-town Movement” (Bairro Ecológico) and to make sidewalks permeable.
Park provision	184 kg/day[3)]	5,810,000 m^3/yr[7)]	Protection of vacant land from soil erosion Protection of favera formation (SBC has experienced compulsory clearance of favela in the past.)	SBC has a plan to construct a park in parallel with the works for trunk installation and river improvement along the Alvarenga Stream.
Former Alvarenga solid waste dumping site	1 kg/day[4)]	307,000 m^3/yr[8)]	Storage of leachate and its conveyance to the ABC WWTP for treatment	Danger area for steep slope collapse Danger area designated by the CETESB
Bottom sediment dredging[5)]	T-N 633 kg/日 T-P 26 kg/day (see **11.8**)	—	Reduction of elution pollutant load from sediments piled in the lake bottom	Occurrence of odor and methane gas locally It is difficult to identify the effect of sediment dredging due to continuation of pumping the Tiete river water.
Installation of a pilot plant for lake purification using aquatic plants	—	—	Technology development for TN and TP removal as causing materials of eutrophication	Pilot plant scale

1) 1,022,387prs. x54 g/capita・day= 55,209 kg/day

2) (37,159prs. + 4,041prs.) x 54 g/capita・day - (5,945 m3/day+647 m3/day) x 20 mg/L/1000 = 2,093 kg/day (see Tables **22.1.2**, **22.1.5 and 22.2.1**)

3) Difference of generation load between the low income residential area like favela (400 g/ha・day) and a park (11 g/ha・day)

   4,727,748 m^2/10,000 x (0.400 kg-BOD/ha・day- 0.011 kg-BOD/ha・day) = 184 kg/day (see **11.5**)

4) 201 mg/L/1000 x 3.46 m^3/day= 1 kg/day (see **25.1**)

5) BODelution is abbreviated due to no data. The removal amount of TN and TP is calculated by limiting the dredging area to a part (1/4) of Alvarenga Arm

6) Total rainfall below 10 mm/hr + Rainfall of 10 mm multiplied by rainfall frequency over 10 mm/hr = (667.7 mm + 293.3 mm) + (10 mm x 268 times/10 yr) = 1,229 mm/yr

   2,991,949 m^2 (total area of unpaved roads) x 1,229 mm/yr = 3,677,000 m^3/yr

7) 4,727,748 m^2 (total area of parks proposed) x 1,229 mm/yr = 5,810,000 m^3/yr

8) 250,000 m^2 x 1,229 mm/yr = 307,000 m^3/yr

Table 13.2.2 Outline of the projects proposed in the Master Plan

	Executing agency	Outline of the Project
Sewerage construction in urban areas	SABESP, Diadema, santo Andre	On assumption that sewerage construction in the basin of the Lake Billings in the will be done by SABESP, Diadema and Santo Andre as planned, sewerage construction is proposed for the northern part of the Lake Billings in Sao Bernardo do Campo will be provided with sewerage Trunk sewers and sub-trunk sewers: 32.9 km, Sewers: 104.2 km, Main pumping stations: 3, other pumping stations: 78
Sewerage construction in isolated communities	SABESP	Riacho Grande District (SBC): Expansion of service area + Reconstruction of an existing WWTP using a OD process with phosphorous removal Served population: 37,000prs., Treatment capacity: 7,140 m^3/day Santa Cruz District (SBC): Sewer installation (partially) ＋New construction of WWTP using a OD process with phosphorous removal Served population: 4,000prs., Treatment capacity: 780 m^3/day Cost: R$23million (JY120 million)
Environmental centre for experimental study	SBC	Building in Estoril Park (SBC) Structure: Reinforced concrete and Steel (Partially), Floor area: 2,700 m^2 Construction cost: JY 0.43billion (R$ 8.2 million) including the water quality management centre
Water quality management centre	SBC	Building in Estoril Park (SBC) neighboring the Environmental centre for experimental study
Permeable pavement	Basin-involved municipalities	Lakeside areas of the Lake Billings in Sao Paulo, Diadema and Sao Bernardodo Campo Total length: 502km, Total paved area: 465ha, Cost: R$465 million (JY2,470 million)
Park provision	Basin-involved municipalities	Public parks and greens planned in Sao Paulo, Diadema and Sao Bernardodo Campo Total park area: 473 ha, Cost: R$18.4 million (JY96 million)
Old Alvarenga solid waste dumping site	SBC	Located in Sao Bernardo do Campo, Works included: earth coverage, collection and storage facilities for leachate, plantation an gas emission pipe at the high zone, roads and drainage facilities in the low zone Working area: 25 ha, Cost: R$12.0 million (JY62 million)
Bottom sediment dredging[5)]	Basin-involved municipalities	Arms in Sao Paulo, Diadema and Sao Bernardodo Campo, Works included: dredging by pumps, ship conveyance, land conveyance by vacuum cars Total working area: 705 ha for eight arms, Cost: R$ 480 million (JY2,500 million) Working area: 15 ha (limited to 1/4 of Alvarenga (Pereira), Cost: JY5.3 million
Installation of a pilot plant for lake purification using aquatic plants	SBC	Waters in front of the Pinheirinho WWTP (Sao Bernardodo Campo) Waters area: 2,250 m^2, Aqatic plants: water hyacinth, Cost: R$0.7 million (JY3.5 million)

13.3 Project Implementation Program for Master Plan

The project implementation program is shown in **Figure 13.3.1**, dividing into software measures and engineering measures.

The whole period is divided into Phase 1covering from 2005 to 2015 (design year for a middle-term) and Phase 2 from 2016 to 2025 (design year for a long-term). The sewerage construction in the urban areas will be completed in Phase 1, while that in the isolated communities for three years starting from 2010 in Phase 1.

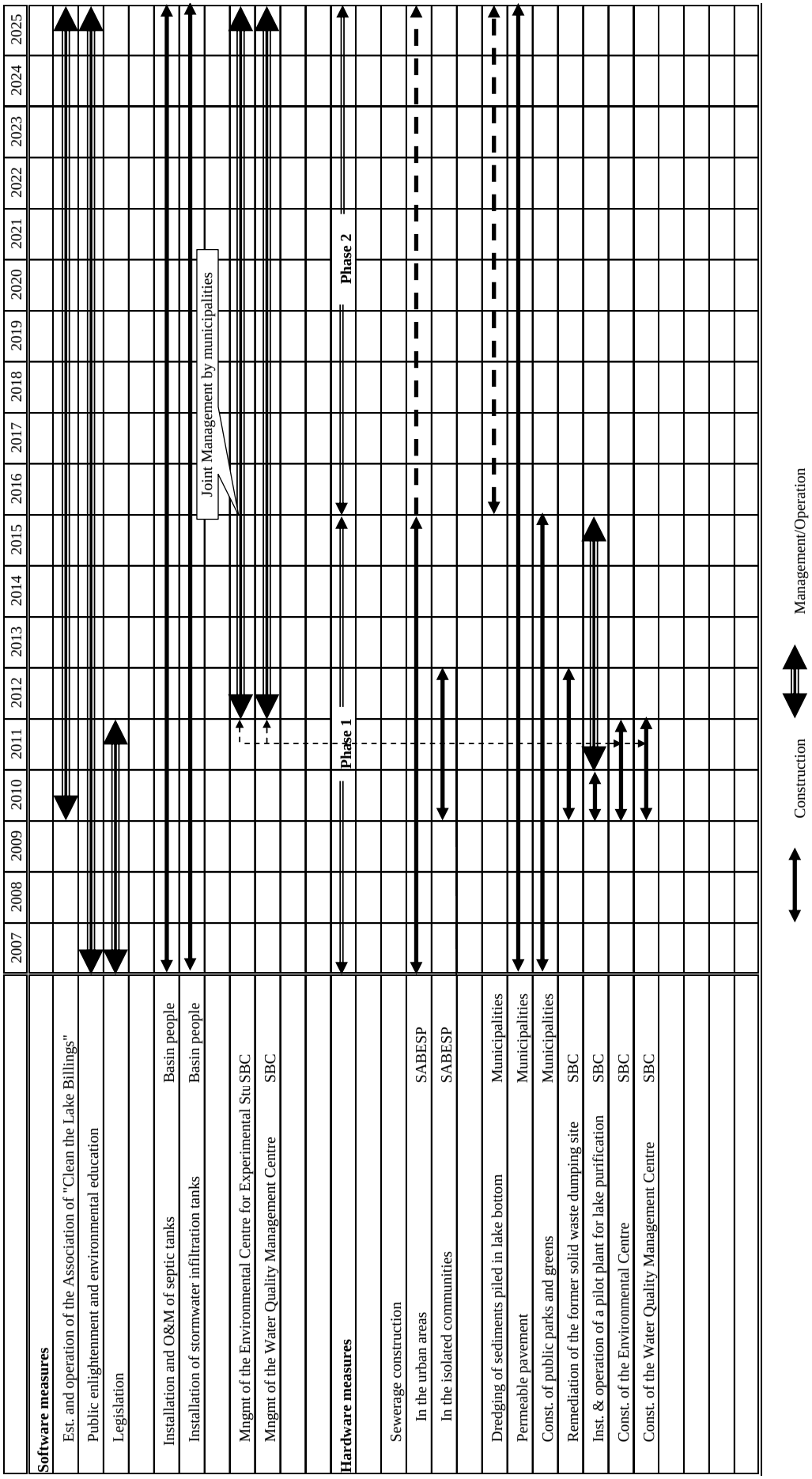
The residential areas to be not sewered is better to be provided with private septic tanks as early as possible, but installation of septic tanks will be continued by 2025, since a new housing is provided with a septic tank by its completion.

Dredging of sediments piled in the lake bottom and construction of public parks and greens are scheduled in Phase 1.

The projects to be undertaken by the Municipality of Sao Bernardo do Campo is basically implemented in Phase 1

Out of software measures, public enlightenment and environmental education shall start immediately and be basically conducted permanently. Legislation will be prepared in the earliest time. The Association of “Clean the Lake Billings” is desirable to be established as early as possible to move towards basin environment improvement of the Lake Billings, it is assumed to start its activity in earnest from 2010.

Figure 13.3.1 Project Implementation Programme for Master Plan



Chapter 14

ORGANIZATIONAL AND INDUSTRIAL PROGRAM

14. ORGANIZATIONAL AND INDUSTRIAL PROGRAM

14.1 Organizational and Institutional Program

14.1.1 System for Program Promotion

Once the lake or lagoon was polluted, it is not easy to restore the previous conditions, requiring a long time and accumulation of little efforts. This restoration cannot be done by the individual stakeholder solely, but can be achieved by sharing the roles among stakeholders in the whole basin and coordinating mutually. For this purpose, it is recommended to organize the Association for "Clean the Lake Billings" collecting all the stakeholders concerned with the Billings Lake as shown in **Figure 14.1.1**.

Most stakeholders consider that he is always one of victims and never consider that he may be one of polluters. Before being grieved watching the polluted lake, let's consider for himself whether there is no pollutant source in his casual deed. In this meaning, the environmental education and people enlightening is very important and the administration side should work the people on them through a variety of channels such as public relations, cooperation with mass media, from children to family by school education, NGOs activities, etc.

Initially, there may be the difference in hidden agenda and talk at cross purpose. Also, there may br difficult that all the stakeholders sit on the same discussion table. In such a case, the stakeholders who can take hands should participate in the meeting and start the practical activities, which may let other stakeholders join the activities.

As the Association for "Clean the Lake Billings" is the place for agreement formation and decision making basically, the stakeholders often make discussions and, in accordance with the decisions over there, should take action hopefully. The relationship between the association and stakeholders are as follows:

(1) Association for "Clean the Lake Billings"

- Progressive promotion of programs
- Evaluation of tackling status and target achievement situation
- Forwarding of information
- Review of programs

(2) From the Association to each stakeholder

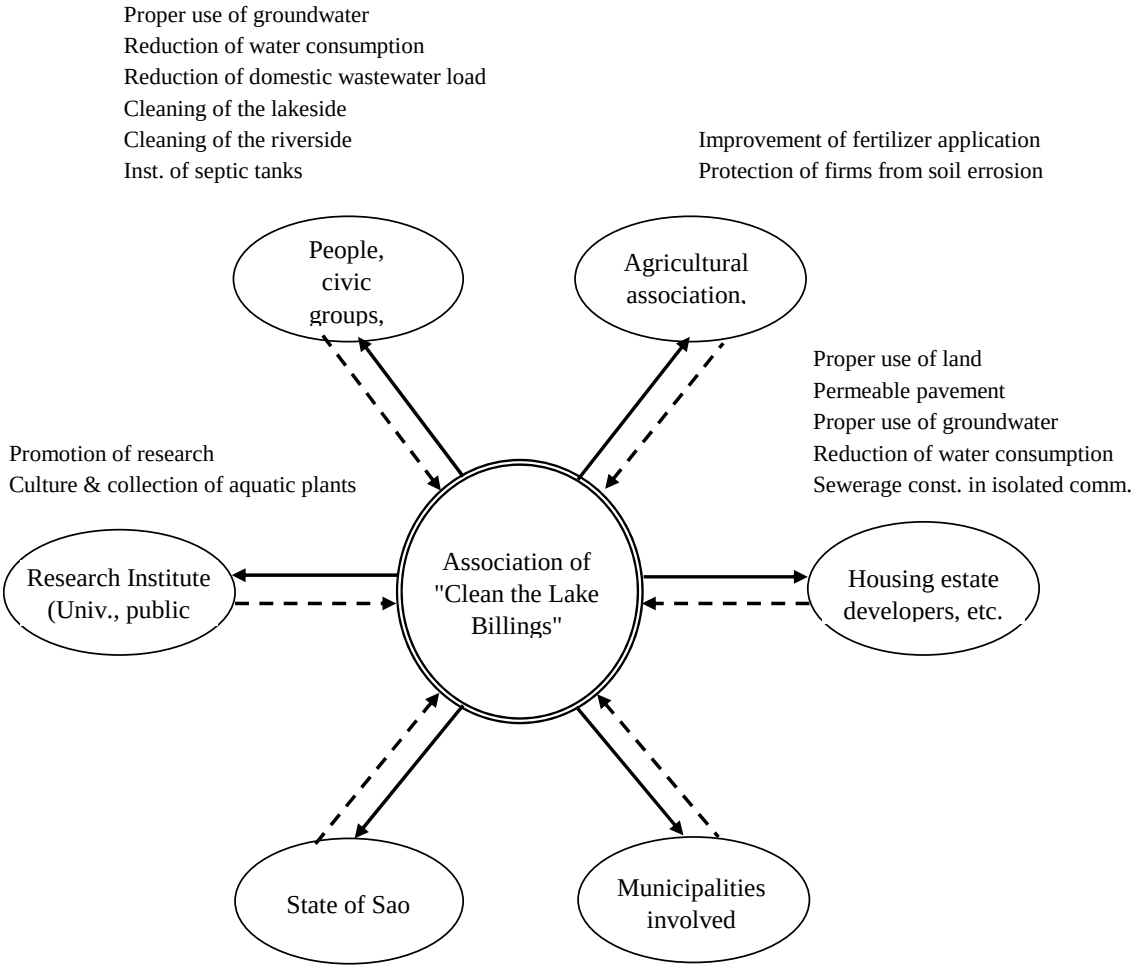
- Provision of information on target achievement situation
- Recommendation of tackling promotion

(3) From each stakeholder to the Association

- Report on tackling situation

- Report on monitoring results
- Idea and proposal

Figure 14.1.1 shows the construction of the Association and the examples of role sharing presented in **Table 9.5.1**, respectively.



State/ EMAE	Aeration in the lake	Permeable pavement
	Dredging of sediments piled in lake bottom	Const. of public parks & greens
		Restoration of natural forest
SABESP	Sewerage const. in urban areas	Direct treatment in the streams
	Sewerage const. in isolated comm.	Remediation of the former dumping site
	measures for water bloom	Conservation of ecology
		Conservation of natural landscape & water front
CETESB	Water quality management	Const. of the Environmental centre
	Promotion of research	Const. of the Water Quality Management Centre
		Research on treatment using aquatic plants
Common	Inf. provision & support to civic activities	Inf. provision & support to civic activities
	Environmental education	Environmental education
		Const. of water front parks

Figure 14.1.1 Association of Clean the Billings and Role Sharing among Stakeholders

There are three ideas for the organizational body of the Association for Clean the Billings as follows:

- Tamanduatei-Billings sub-committee
- ABC Consortium
- New Organization

Tamanduatei/Billings Sub-committee is already established by the law and composed of state and its agencies (1/3), relevant municipalities (1/3), and regional people (1/3). The sub-committee is positioned to make discussions on matters concerned with the basin but has no right to decide.

ABC Consortium is the regional municipality association and named taking the initials from Santo **A**ndre, Sao **B**ernardo do Campo, and Sao **C**aetano do Sur. Other members are Diadema, maua, Ribeirao Pires and rio Grande da Serra. The present president is the Mayor of Sao **B**ernardo do Campo. It already has the performance tackled over the garbage dumping site as a common regional problem. Sao Paulo currently does not join the consortium

As the above existing organizations have some limitations in activities, it is advisable to newly organize the association with some freedom and flexibility, in the meaning that all stakeholders gather, discuss freely and take actions based on the decision.

Out of all stakeholders, “Community Association, Civic Association and School”, “Agricultural Cooperative Association, etc.” and “Housing Estate Developer and Wastewater Discharging Factory” are duly responsible to install the obligatory facilities based on the law and administrative guidance but for other issues are mainly expected volunteer activities enlightened by environmental education.

However, it may be difficult for all stakeholders to sit around the same table due to a difference in idea. In such a case, it is important to start with the stakeholders to be shaken hands with, heat up the society through accumulation of actual performance and let other stakeholders think t heir participation to the association.

For this purpose, the organization to become its mother’s body is required. It is strongly recommended that the Municipality of Sao Bernardo do Campo, which is located in the center with the largest administrative and water surface areas in the basin and has taken trouble for the realization of the JICA Study with devotion to the Lake Billings, will play such a role for a while, until t the Association will be in business.

14.1.2 Immediate Organizational and Institutional Program

The SABESP is responsible for all matter on sewerage services, but it is regarded as one of the most efficient water supply and sewerage provider in the world as described in **14.2** and therefore, there is less organizational/institutional problem. This section describes only matters on the SBC.

(1) Overall Municipal Organization

The overall organization of the SBC is shown in **Figure 14.1.2** which is composed of 17 departments in charge of direct administration and four (4) agencies in charge of indirect administration.

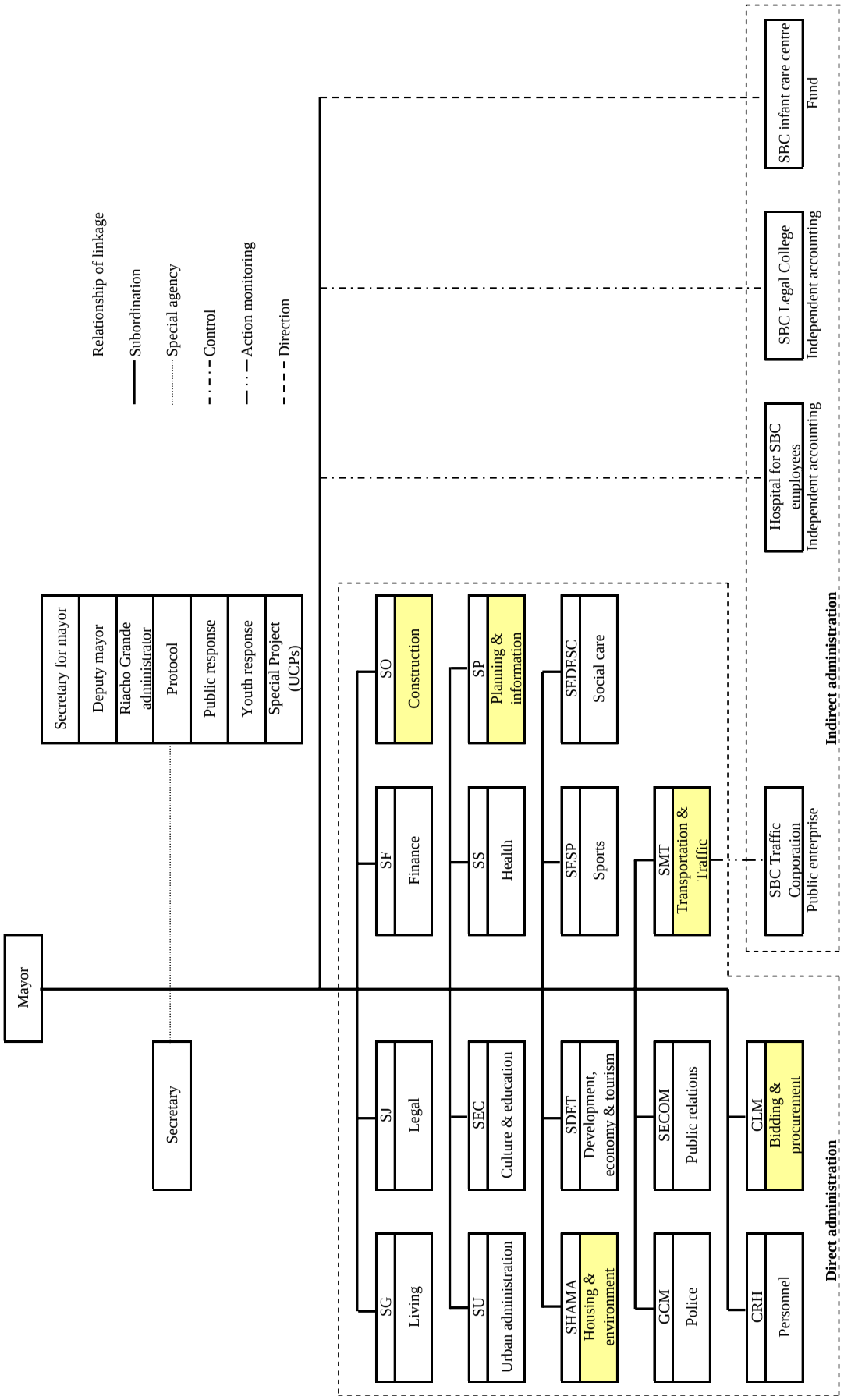


Figure 14.1.2 Organization of the Municipality of Sao Bernardo do Campo

(2) Department of Planning and Information Technology (SP)

The Department of Planning and Information Technology (SP), the counterpart (C/P) of the JICA Study Team in the municipality, was newly established on February 2, 2005 under the Municipal Act No. 5,370 and is composed of three (3) divisions and four (4) sections with a staff number of 163 as shown in **Figure 14.1.3**.

In the SP, the Division of Strategic Planning in charge of the JICA Study takes the following duties:

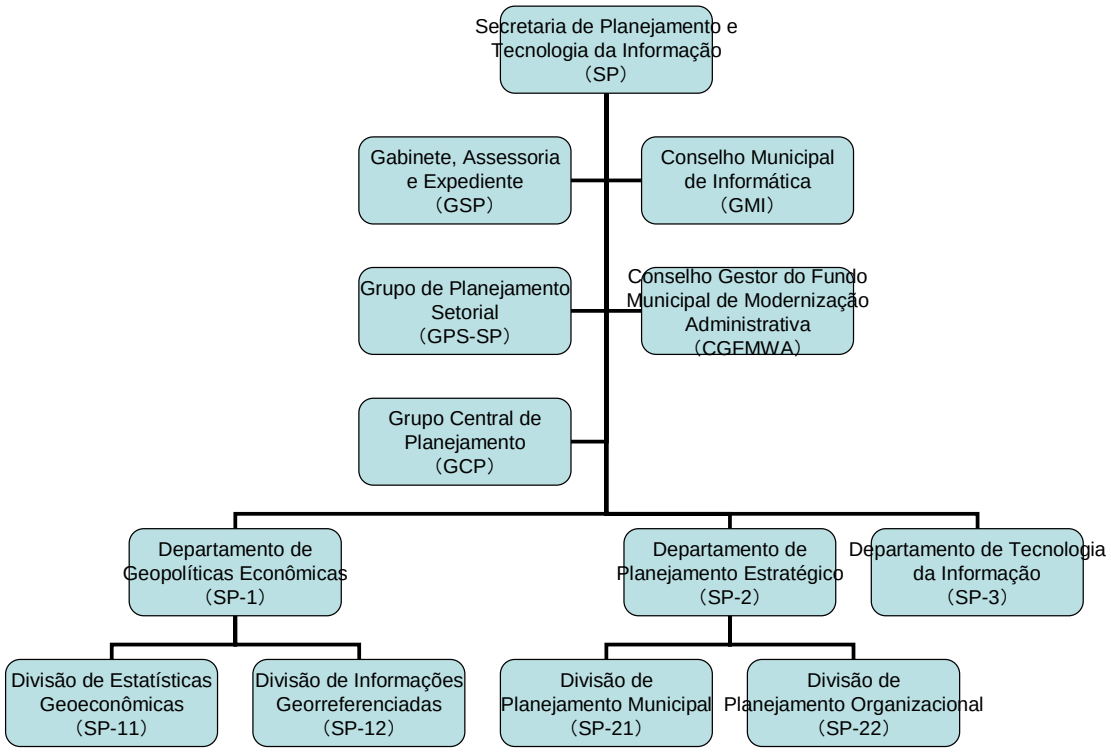


Figure 14.1.3 Organization of the Department of Planning and Information Technology (SP)

a) to coordinate and to control the elaboration and updating of the Master Plan of the municipal area, in their aspects organizational, town planning, social and economical, in agreement with established guidelines for the general office;

b) to control and to accompany the execution of Government's Plan, in the aspects organizational, town planning, social, economical and financial;

c) to define, together with the other would work as a secretary, the programs and subprograms that compose Government's Plan in the aspects organizational, town planning, social, economical, as well as to coordinate and to control its execution;

d) to constitute the technical nucleus and the nucleus of control of the Central Planning Group (GCP);

e) to elaborate proposal of the law of budget guidelines, of the plural annual plan, and of the annual budget, reflecting Government's Plan, together with the general office of finances, and to direct her/it to the Central Planning Group (GCP);

f) to define, to elaborate and to execute the projects and activities that compose the sub-programs of the General office;

g) to supply to the general office support for the decisions as for the needs to develop new specific projects;

h) to supply general guidelines about the projects and activities attributed to the Department;

i) to elaborate, to update systematically, to coordinate and to control the implantation of the Plan of Institutional Administration. PGI;

j) to elaborate, to update systematically, to coordinate and to control the implantation of the plan of positions and careers and program of evaluation of acting, together with Coordination of Human Resources (CRH);

k) to elaborate the development projects, rationalization and implantation of administrative systems for the institutional administration and of systems of information, as well as, of improvement of the existent systems;

l) to elaborate and to implant projects disposing about the creation, alteration or extinction of the organs that integrate the organizational structure of the City hall, as well as to describe the functions and to define the basic competences of the organs, adapting them to the needs of the Municipal Administration;

m) to elaborate, to distribute and to update the Manuals of Organization and of Procedures;

n) to define and to develop projects destined to evaluate the processes and work methods, as well as to evaluate the acting of the component organs of the administrative structure and of the systems and implanted procedures;

o) to develop and to implant projects contemplating new work methods, aiming at to promote the continuous improvement of the services rendered the population

p) to administer and to control the necessary forms to the administrative procedures deciding about his/her creation, elimination or modification;

q) to make risings, diagnoses and studies of administrative procedures, as well as, to prepare proposed for information;

r) to make the rising, description, analysis, classification and evaluation of positions and

functions, together with the Department of Human resources and Council of Guidelines of Personal;

s) to define, together with the Department of Human resources and Council of Guidelines of Personnel, patterns and recruitment methods, selection and functional evaluation of the municipal servants;

t) to elaborate the rising of training need in the extent of the Municipal Administration, together with the Division of Training of Personal;

u) to give technical support to the Central Group of Planning in organization subjects, systems and methods;

v) to participate, to elaborate and to supply subsidies for subjects of interest inter-municipal.

Out of the above duties, the Division of Municipal Planning (SP-21) is responsible for Items a) to h), while the Division of Organizational Planning (SP-22) responsible for Items i) to s). The duty a) belonging to the SP-21 includes the following as well as the Municipal Master Plan:

- Municipal master plan
- Integrated plan of road network
- Environmental planning and urban furniture
- Transportation planning in consonance with regional characteristics

The Article on duties for SP-21 include the following provision:

"to define, together with the other would work as a secretary, the programes and subprogrames that compose Government's Plan in the aspects organizational, town planning, ***environmental,*** *social, economical, as well as to coordinate and to control its execution",*

in which the word of "**environmental**" is added, although not included in the Article on duties for SP-2.

The JICA Study Team belongs to the UCP-JICA, the special unit of which the head is held concurrently by the director of the Department of Planning and Information Technology (SP) and the study conducted by the JICA Study Tem is classified into environmental planning.

(3) Department of Housing and Environment (SHAMA)

There is the department dealing the environment other than the SP, which is the Department of Housing and Environment (SHAMA), as shown in **Figure 14.1.4.**

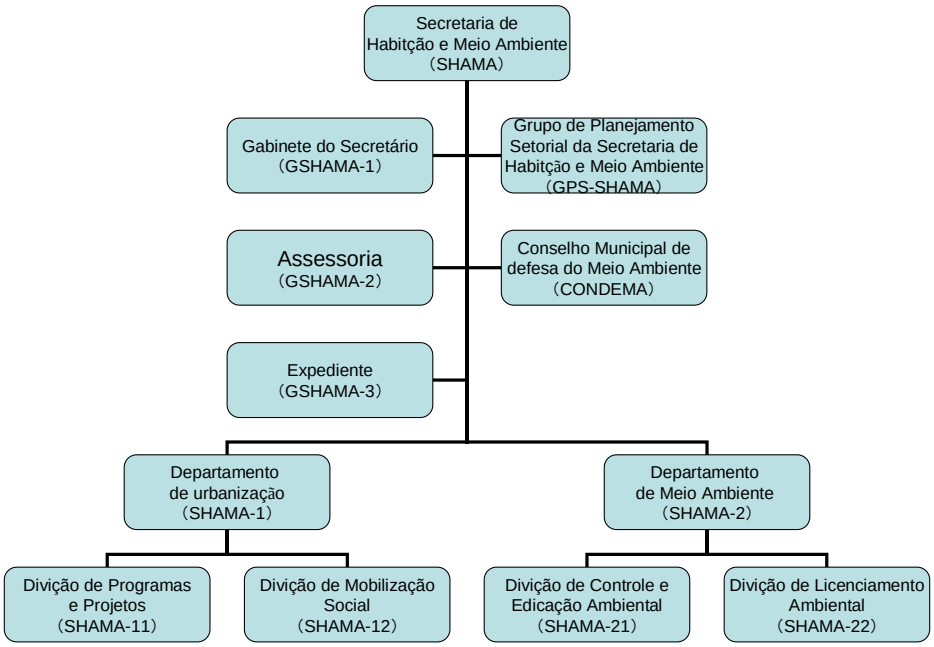


Figure 14.1.4 Organization of the Department of Housing and Environment (SHAMA)

The duties of the Division of Housing (SHAMA-1) are as follows:

a) to prepare guidelines of the housing project of the Municipal district;

b) to drift and to coordinate the work with other general offices and or involved organizations;

c) to participate in meetings with the population, whenever necessary;

d) to coordinate the works developed in the subordinate units;

e) to coordinate the infrastructure work of the housing projects;

f) to execute other activities correlates.

While the Division of Environment (SHAMA-2) is in charge of the following:

a) to maintain and to promote the ecological balance and the improvement of the environmental quality;

b) to coordinate and to control the process of environmental licensing;

c) to coordinate special projects inside of the municipal area of performance, especially the ones that are related to the maintainable development and others that involve interventions to mitigate or to recover situations of the environment degradation.

14.1.3 At the Stage of Project Implementation

The projects undertaken by the SBC are composed of several components different in nature.

(1) Engineering Components

Although the SP as the C/P has no construction division/section, it is proposed to establish the Project Management Unit (UCP-Billings) gathering capable staff from other relevant departments as shown in **Table 14.1.1** and **Figure 14.1.5** and to implements the projects under the SP's leadership by sharing the roles among the members. The consultants are hired to take the responsibilities for planning, designing and construction supervision under the UCP-Billings and to conduct the detailed design, prequalification, technical evaluation of bidding documents and construction supervision. Among others, the most important work is the coordination with the SABESP that extend the construction works of sewerage facilities everywhere in the western and southern area in the municipality, requiring the discussion with the SABESP in various aspects of the works such as traffic jam, meeting with the people, land condemnation/use procedures and so on.

(2) Soft Component

It is recommended that the Association for "Clean the Lake Billings" will start the preparation and discussions with possible stakeholders under the joint leadership of the SP and SHAMA before the construction of the environment center for experienced study and water quality management center. As the civic associations that already have the performance for the environmental improvement of the Billings Lake are expected to bear the core of activities in the future, it is important to contact them earlier seeking for their participation. As it may take much time until the association will be smoothly operated among the stakeholders, it seems unavoidable that the SBC takes leadership initially. But in the future, the association will be managed by the joint operation committee composed of the representatives of respective stakeholders.

As for environmental education, there are so many subjects, it will be operated by the leadership of the SHAMA in cooperation with the Department of Culture and Education (SEC) and the Department of Communication (SECOM). The SHAMA is responsible for both community and civic associations, SEC for school education and SECOM for public relations.

Table 14.1.1 Role Sharing at the Stage of Project implementation

Hard components			
Stage of project impl.		Role sharing	Stage of O&M
Dept. of Planning & Information Technology		Strategic planning and coordination	
Dept. of Housing & Environment		Review on facility concepts for the environmental center and water quality management center	
Dept. of Transportation & Public Roads		Review on facility for roads and permeable pavement	
Dept of Works		River provision accompanied with sewer installation	Dept. of Urban Services
		Road provision accompanied with sewer installation	
		permeable pavement	
		Construction of the environmental center	Dept. of Housing & Environment
		Construction of the water quality management center	
Dept. of Finance		Budgetary securance	
Dept. of Bidding and Materials		Conduct of international bidding	
Dept. of Planning & Information Technology		Negotiation of land condemnation/use	
Soft components			
Dept. of Planning & Information Technology	┐	Operation of the association for “clean the Billings”	
Dept. of Housing & Environment	┘		
Dept. of Housing & Environment	┐	Environmental education	
Dept. of culture & Education	|		
Dept. of Communication	┘		

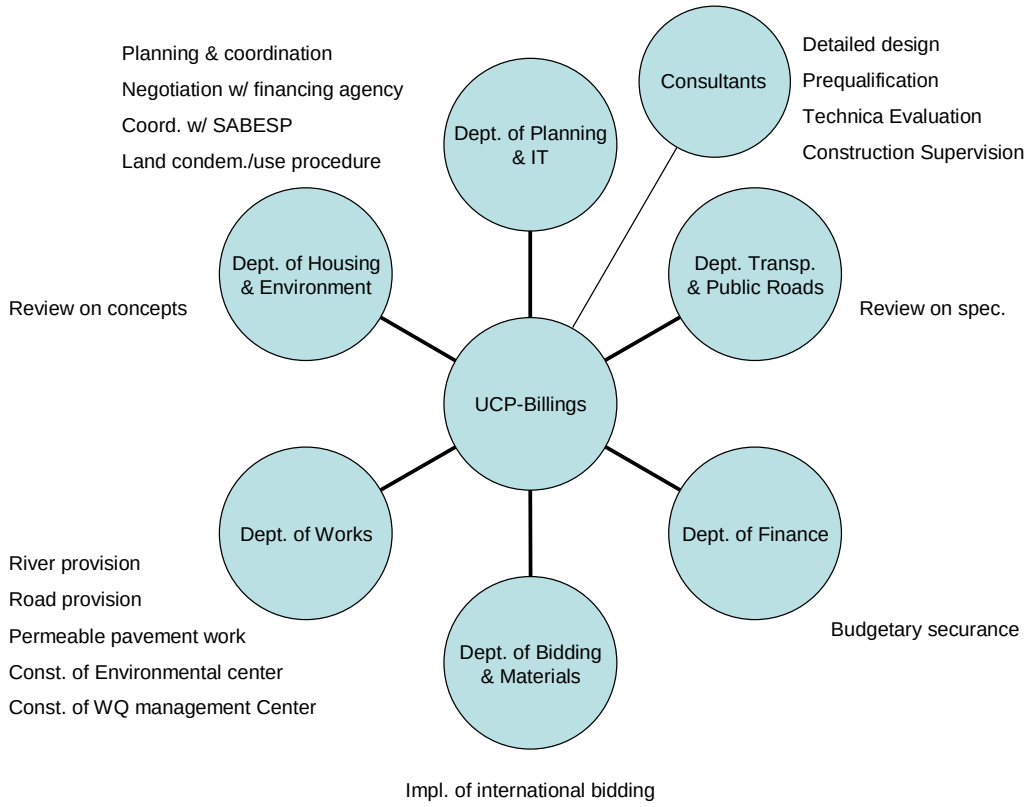


Figure 14.1.5 Project Implementation System in SBC

14.1.4 At the Stage of Operation and Maintenance

At the stage of operation and maintenance, similarly to the other infrastructures, the rivers, roads, permeable pavement and so on will be undertaken by the Department of Urban Services (SU) routinely and by the Department of Works (SO) in case of large-scale repairing works. The maintenance of river cleaning and permeable pavement is desirably sought for the people involvement in cooperation with the environmental education group.

14.1.5 Legislation

At present, there is already the legislation to protect a water source, but a lack of strict stance to apply the provisions in the laws results in losing substance little by little.

Water flows by gravity in strict accordance with Mother Nature and accordingly, the wastewater trunk along the river satisfies it. The regulation to prohibit the construction of any structure within 15m from the river shows wonderful foresight. If a wastewater trunk is forced to make a detour or to construct a pumping station due to existence of any structure along a river, such cost is surcharged and paid by all users. It is heavily unfair that one who do not comply the law gets a

profit and the other who comply the law suffers in his pocket.

If the land within 15 m from a river is available for public use, it makes wastewater collection easy and reduction in the number of pumping stations possible. If the road can run along a river, it makes garbage collection easy and garbage dumping into a river reducible. The key is in strict application of the provisions in the present law.

As stated earlier, the CETESB's monitoring is so strict that there is no factory in problem regarding industrial wastewater. They conduct wastewater treatment at their own plants and minimize effluent discharge into the lake by sprinkling it on land or for irrigation. In some factories, they store wastewater in a tank for conveyance outside the basin. The almost livestock keeping such as cow, pig and chicken is forced to be closed. And the remains are very small. From the viewpoint of pollutant loads into the lake, there is no reason to make the standards for such wastewater more stringent.

From the situation mentioned above, the following regulations are proposed:

(1) Ordinance for Proper Use of Groundwater

Although groundwater is used in the Billings Lake basin but its actual situation such as location, number and pumping discharge of wells are unknown due to no registration or license system of wells. As it is more difficult to develop the new water sources in the Sao Paulo Metropolitan Area, SABESP is now controlling the increase in water supply which will lead expectedly to an increase in groundwater use to meet individual water demand in the future. It is important to promote the proper use of groundwater through the people's enlightening for reduction in wasteful use of groundwater and recharge of groundwater. For this purpose, it is recommended to introduce a licensing system of groundwater development for management of groundwater use.

(2) Ordinance for Installation of Storm water Infiltration Facility

In the Billings Lake basin, it is expected to raise the storm water runoff coefficient due to the expansion of an urbanization area, which lead to an increase of storm water runoff, resulting in an increase in pollutant load at the first flush during the rainfall. The installation of wastewater infiltration facility is considered as the measure to mitigate the first flush during the rainfall. It is advisable that a person or company which construct a housing with more than a certain level of housing area or develop the housing estate with more than a certain level of land area are obliged to install wastewater infiltration facilities having the structure and capacity defined separately by the municipality, resulting in the recharge of groundwater.

(3) Ordinance for Subsidy for Voluntary Activities Contributing to Environmental Improvement in the Billings Lake

The civic groups will hopefully play a big role in the environmental improvement of the Billings Lake. For this purpose, it is important to construct cooperative systems among stakeholders for keeping sustainability in activities, in which the municipality provides a subsidy for purchasing minimum tools such as broomsticks, garbage pickers, vinyl gloves, vinyl bags, collection carts, etc. to, for example, a group to clean the lakeside and rivers as well as mobilization of collection vehicles to convey the garbage collected to the dumping site.

(4) Regulation on groundwater contamination

The population (2005) of the-Billings-Lake basin is approximately 1 million people, and this was assumed to increase to 1,550,000 population in 2025. It is thought that urbanized area will be newly formed in chacara (small-scale agriculture garden), capoeira (prairie), etc. to fix such increase population. The proposed sites of this newly developed urban area are scattered in the basin. Since the sewerage system is not installed, it is thought that it will depend on septic tank. In the scenario 2, it will be expected in 2000 that the permeation quantity from the septic tank which was 52,000m^3/day will increase in 2025 on 124,000m^3/day (1.435m^3/sec) as shown in **Annex 11.11.1**. In many cases, the small residential area in a basin depends for the water resource on the deep well. By the time influence comes out, it will seem that years cut, but while performing a study of the seaway within the-Billings-Lake lower geology, and the monitoring of periodical water quality, it is thought that regulation should be hung for preservation of ground water. It is a water quality standard in the case of depending on the discharge water quality standard and irrigation in the case of being based on a setup and domestic sewage treatment tank of a septic-tank use prohibited area as contents of regulation etc.

(5) Regulation about disposal of septic-tank sludge

Although septic tank sludge was drawn up when the residue filled, it was entrusted to the contractor and removed, proper sludge disposal by a dipping-up contractor is performed, or the confirmation of it was not completed. According to the hearing, there is no manifest system and a dipping-up contractor's governing legal authority has not become settled.

It is necessary to introduce a manifest system and to perform proper sludge disposal.

(6) Foundation of basin maintenance organization

The organization which supervises the basin, and checks and exposes illegal housing construction periodically in view of the importance of being a water resource in the great Sao Paulo bloc is required. The Billings Lake basin preservation organization is necessary to be founded by state police, ABC consortium or the sub-basin committee. It will act as a monitor about the following matters, it cooperates with each municipalities concerned, and expansion of favela or illegal residence will be prevented.

- Direct run off of the sewage
- Abandonment of sludge and waste
- Illegal invasion
- Illegal house construction
- Illegal felling and development

14.2 Operation and Maintenance Program

Out of the facilities proposed in the M/P, the SABESP is responsible for sewerage facilities, while SBC for others such as the provision of river and road, permeable pavement, and construction of the environmental center for experimental-study and water quality management center. Hence the description is made separately for SABESP and SBC below.

14.2.1 SABESP

The SABESP is the private company of which the stocks are open in the New York Stock Market and approximately half owned by the State of Sao Paulo, and its operational status is made public. **Figure 14.2.1** shows the number of connections per employee. The number of employees has a trend to be contained or reduced, while the number of connections increases steadily, resulting in the elevation of labor productivity expressed by the number of connections per employee which rises 626 connections in 2004 from 370 connections in 1995 or 69% up. For this reason, the number of staff per 1000 connections is calculated at 1.60 (=1000/626), which is in a internationally high level as shown in **Figure 14.2.2**

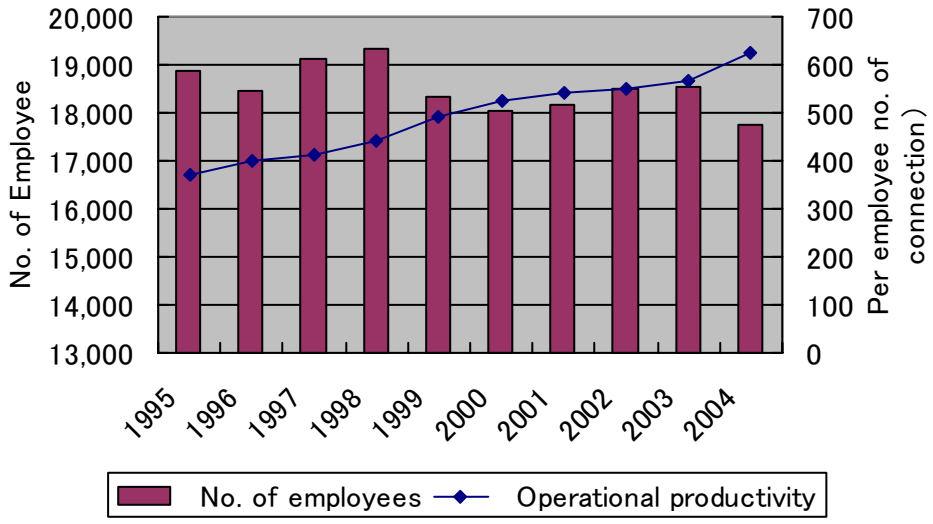


Figure 14.2.1 Number of Employees and Labor Productivity in SABESP

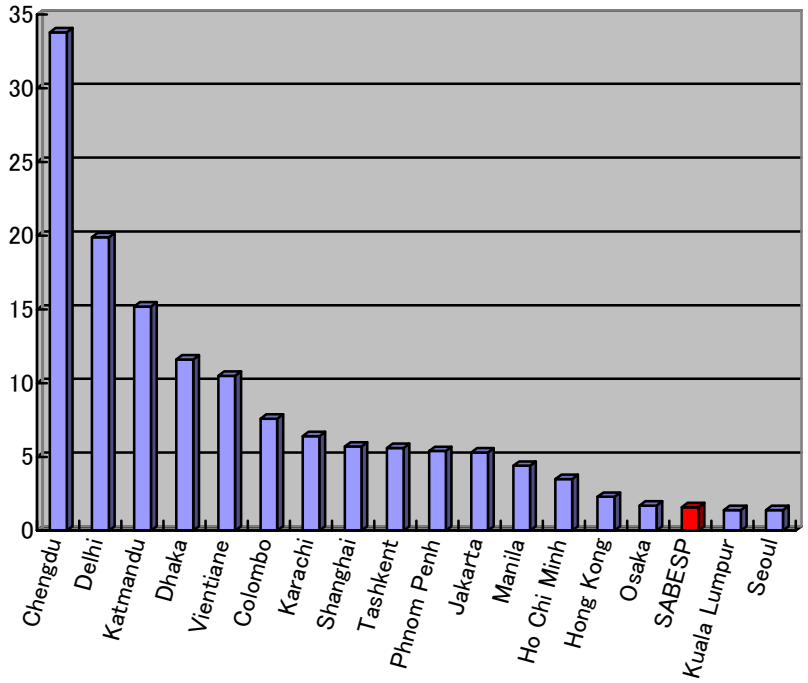


Figure 14.2.2 International Comparison of the Number of Staff per 1000 Connections

Source: "Water in Asian Cities", ADB, 2004

Note: 1) Compared with Asian countries, since the source is from the ADB.
2) The number of connections show “for water supply” plus “for sewerage” in 2004 for SABESP and “ for water supply only” in 2001 for other countries.

SABESP with the ownership of all the sewerage facilities in SBC, places its office in the city to provide services as follows:

Commercial: Billing, data arrangement, house connection works for water supply and sewerage, replacement of water meters, supervision and inspection, and accounting analysis

Service: leakage detection and repair, mutual connection work of networks, change of networks, installation of hydrants, preventive management of water mains, removal of sewer clogging and repair, identification of manhole location and inspection, cover placement for open manholes, installation of manholes, sidewalk restoration after works, and sewer diagnosis

Wastewater generated in the urban area of the Billings Lake basin is principally conveyed outside the basin, or wastewater from Sao Paulo to ETE Barueri and that from other municipalities to ETE ABC. Out of these wastewater treatment plants under the management of the Unidade de Negócio de Tratamento de Esgotos da Metropolitana (MT) in the Diretoria Metropolitana (M), the former was expanded by 2.5 m^3/s and the latter was newly constructed with a capacity of 3.0 m^3/s in 1998. Other small-scale wastewater treatment plants are directly operated and maintained by the Unidade de Negócio Sul (MS).

There is the Riacho Grande WTP in the middle basin of the Billings Lake transferred from the SBC. The SABESP has a policy to improve this plant for continuous use in the interim for expanding the service area. To meet the environmental requirements, the present M/P has a plan to add the tertiary treatment units to the plant, which is currently operated and maintained by one operator. Even so, the plant will be similarly operated without any trouble due to less additional O&M requirements.

There are several communities isolated from the urban area in the southern basin of the Billings Lake. The independent wastewater treatment has an advantage in these communities, after integrating a few communities systematically. In such cases, one operator will be required to station at each plant similarly to the Riacho Grande WTP. Also, sludge generated in each plant will be desirably withdrawn by a vacuum car to convey to the ABC WTP for handling as well as the Riacho Grande WTP.

Planning of a sewerage system is generally undertaken by the Unidade de Negócio Sul (MS), but as for planning of a trunk sewer or interceptor, the Superintendência de Planejamento Técnico Integrado (TP) and the Superintendência de Gestão de Projetos Especiais (TG) of the Diretoria Técnica de Planejamento (T) join the discussion and the TG is responsible for the construction of a trunk sewer or interceptor.

14.2.2 SBC

(1) Provision of river and road accompanied with sewerage construction

The Alvarenga and Lavras Rivers in Alvarenga and Lavras are in the state of natural rivers at present, but will be provided including the new roads along the routes of sub-trunk sewers to be planned. They will be maintained by the department of urban services (SU) after their completion. There will be fewer burdens on the SU due to their short length. The major maintenance works are as follows:

For rivers

- Repair of damaged slope or collapsed bank edge
- Cleaning

For roads

- Repair of road irregularity
- Repair of damaged shoulder

(2) Permeable pavement (including storm water infiltration facility)

Permeable pavement is aimed at infiltrating storm water into the ground aggressively and has a structure of the surface layer using permeable material on the infiltration layer. Due to its function

to infiltrate water into the ground, it has effects of flood control of wastewater or storm water during the heavy rain, improvement of vegetation and underground ecology, recharge of groundwater and used at sidewalks, promenades, parking lots, parks and so on.

Permeable pavement including infiltration facilities at chambers and manholes and tree planting will be conducted in Alvarenga and managed by the department of urban services (SU) after its completion. The major maintenance works of permeable pavement consists of inspection and cleaning to protect it from reduction of infiltration capacity caused by clogging. Cleaning is done manually or by jetting.

In Brazil, the sidewalk is sometimes dealt with devices in design and material as if it is his own land and cleaned with washings and hoses. It is necessary to conduct its maintenance work regularly and sustainably. Maintenance through people involvement, therefore, must be sought, as there are more and more points to be checked.

(3) Environmental center for experienced study

The environmental center for experienced study will be constructed as the place for environmental study and open not only to SBC citizens but also the people in the basin of the Billings Lake. It will be constructed mainly by SBC and managed by the department of housing and environment (SHAMA) of SBC until the activities will be going well, but the establishment of the joint management committee is proposed at the stage when understanding and cooperation among stakeholders will be deepened.

Since the work at the environmental center for experienced study will be a completely new service, at least three staff will be initially required to conduct the following works routinely, even though the volunteers will be recruited or accepted:

- Building maintenance
- Promotion for building use
- Consultation on building use
- Planning of display
- Explanation of display to visitors
- Guidance of experienced study
- Development of studying materials
- Development of studying courses
- Collection of relevant information on the environment of the Billings Lake
- Library management
- Public relation to the outside (opening of website, etc.)

- Report on activities and proposal to the Committee for "Clean the Billings"

The location of the environmental center for experienced study is proposed in the Estoril Park, facing the Rio Grande Arm and on the opposite side of the Rio Grande Intake Works, where the visitors can make a contact with water relaxingly.

The contents are displayed so as to understand the history, nature, water quality and ecology of the Billings Lake through models, videos, photos and the like as well as placing panels on living and environment so as to conduct the environmental education and experienced study. The floating course is also provided. Since there are both a water treatment plant and WWTP near the center, it is possible to prepare the course to study the water cycle in cooperation with the SABESP.

At the initial stage, it will be necessary to actively make a promotion to the basin-involved municipalities so that the center will be used as the field study in the school curriculum.

In case that the center will also function as the secretariat for the Committee for "Clean the Billings", one more staff will be added as well as the conference room for excusive use.

(4) Water quality management center

The present water quality monitoring system established by the CETESB is composed of four points in the Billings Lake and four points in the Rio Grande Arm, but obviously insufficient to grasp the regional characteristics of each basin which is different in water quality and measures to be taken. For this reason, the water quality management center will be constructed and managed by SBC, but positioned as the water quality monitoring center for the Billings Lake of the Agency of Alto Tiete. The water quality monitoring sub-system is structured so as to complement the CETESB's monitoring system through mutual linkage. In the future, the joint use of the center will be sought by the basin-involved municipalities

Chapter 15

ENVIRONMENTAL AND SOCIAL CONDIDERATIONS

15. ENVIRONMENTAL AND SOCIAL CONDIDERATIONS

15.1 General

The Initial Environmental Examination (IEE) was conducted based on the JICA's Guidelines for Environmental and Social Considerations ("JICA's Guidelines") for the proposed projects at master plan level on the environmental improvement of the Billings Lake basin in order to assess the possible adverse impacts and recommend the mitigation measures for such impacts. Screening at IEE level was followed by examining the assessment results of above impacts to be caused by the proposed projects and also taking into the recipient's country's institutional requirement for environmental impact assessment (EIA).

15.2 Current Environmental and Social Situation around Project Sites

The current state of environment and society around the project sites is shown as below and its summary is shown in **Table 15.2.1**. The location map of the project sites is shown in **Figure 15.2.1**.

(1) Sewerage construction Project in Urban Areas

The project site is located in the urbanized area and its major land use is residential, industrial area and public roads with high population density. (see **Photo 15.2.1**) In most of the project site sewer pipes are not buried except partial areas, and the untreated sewage from the residential areas is directly discharged into the adjacent water channels and rivers, which finally causes the water quality degradation of Billings Lake. The project sites in the municipalities of Diadema, Sato Andre and Riberao Pires partly cross the municipality parks with green space, where road areas extend and the residential area is located closely. These parks are the places of the citizen's frequent visits for their rest. In SBC city, the irregular residential area (7 areas: 3,343 residents) where the urban upgrading project (*PAT PROSANEAR*) is being planned by SHAMA, is located approximately 3 km east from Courus river running along the project site. The project site partly crosses several private houses and factory areas, which will require resettlement and land acquisition.

Photo 15.2.1 Project Site of Sewerage construction Project in Urban Areas (SBC city)

(2) Sewerage construction Project in Isolated Communities

The project site is located in the two isolated communities of Riacho Grande and Santa Cruz in the southern lakefronts of Billings Lake which are currently not connected with existing sewer networks to be treated in urban centralized treatment facility. Riacho Grande currently has an existing sewage treatment plant (see **Photo 15.2.2**), while Santa Cruz has no sewage treatment facility in spite of lay-down of sewer lines in the project areas (see **Photo 15.2.3**). The present land use around the project sites are residential and commercial areas of restaurants. The proposed project at Riacho Grande does not require land acquisition because of its renewal development of existing treatment facility inside the existing facility area, while a new sewage treatment facility should be developed in a new land at Santa Cruz. In case of Santa Cruz, the project land is currently an empty land, which will not require resettlement but it will require land expropriation (acquisition) because of the existing private land title.

Photo 15.2.2 Riacho Grande WWTP

Photo 15.2.3 Santa Cruz Project Site

(3) Permeable Pavement Project in Road Areas

The project site is the road areas located in the densely populated areas of Pedreira to Grajau district in Sao Paulo city, south part of Diadema city and Alvarenga district in SBC city, where the domestic wastewater from housing areas and the surface pollutants is discharged into Billings Lake. They are assumed to trigger partial cause of the lake contamination. The surface is bared in some roads, where the surface polluted mud is flowed out (see **Photo 15.2.4**).


Photo 15.2.4 Project Sites of Permeable Pavement Project (Alvarenga & Santa Cruz)

(4) Public Parks and Green Space Development Project

The project sites are located at the existing municipal parks or their future development areas in Sao Paulo, Diadema and SBC cities of the Billings lake basin (see **Photo 15.2.5**). The surrounding land use of the proposed project site is the high density populated area which has already been urbanized. The project sites are the places with the vegetation in secondary forests where the basin residents frequently visit them for their rests. The current land use of the project site in SBC city is parking area and bare land scattered with wood refuse and rubble.


Photo 15.2.5 Project Sites (Alvarenga District in SBC & Municipal Park in Diadema)

(5) Environmental Remediation Project at Former Open Dumping Site

The project site is located in a former open dumping site of solid waste at Alvarenga district of SBC city, which is currently covered with the shrub in secondary vegetation after the closure of the open dumping operation. The contaminated leachate is discharging into the irregular residential area nearby the site (see **Photo 15.2.6**). Several houses inside the project site were identified (see **Photo 15.2.7**). The project requires resettlement of these houses. The project site currently owns to private land and its land has not been secured by SBC city,

which means that SBC city should take the land expropriation (acquisition) procedures prior to commencing the project.

Photo 15.2.6 Former Open Dumping Site (Resident Houses at left side)

Photo 15.2.7 Exit of Leachate Discharge

(6) Dredging of lake bottom sediment Project

The project site is located at the Pedreira / Taquacetuba arm in Sao Paulo city, south part of Diadema and Alvarenga district of SBC city where the domestic wastewater is discharged from the rivers and water channels, and where the extreme water degradation is progressing. The surrounding land use is highly populated area and of high proportion of the population in irregular residents to the total population in the district. The project sites indicate the high BOD parameters of 6 to 15 mg/L, which shows high degradation of water quality environment (see **Photo 15.2.8**).

Photo 15.2.8 Project Sites (Cove in Sao Paulo and SBC city (Alvarenga District)

(7) Water Purification Pilot Project using Water Plants

The project sites are located at the front water area of the existing Pinheiros sewage treatment plant at Alvarenga district and the water area of the east part of Anchietta highway to the front water area of Estoril park. Jardin Pinheiros is the area of high density of population which is

currently converted to the environmental model area by the agreement between the residents and the municipality (TAC) from the former illegal housing lots. Estoril park is the area which has the high density of vegetation, the boat pier and the place for the citizen's rest. The flourishing of water plants is identified in dry season at the water area of the east part of Anchietta highway (see **Photo 15.2.9**).

Photo 15.2.9 Project Sites (Water Area in front of Pinheirinho WWTP and Estoril Park)

(8) Environmental centre for experimental study

The project site is located in the existing Estoril Park of SBC city's public area. The proposed facility will be provided with on-site training room for environmental / sanitation education and water quality laboratory centre, etc. The project site is planned to be developed in the existing parking area among plenty of green areas in the park.

Photo 15.2.10 Project Site inside Estoril Park

(9) Water Quality Management Centre

The project site is located in Estoril park as same as above environmental centre for experimental study, which will be developed in parallel to above centre. The major facilities of the centre is planned to be installed with water quality analysis room, laboratory and training room.

Table 15.2.1 Current Environmental and Social Situation around Project Sites (1)

	Project	Candidate Project Sites	Current Situation		
			Social Environment	Natural Environment	Pollution
1. Sewerage construction Project in Urban Areas					
1-1	SBC city	Adjacent area of Courus river, Alvarenga, Lavras	The project site is an urbanized and composed of road and industrial area. The general social situation is as follows; • Population density: 29 – 40 person/ha • Irregular residential area: Identified (Population ratio to total district population: 36% in average) • Land use: Residential and industrial area (approximately 37 – 60 % to total district area)	The project site is an urbanized area of road space and industrial area and includes no public parks or nature reserve area.	Sewer pipes are partly buried in the project site, and the untreated wastewater is discharged to Billings Lake because they are not connected to exiting sewerage networks to be treated at final treatment plant.
-2	Sao Paulo city	Urban area located in northern to western Billings Lake basin (Pedreira, Grajau district)	The project site is an urbanized area. The general social situation is as follows; • Population density: 5 – above 200 person/ha • Irregular residential area: Identified (Population ratio to total district population: 20 - 38%) • Land use: Residential area (above 60% to total district area)	The project site is an urbanized area and includes no public parks or nature reserve area.	The extreme water pollution is identified at the water channels close to the residential area (BOD: 220 – 300 mg/l).
1-3	Diadema city	South-west part of Diadema city	The project site is an urbanized area partly including public park rich in green space. The general social situation is as follows; • Population density: 0 – above 200 person/ha • Irregular residential area: Identified (Population ratio to total district population: 15 % in average) • Land use in district: Residential area (above 58 % to total district area)	The project site is an urbanized area, and it includes a municipal park (*Eldorado do Calango*) which is under process of legal designation. The current vegetation of the park is mainly composed of secondary forest.	The extreme water pollution is identified at the water channels close to the residential area (BOD: 220 – 300 mg/l).
1-4	Santo Andre city	West part of Santo Andre city of northern lake basin of Billings lake	The project site is an urbanized area partly including public park rich in green space. The general social situation is as follows; • Population density: 0 – 200 person/ha • Irregular residential area: Identified (Population ratio to total district population: 0 –20%) • Land use: Most part is forest land (54 – 80 % to total district area) and followed by residential area (12 – 42 %).	The project site is an urbanized area, and it crosses a municipal park (*Parque Regional e Jardim Botânico do Pedros*). The park is the place where basin residents frequently visit for their rest. The current vegetation of the park is in the stage of regeneration of the secondary forest composed of common flora species such as *Quaresmeiras* (*Granular Tibouchina*). The park is the area for many basin residents' visits for their rest. The east part of the project site is urbanized area not including public park and natural reserve.	The extreme water pollution is identified at the water channels close to the residential area (BOD: 8 – 139 mg/l).
1-5	Riberao Pires city	Whole urbanized area of Riberao Pires city	The project site is an urbanized area partly including public park rich in green space. The general social situation is as follows; • Population density: 0 – 200 person/ha • Irregular residential area: Little (Population ratio to total district population: 0.6% in average) • Land use: Most part is forest land (59 % to total district area) and followed by shrub (22 %).	The project site is an urbanized area, and it crosses a municipal park (*Parque Municipal: Milton Marinho do Moraes*). The park is the place where basin residents frequently visit for their rest.	The sewerage system is used to 65 % of citizens and 36 % of the collected sewage is treated at the existing treatment plant, but the untreated remaining sewage is directly discharged into Billings Lake. The sewage from insanitary septic tanks is infiltrated into groundwater and causes water pollution of the surrounding wells close to the septic tanks. The water quality in Pires river lower reach is under anaerobiotic state and generates marsh gas.

Table 15.2.1 Current Environmental and Social Situation around Project Sites (2)

No.	Project	Candidate Project Sites	Current Situation		
			Social Environment	Natural Environment	Pollution
2	Sewerage construction Project in Isolated Communities	Riacho Grande / Santa Cruz (SBC city)	The project site is located at the residential area, where some restaurants facing Billings Lake were identified. The general social situation is as follows; • Population density: 177 person/ha (Riacho Grande), 115 person/ha (Santa Cruz) • Irregular residential area: Identified (Population ratio to total district population: 0 - 7%) • Land use: Residential area (23 – 32 %) and followed by shrub area	The project site is located at urbanized area and includes no public parks or nature reserve area.	The existing sewage treatment plants are not equipped with advanced sewage treatment system, and their current effluents do not fulfill the CONAMA effluent standards
	Permeable Pavement Project in Road Areas	The urbanized areas as shown below; • SBC city: Road areas along Immigrantes, Alvarenga, Santa Cruz districts • Sao Paulo city: Grajau, Pedreira district • Diadema city:	The project site is the urbanized areas including irregular residential areas. The general social situation is as follows; • Population density: 0 – over 200 person/ha • Irregular residential area: Identified (Population ratio to total district population: 9 - 36 %) • Land use: Generally high rate of residential area (over 50 %)	The project site is located at urbanized area, and it includes a municipal park (*Eldorado do Calango*) which is under process of legal designation.	The project site is located at urbanized areas and is estimated to cause the extreme water pollution into the Billings water areas because of the flow-in the pollutant discharge from the sites.
4	Public Parks and Green Space Development Project	Existing municipal park or future development area for municipal parks in the lake basin of Sao Paulo, Diadema and SBC city.	The major surrounding land use is the residential area with high density of population.	Some of the proposed sites are the existing municipal parks with high occupancy of vegetation of secondary forests and they are the places for the citizen's frequent rest. The current land use of the project site in SBC city is parking area and empty land.	The significant environmental issues are identified. The project site in SBC city is scattered with wood refuse and rubble
5	Environmental Remediation Project at Former Open Dumping Site	Alvarenga district (SBC city)	The project site is located in a former open dumping site and several houses were identified inside the project area. The project site currently belongs to private owners. The general social situation is as follows; • Population density: 74 person/ha • Irregular residential area: Identified (Population ratio to total district population: 16 % in average) • Land use: Residential area (about 58 %) and followed by forest land (about 22 %)	The project site is located in the urbanized area and covered with secondary shrub after the closure of its operation.	The former dumping site was not a sanitary landfill and its bottom was not controlled for leachate outflow. The leachate water is discharged into the neighboring irregular residential areas.
6	Dredging of lake bottom sediment Project	Pedreira / Taquacetuba arm in Sao Paulo city, south part of	The project site is the arm area where the discharge water is flowing from the surrounding rivers and water channels. The surrounding land use is the residential area with high populated density.	Some toxic algae is identified at the proposed project sites. Analysis results for fishes shows that small amount of hazardous substances of PCB and BHC were detected[1)]. Some residents were engaged	The water area of the project site indicates 6 – 15 mg/l of BOD parameter, which exceeds the environmental standard (5 mg/l of CONAMA 20/86) and it stands for the extreme water pollution.

		Diadema and Alvarenga district of SBC city	The general social situation is as follows; • Population density: 0 – over 200 person/ha • Irregular residential area: Comparatively large (Population ratio to total district population: 15 % ～38%) Land use: Residential area (over 37 %)	in fishery before and no more activity of fishery at present	Biodegradable organic material, nutrient, faecal coliform and odor has been identified. The analyzed results of bottom sediments indicates the high concentration of Hg and Ni (nickel) exceeding the guideline values of Australia, New Zealand and Canada, which is exposing a threat to conservation of ecosystem.
7	Water Purification Pilot Project Using Water Plants	The front water area of Pinheiros sewage treatment plant at Alvarenga district and the water area of the east part of Ancietta highway to Estoril park	The surrounding area of the project sites is Alvarenga district, Riacho Grande sewage treatment plant, residential areas and Ancietta highway. Population density: • Alvarenga district: 74 person/ha • Estoril district: 14.1 person/ha	The project site is the water area of Billings lake near the residential areas and municipal park. The flourishing of water plants is identified near the intake of Rio Grande purification plant facing the water area in fro nod Estoril park.	According to CETESB's report on water quality (2000), the water quality of total phosphorous, Pb, Cu, Mn and Phenol at the intake of Rio Grande purification plant exceeds the environmental standards of CONAMA. However the exceeding of biological parameters such as coliform has not been identified.
8	Environmental centre for experimental study	Estoril park	The park has the area of about 37 ha rich in green areas where the citizens visit for the rest in an amusement park, small zoo and boat riding area. The surrounding landuse is residential areas. The land of the park was transferred to SBC city from the previous owner of Light Electric Company. The surrounding population density is 14.1 person/ha.	The project site (Estroril park) is covered with secondary vegetation after its tree cutting was made for the development of access road and relevant facilities.	Environmental degradation is not identified.
9	Water Quality Management Centre	Estoril park	- Ditto -	- Ditto -	- Ditto -

Notes:
1) "Terrmo de Referencia para o programa de Recuperacao Ambiental da bacia Billings", July 1999, SMA

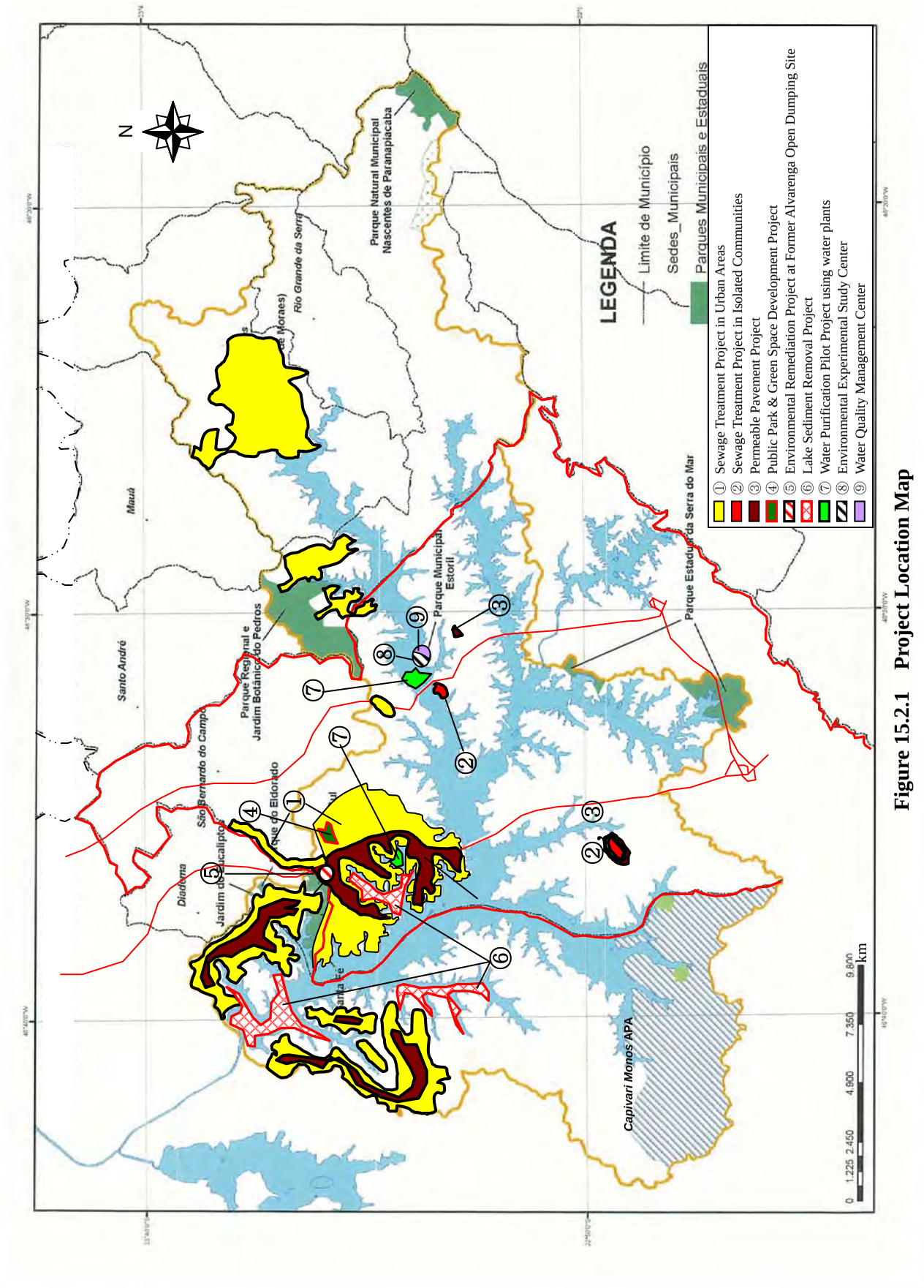


Figure 15.2.1 Project Location Map

15.3 Environmental and Social Impact

The environmental and social impact level were examined for the proposed projects in the master plan study for the environmental, social and pollution items based on JICA guideline. In the case without any projects for the environmental improvement in the Billings lake basin, the sanitary degradation caused by the untreated domestic wastewater and sewerage discharge will be remaining to the future, and there will be no possibility of the environmental improvement of the lake which is the important water source in Sao Paulo metropolitan area. The goal of each proposed projects in the master plan is basically to improve the environment (water quality) of the Billings lake basin, and the improvement of the Billings water environment is expected when each projects are implemented. However, some adverse impacts are estimated as shown below on the social and environmental situation for the project stages of before and during construction and operation.

(1) Sewerage construction Project in Urban Areas

The public space such as public roads will be basically utilized for the project site. However, some parts of the project area currently belong to private lands. At present, the land secure has not been completed by the project proponent, and the appropriate procedures for the land acquisition will be necessary for the project implementation. The resettlement will be required since the project area partly crosses the private houses. The project will be planned taking the reception of the sewage amount from the irregular residential areas into consideration. The proposed project is planned to be connected with existing sewer networks, which may cause the impact on the reception capacity of such existing sewer networks. However, the project will not cause significant impact on above capacity since such existing sewer net works have sufficient capacity because of the estimated lower spreading rate at the initial stage of its operation. The basic policy of the project proponent (SABESP) is to receive the sewage of project areas into the existing sewer pipes and he has the plan for increasing the capacity of existing sewer pipes. In addition, at the final sewage treatment plant (ABC plant) which is planned to treat the sewage of the project site, currently only one process line is operating in spite of its designed two process lines, which will have enough treatment capacity for above reception of additional sewage from the proposed project. Therefore, the impact on existing sewer pipes by the proposed sewage transport is estimated as small.

In regard to irregular residence issues, the proposed project does not cover such irregular residential areas where public infrastructure such as public roads is not currently developed legally. Such irregular areas are planned to be normalized and then legally developed by the urbanization control projects by the recipient country (e.g. *PAT PROSANEAR* by SHAMA in SBC city) (See the figure below).

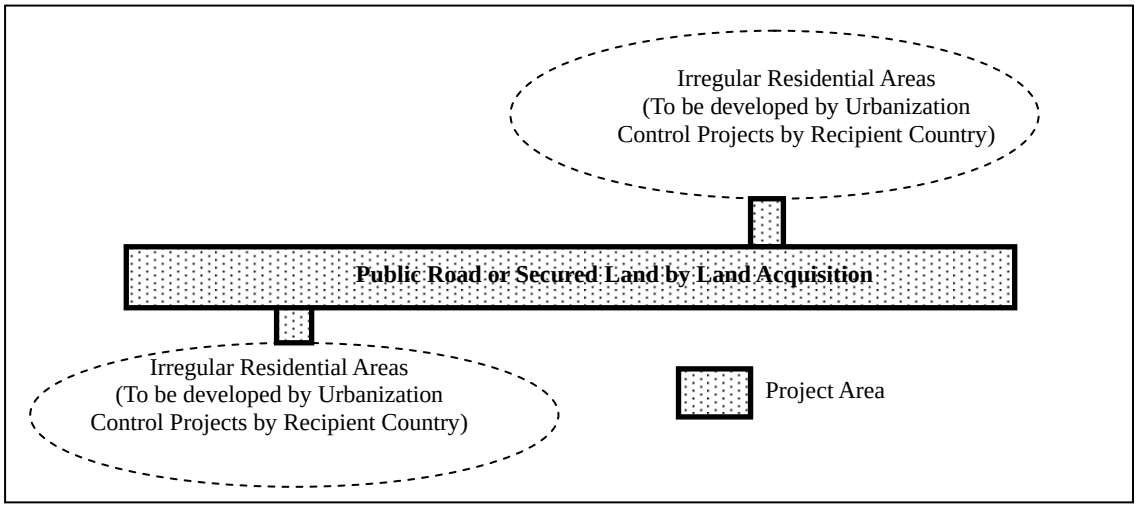


Figure 15.3.1 Concept of Project Area

The additional tariff will be collected after the development of the project, and this may cause some negative impact on the basin residents' economic life (the increase of their domestic expense) since they are in low income level (According to the public awareness survey for the basin residents, almost 60 % of them are not willing to pay for the additional tariff collection).

As for the traffic issue, the construction of the facilities at the public road spaces will have an impact on the surrounding traffic at construction stage. The interference with the existing utilities such as electric, telephone cables and water supply pipes, etc. is anticipated by the proposed project. Also noise may be caused by the construction equipment at construction stage and by the operation of the pumping equipment at operation stage.

(2) Sewerage construction Project in Isolated Communities

In case of Riacho Grande, land / resettlement issues may not be caused by the project since the project does not require a new land because of the development of its treatment capacity in its existing facility area. In case of Santa Cruz, the land issue on transfer of land title or land use may be caused by the project since it requires a new land. However, it may not require resettlement since the existing project site is currently open area.

AS the impact at operation, the waste issue by the treatment of sewage sludge and odor issue in the sludge treatment process may be caused. In case of Riacho Grande, the impact on water quality to be caused by the future effluent increase may be small since the current effluent quality is maintained.

As mentioned in the sewerage construction project in urban areas, the future additional tariff collection will have an impact on the basin residents.

(3) Permeable Pavement Project in Road Areas

Neither land issue nor resettlement may be anticipated since the project will be developed in existing public road spaces. However, some impact will be predicted on the surrounding traffic, safety, and the noise issue during construction stage in the project implementation at public road space. Also, the waste issue will be caused by the treatment of the surface excavated materials since the project will improve existing road facilities (pavement and surface soil materials, etc.). In addition, the safety issue at steep slopes is anticipated by the landslide caused by the degradation of ground condition at heavy rainfall.

(4) Public Parks and Green Space Development Project

The project site is not currently owned by the project proponent (SBC city, etc.) and some of the sites are private lands. Thus, the land acquisition is essential for the implementation of the project. The dwelling houses are not identified at the project site, which will cause no resettlement. Some of the project site is currently covered by shrub and weed and the planting works with common tree species is scheduled by the project, which will not cause significant adverse impact on flora and fauna.

(5) Environmental Remediation Project at Former Open Dumping Site

Currently, the project site is not secured by the project proponent and the land acquisition will be necessary for the implementation of the project. Resettlement will be required for the project implementation for the houses (about 5 houses) inhabiting inside the project area. The project site is currently covered by the shrub as secondary vegetation after the closure of the open dumping operation, the tree cutting is planned but the excavation of surface soil is not planned. The impact on soil erosion may be small since a regulating pond and tree planting is planned. The safety risk of structure may be caused at construction and operation since the proposed facility is planned on the garbage sediment and since it is planned on the instable topography.

(6) Dredging of lake bottom sediment Project

There will be no issue of resettlement since the project site is located at the water area of Billings lake. However, the lake currently belongs to EMAE, the coordination or agreement for the use of water area with EMAE will be necessary for the project implementation. The proposed project plans to transport the lake sediment to existing sewage treatment plant by using vacuum cars and pressurized pipes, which will affect some impact on the capacity of existing sewer pipes and sewage treatment plant. Some impact on the transportation operation is anticipated by the unexpected leakage from vacuum cars. The appropriate disposal in safe manners will be necessary at the final disposal. In addition, some water contamination is

anticipated by the dispersion of hazardous substances because of the excavation of the lake bottom during operation works.

(7) Water Purification Pilot Project Using Water Plants

As mentioned previously in (6) Dredging of lake bottom sediment Project, project proponent should coordinate and obtain agreement with state government authorities including EMAE since the target water area is under asset management by EMAE. The proposed project plans to implement the water purification by free-floating water plants such as water hyacinth indigenous to South America. The impact on surrounding ecosystem and the water quality degradation due to poor oxygen condition since above species may form a large community in flat water in a short term because of its strong fertility. In addition, some impact on the public health is anticipated by the generation of infectious disease such as dengue fever since the flat water to be formed by above community of water hyacinth may generate the breeding of mosquitoes. Thus, the regular mowing of above water hyacinth is indispensable, which will cause another issue of the treatment / disposal of above mowed water hyacinth and its accompanying issue of odor.

(8) Environmental centre for experimental study

The project may not cause any significant impact on surrounding environmental and society since one middle scale building is planned at the project site of existing parking area.

(9) Water Quality Management Centre

Likewise as Environmental centre for experimental study, significant impact may not be caused on the surrounding environment and society by the project. However, some impact on water quality and waste is anticipated since the project will use some chemicals at the laboratory.

15.4 Screening

The result of screening for the proposed projects in the master plan study is shown in Table 15.1.2 based on IEE results and taking the recipient country's environmental impact assessment (EIA) requirement into consideration. Almost all proposed projects are estimated to be categorized as "B", which means that they may not cause significant adverse impact on the surrounding environment and society compared to "A". On the other hand, according to the recipient's country's requirement on EIA, any project proposed in Master Plan does not require Environmental Impact Assessment (EIA/RIMA) except Dredging of lake bottom sediment Project since they does not cause significant adverse impact on the surrounding

environment according to the interview with the reviewing authority. The Dredging of lake bottom sediment Project will require the preparation of EIA/RIMA, the procedures after LP and the licenses for the treatment, transportation and disposal will be necessary.

Therefore, above proposed projects are estimated as Category "B" except Dredging of lake bottom sediment Project.

Table 15.4.1 Screening Results for Proposed Projects in Master Plan

No.	Name of Project	Category based on IEE Results	EIA Requirement in Recipient's Country	Final Screening
1	Sewerage construction Project in Urban Areas	B	The project which transports the sewage to existing sewage networks require neither preparation of EIA/RIMA nor LP (Licenca Previa: Preliminary Licence) and it only requires the procedures commencing LI (Licenca do Instalacao: Installation Licence).	B
2	Sewerage construction Project in Isolated Communities	B	The project needs to prepare only RAP (Relatorio Ambiental Preliminar: Preliminary Environmental Report), and it requires LP and LI.	B
3	Permeable Pavement Project in Road Areas	B	The project does not require EIA/RIMA.	B
4	Public Parks and Green Space Development Project	B	The project does not require EIA/RIMA.	B
5	Environmental Remediation Project at Former Open Dumping Site	B	The project does not require EIA/RIMA.	B
6	Dredging of lake bottom sediment Project	B	The project requires the preparation of EIA/RIMA and the environmental authorization procedures commencing at LP. The acquisition of the licenses for treatment, transportation and disposal of lake bottom sediment is necessary.	A
7	Water Purification Pilot Project Using Water Plants	B	The project does not require the preparation of EIA/RIMA, but it will require the procedures after LP.	B
8	Environmental centre for experimental study	C	The project does not require EIA/RIMA.	C
9	Water Quality Management Centre	C	The project does not require EIA/RIMA.	C

15.5 Recommended Mitigation Measures

The mitigation measures as shown below are recommended for the anticipated adverse impact as mentioned as follows for the implementation of the proposed projects. Its summary is shown in **Table 15.5.2**. The proposed projects do not require preparation of EIA/RIMA and institutional monitoring except Dredging of lake bottom sediment Project. However, the projects of sewerage construction in isolated communities and the environmental remediation in former open dumping site is recommended to conduct monitoring for water quality.

(1) Social Environment

1) Land / Resettlement

The project land should be secured in case of the projects of sewerage construction in urban areas, sewerage construction in isolated communities, public parks and green space development project and the environmental remediation in former open dumping site. The existing public land such as public roads will be basically selected for the project land, however, in case that the project areas belong to private owners, the project proponent will have to conduct negotiation with land owners for the necessary compensation, conduct appropriate procedures and make agreement with the landowners when the compensation is necessary. When the sewerage construction project in urban areas is implemented in private lands, there are two cases of the secure of project land as shown in **Figure 15.1.3**. One is the Project proponent's payment to land owners for the partial use of the land and another is the land acquisition of whole area.

Federal Constitution (FC), the federal law of No. 4,132/62 and the federal decree law of No. 3,365/41 are applied for the land expropriation in Brazil. Pursuant to FC, the legislative authority belongs to only federal government, and the execution authority of land expropriation for the purpose of the realization of public interest belongs to federal government, state government, municipalities and the public utility organization who is granted with its execution authorization by mutual agreement.

Land expropriation can be executed for the proposed projects of sanitary facilities such as sewerage systems or improvement / maintenance of public roads which aims at high public interest The land expropriation in the proposed case can be carried out by the project proponent of SBC city or SABESP after their declaration of the purpose for the public interest. Decree law of No. 3,365/41 or 1,075/70 is applied for the lawsuit process of the land expropriation.

Table 15.5.1 shows above regulations and some parts of their articles.

Table 15.5.1 Governing Laws and Applicable Articles related to Land Expropriation (Partial)

Governing Law	Article No.	Contents
Federal Constitution (FC)	5	Prior procedures for compensation shall be taken for the expropriation for the purpose of public needs, public interest or social interest.
	22	Legislative authority related to land expropriation shall belong to federal government.
	182	In case of implementation of projects which have social interest, the administrative authority of land expropriation shall belong to federal government, state government and municipalities
	184	In case of land expropriation of the target land acquisition, its administrative authority for its execution shall belong to the municipalities which have administrative jurisdiction.
Federal Law No. 4,132/62	2	When the project aims at social interest under the following land use or its project purpose is as shown as follows, land expropriation can be executed; 1) Existing Land Use • Land use in low productivity or land use against the purpose for residence, employment and livelihood support, etc. • Crop cultivation not in its land classification for agriculture 2) Project Purpose • Construction of public housing • Development of public sanitary facilities, harbors, electrification works and water storage, etc. • Land conservation, development of groundwater, water channels and forest conservation, etc.
Federal Decree Law 3,365/41	5	The following projects shall be applicable to the projects for public interests or their operation areas; • Projects related to national security guarantees / national defense • Projects aiming at rescuing residents at disaster • Development of sanitary facilities • Industrial development (Mining, water resource, hydraulic power generating, etc.) • Construction of facilities aiming at public welfare, sanitary, landscape conservation • Operation and maintenance of public roads • Other projects aiming public purpose which are regulated by government
	7	Condemner is allowed to enter into the land to be secured and receive the support from police if necessary
Federal Decree Law 1,075/70	-	Stipulation on the process on land expropriation for urban residents.

In case of land expropriation accompanying resettlement pursuant to Brazilian legislation system, only “land owner” or “legitimate land occupant (posseiros)” shall be compensated and no legislation systems on giving relief to “illegal land occupant” has not been established. For the latter case, when the project is implemented by the finance of international donors such as World Bank, “involuntary resettlement”, which is one of the safe-guard policies of World Bank, should be applied. Such issue of “involuntary resettlement” is included in the scope of

environmental and social impact in the regulation of CONAMA resolution on environmental license systems.

Resettlement is estimated in case of the sewerage construction project in urban areas and the environmental remediation project in former open dumping site. In those cases, the measures by the project proponents' preparation of appropriate resettlement plan, information disclosures to the local residents, public consultation and final agreement should be required.

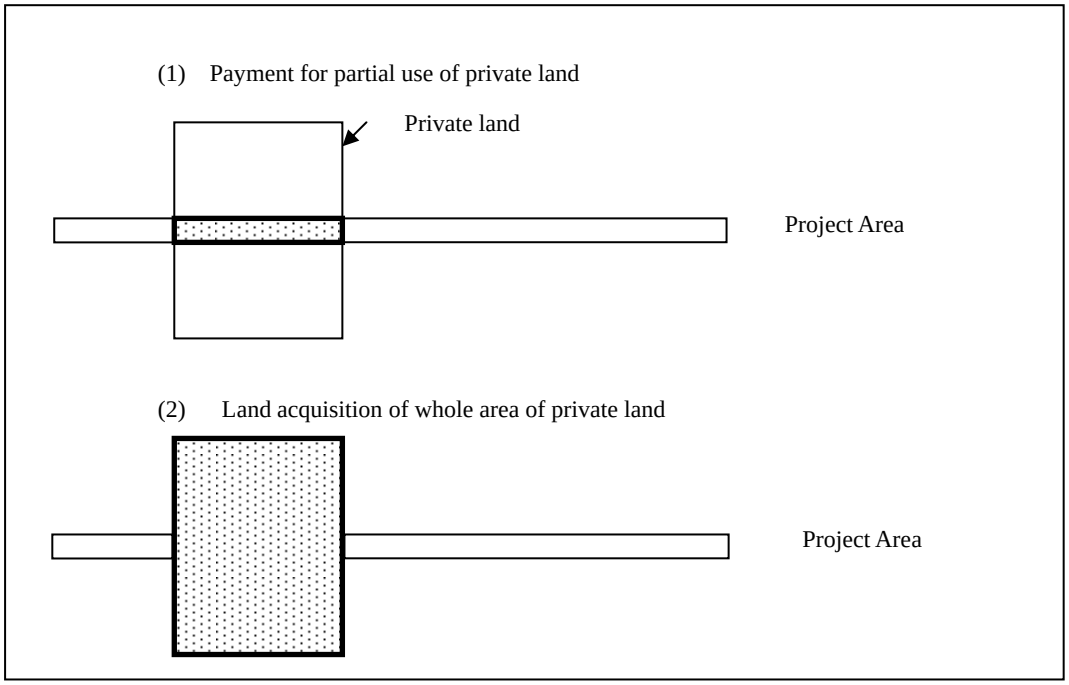


Figure 15.5.1 General Method of Secure of Project Area in Sewerage Project

As for the Dredging of lake bottom sediment Project and Water Purification Pilot Project using Water Plants, project proponent should coordinate and make agreement with the relevant state authorities including EMAE since the proposed projects are implemented in lake water area.

2) Economy

In sewerage construction projects in urban areas and isolated communities, the low tariff established by SABESP or municipalities will be applied for the low income basin residents or irregular residential areas. However, some rejection will be estimated for the payment for additional water charge collection. For such case, appropriate public enlightenment should be conducted by the project proponents.

3) Human Right (e.g. Vulnerable Social Groups / Gender Issue)

For the residents to be resettled in case of the projects of sewerage construction project in urban areas and the environmental remediation at the former open dumping site in Alvarenga

district, the prior information disclosure should be made, and the establishment of appropriate resettlement plan and its implementation will be necessary considering the right to existence / life and appropriate secure of resettlement land.

4) Traffic / Public Infrastructure

For the anticipated impact on the surrounding traffic in the sewerage construction project in urban areas and the permeable pavement project in road areas, the project proponent's prior notice to the relevant agencies (e.g. municipal department of transportation, traffic police, etc.) and the permission for the use of road space will be necessary. The measures not causing obstacle for the surrounding traffic will be necessary by allocating traffic control personnel in order to secure road safety during construction. For the interference issue with existing utility facilities such as electric, telephone cables and water supply pipes, it is necessary to conduct the survey for burial objects, contact to the relevant authorities and obtain the prior permission for the project implementation at pre-construction stage.

5) Public Health

-Dredging of lake bottom sediment Project

The transport and treatment quantity considering the capacity of existing sewage treatment facilities should be taken into consideration for the planning of the transport and treatment of the lake sediment.

-Water Purification Pilot Project Using Water Plants

Regular mowing operation for water hyacinth should be carried out for the prevention of the estimated breeding of mosquitoes. The monitoring for above breeding of mosquitoes is also recommended.

6) Waste

-Sewerage construction Project in Isolated Communities

The treated sludge in the sewage treatment plant and the lake bottom sediment may contain pollutants or hazardous substances, respectively. The secure of the sanitary landfill ensuring sanitary and safe disposal will be necessary.

-Environmental Remediation Project at Former Open Dumping Site

Environmental monitoring plan and its periodical monitoring will be necessary to ascertain the presence of hazardous substances before and after construction. The project has no plan to excavate the surface soil, which will not cause the treatment issue of the surface soil and its final disposal.

-Permeable Pavement Project in Road Areas

As for the construction waste during construction, the secure of the appropriate final disposal site for disposing the construction waste and its appropriate disposal is necessary. At the same time, the re-use of such waste should be also examined.

-Dredging of lake bottom sediment Project

The lake bottom sediment may include the hazardous substances such as heavy metals, the measures for prevention of the leakage of such matters should be taken at the operation works of transport and final disposal. The acquisition of environmental licenses for treatment, transport and final disposal of the sediment should be required from CETESB.

-Water Purification Pilot Project Using Water Plants

The waste will be generated after the mowing of the water plants. Appropriate care should be taken for the treatment method and the secure of the disposal site. The effective utilization of above treated water plants also should be studied.

-Water Quality Management Centre Project

The agent / chemical waste used in the laboratory should be appropriately treated including external treatment by the professional waste disposer treating such waste.

7) Safety Issue (Risk)

The impact on safety is anticipated in almost all projects, the establishment of safety measures and its implementation should be required by the project proponents. In the sewerage construction project in urban areas and the permeable pavement project in road areas, the establishment of construction planning and its actual practice considering traffic safety is necessary since these projects tend to have higher risks of traffic accidents because of their project sites to be influenced by surrounding traffic compared to other projects. Furthermore, in Permeable Pavement Project in Road Areas, the landslide is anticipated in the steep slope areas, and the project sites which are not causing landslides should be selected by examining their topography, geology and the surrounding land use, etc. In case of the environmental remediation project in former open dumping site, the project is planned at the garbage sediments and steep topography, which should require the consideration for the appropriate design for structure stability, its actual practice for construction and appropriate maintenance for the control for prevention of disaster risk at operation stage.

(2) Natural Environment (Flora and Fauna)

-Water Purification Pilot Project Using Water Plants

The maintenance by mowing above water hyacinths should be carried out for prevention of the fertility expansion of water hyacinths.

(3) Pollution

1) Water Pollution

Sewerage construction Project in Isolated Communities / Environmental Remediation Project at Former Open Dumping Site

For the increase of future effluent and new generation of effluent in sewerage construction project in isolated communities, the impact on water quality may be small since their effluent quality is maintained to the current state or beyond its state. However, the establishment of environmental monitoring plan (water quality) and the periodical monitoring should be implemented in the sewerage treatment plant and leachate treatment plant.

-Dredging of lake bottom sediment Project

The installation of fences should be carried out for prevention of the dispersion expansion of hazardous substances. Regular monitoring should be conducted for the water quality of the surrounding water area of the operation work lot of the lake bottom sediment.

-Water Purification Pilot Project Using Water Plants

Appropriate maintenance work by regular mowing of above water hyacinths should be conducted for the prevention of the serious proliferation.

-Water Quality Management Centre Project

The appropriate treatment including temporary storage in safe containers and treatment by professional waste disposers should be required for the issue of wastewater after water quality analysis.

2) Noise / Vibration

For the noise to be caused by the pumping operation, the facility plan / design including noise abatement measures and the tree planting plan, should be required for the noise reduction. Periodical monitoring should be implemented in compliance with regulatory requirement when there are complaints from the surrounding residents.

3) Odor

-Sewerage construction Project in Isolated Communities

In case of Riacho Grande, the complaints from the surrounding residents are not identified. However, for the generation of odor at operation, the facility plan for odor control (e.g. shielding the building) and process plan using the chemicals for removing the odor should be required in order to prevent odor generation.

-Water Purification Pilot Project Using Water Plants

Appropriate maintenance work should be conducted for the prevention of the generation of odor.

Table 15.5.2 Recommended Mitigation Measures（1）

Impacts to be Assessed		Name of Project	Anticipated Adverse Environmental and Social Impacts	Recommended Mitigation Measures by Project Proponents
Social Environment	Land / Resettlement	• Sewerage construction Project in Urban Areas • Sewerage construction Project in Isolated Communities • Public Parks and Green Space Development Project • Environmental Remediation Project at Former Open Dumping Site • Dredging of lake bottom sediment Project • Water Purification Pilot Project Using Water Plants	➢ Before Construction • Land issue to be caused by land acquisition of project area • Resettlement / Land issues to be caused by land expropriation • Right of use of land and water area	• Public information to stakeholders, consultation meetings and agreement with stakeholders regarding land acquisition • Appropriate procedures for land acquisition (e.g. Real estate survey, survey for land owner and land title) • Implementation of appropriate compensation • Establishment of appropriate resettlement plan • Public information to stakeholders, consultation meetings and agreement with stakeholders regarding resettlement plan • Appropriate coordination with relevant state authorities including EMAE
	Economy	• Sewerage construction Project in Urban Areas • Sewerage construction Project in Isolated Communities	➢ At Operation • Impact on basin residents' domestic economy to be caused by additional collection of water tariff	• Public information by project proponents to relevant residents, its public consultation and agreement with the residents regarding tariff collection • Public enlightenment for payment for tariff collection by project proponents
	Human Right (e.g. Vulnerable Social	• Sewerage construction Project in Urban Areas • Environmental Remediation Project at Former Open Dumping Site	➢ Before Construction • Impacts on the residents human right of existence caused by resettlement	• Establishment of appropriate resettlement plan by SBC city • Appropriate explanation by project proponents to relevant residents of resettlement plan, meeting and mutual agreement
	Traffic / Public Infrastructure	• Sewerage construction Project in Urban Areas • Permeable pavement project in road areas	➢ During Construction • Impact on surrounding traffic caused by construction works of sewer pipes in road areas • Interference with existing utility facilities of electric, telephone cables and water supply pipes	• Prior notice regarding construction works to relevant authorities (e.g. municipal transport departments, transport police) by project proponents • Obtaining of prior permission for construction works • Traffic control for traffic safety during construction • Survey for burial objects, prior permission
	Public Health	• Dredging of lake bottom sediment Project • Water Purification Pilot Project Using Water Plants	➢ At Operation • Impact on the capacity of existing sewage treatment facilities to be caused by the transport and disposal • Impact on infectious diseases to be caused by the generation of mosquitoes	➢ At Operation • Appropriate plan for transportation of lake bottom sediment and final disposal • Appropriate operation and maintenance (inclusive monitoring)
	Waste	• Sewerage construction Project in Isolated Communities • Environmental Remediation Project at Former Open Dumping Site • Permeable pavement project in road areas • Dredging of lake bottom sediment Project • Water Purification Pilot Project Using Water Plants • Water Quality Management Centre	➢ During Construction • Impact on waste treatment / disposal of the generation of construction waste in permeable pavement works in road areas ➢ At Operation • Impact to be caused by sewage sludge in sewage treatment process • Impact to be caused by the transport and final disposal of the lake bottom sediment • Impact to be caused by the water plants after their mowing • Agents and chemicals for water quality analysis at water quality management centre	➢ During Construction • Secure of the sanitary final landfill • Establishment of environmental monitoring plan and its actual practice ➢ At Operation • Secure of the final landfill for appropriate disposal of sewage sludge • Compliance with regulatory requirements (e.g. operation and maintenance standards in final landfill site) • Appropriate treatment and disposal by professional disposer for industrial wastes such as agents and chemicals • Appropriate plan for the transport and final disposal of lake bottom sediment • Securement of final disposal site of treated water plants • Possibility of reuse for organic fertilizer

Table 15.5.2 Recommended Mitigation Measures（2）

Impacts to be Assessed		Name of Project	Anticipated Adverse Environmental and Social Impacts	Recommended Mitigation Measures
Social Environment	Safety Issue (Risk)	• Sewerage construction Project in Urban Areas • Sewerage construction Project in Isolated Communities • Environmental Remediation Project at Former Open Dumping Site • Permeable pavement project in road areas	➢ <u>During Construction</u> • Construction and traffic accidents caused by construction works ➢ <u>At Operation</u> • Generation of disaster at steep slope at flood	➢ <u>Before Construction</u> • Selection of project sites and design considering topography, geology and surrounding land use ➢ <u>During Construction</u> • Establishment of safety measure plan and its actual practice • Establishment of compensation plan and its actual practice for unexpected accidents • Establishment of liaison and coordination structure at emergency situation • Traffic control measures ➢ <u>At Operation</u> • Maintenance for disaster prevention
Natural Environment (Flora and Fauna)		• Water Purification Pilot Project Using Water Plants	➢ <u>At Operation</u> • Impacts on flora and fauna to be caused by the serious proliferation of water plants (water hyacinths)	• Appropriate operation and maintenance (inclusive monitoring)
Pollution	Water Pollution	• Sewerage construction Project in Isolated Communities • Environmental Remediation Project at Former Open Dumping Site • Dredging of lake bottom sediment Project • Water Purification Pilot Project Using Water Plants • Water Quality management Centre	➢ <u>At Operation</u> • Impacts on water pollution to be caused by the effluent discharge, leachate • Impact to be caused by the treatment of the wastewater of agents/chemicals in laboratory used for water quality analysis • Impact on water quality to be caused by the possible dispersion of the hazardous substances at dredging operation • Impact on the possible water pollution by the poor oxygen water mass to be caused by the serious proliferation of water plants (water hyacinths)	• Compliance with regulatory requirement (e.g. effluent standards) • Establishment of environmental monitoring plan and its actual practice • Appropriate treatment by professional waste disposers • Installation of fences for prevention of dispersion of hazardous substances • Appropriate operation and maintenance including regular mowing of water plants
	Noise / Vibration	• Sewerage construction Project in Urban Areas	➢ <u>At Operation</u> • Noise to be caused by pump operation	➢ <u>At Operation</u> • Facility plan / design for noise abatement measures and its implementation • Planting plan for noise abatement measures and its implementation • Establishment of environmental monitoring plan and its implementation
	Odor	• Sewerage project 2 (onsite treatment of sewage) • Water Purification Pilot Project Using Water Plants	➢ <u>At Operation</u> • Possible odor to be caused by the odor generation in the treatment process of sewage in sewage treatment plant • Possible odor to be caused by the water plants (water hyacinths) after their mowing	• Facility plan for odor control (e.g. shielding the building) considering surrounding land use and its implementation • Compliance with regulatory requirement in odor issue • Appropriate operation and maintenance

Chapter 16

ASSISTANCE FOR INITIAL ENVIRONMENTAL EXAMINATION

16. ASSISTANCE FOR INITIAL ENVIRONMENTAL EXAMINATION

16.1 General

In this chapter, the detail of the information disclosure on the study to the relevant stakeholders which was conducted by the recipient country is mentioned based on JICA Guideline for Environmental and Social Considerations.

16.2 Background of Information Disclosure to Local Stakeholders

The stakeholder meeting based on JICA Guideline is required if necessary according to the minutes concluded in November 2004 between JICA Preparatory Study Team and the recipient country

To that end, JICA study team in this time has appealed to the implementation agency (SBC city) to hold stakeholder meetings under the support of the study team

However, SBC city did not accept to hold above stakeholder meetings including Billings Lake basin residents at the preparation stage of the master plan from the following anticipated problems;

Considering the situation of the recipient's country, holding stakeholder meetings at the stage when the details of the project has not been determined and unnecessarily providing the project menu will be used in a different way politically and will bring the situation into confusion.

SBC city, as a counter part of the study implementation in the study, may lose the social mission and above holding of stakeholder meetings may affect on the future study

SBC city cannot implement above stakeholder meetings for the target area of in all lake basin, while the study area covers the whole Billings Lake basin (about 860 thousand population in 6 cities as year of 2000)

The study aims for the environmental improvement of Billings Lake and it basically brings benefits to all basin residents, on the one hand, it may bring some disadvantage to some residents in the study area. SBC can prepare the printed materials (which contain the contact address of SBC city for collecting the residents' opinions) on the study, distribute them to the basin residents and hold a regional meeting if required.

The background up to the SBC's decision of preparation and distribution of printed materials for information disclosure to the local stakeholders is shown in **Table 16.1.1**.

Table 16.1.1 Background up to SBC's Preparation of Printed Materials

Date / Year	Background
December 14, 2005	Discussion between SBC city and JICA Study Team regarding stakeholder meeting（SBC city replies that he cannot agree to hold stakeholder meetings, and he replies no objection for preparation / distribution to the stakeholders.）
December 15, 2005	JICA Study Team reports to JICA headquarters office on above results and make inquiries on holding stakeholder meetings
December 28, 2005	Acceptance of reply from JICA headquarters office against the inquiry dated December 15th 2005: JICA understand the situation that SBC city cannot hold above stakeholder meetings, and that he has no objection for SBC's handling for information disclosure to the stakeholders by using distributing printed materials.
January 3, 2006	JICA Study Team reports the reply's of JICA headquarter to SBC city
February 3, 2006	SBC's final decision of preparation of printed materials for information disclosure
January 15 to February 10th, 2006	Preparation of printed materials
February 23, 2006 ～	Distribution of printed materials to related areas and collection of opinions

16.3 Information Disclosure by Printed Materials

16.3.1 Objective of Preparation of Printed Materials

The objective of preparation of printed materials is to inform the importance of environmental conservation of Billings Lake basin and the outline of JICA study to the stakeholders, and collect their opinions at the same time.

16.3.2 Area for Distribution

The area where the printed materials are distributed is the Billings Lake basin including Alvarenga and Riacho Grande districts.

The printed materials are delivered to schools, community association, companies and *Poupatempo* (which means "do not waste time" in Portuguese and its function is to provide public service such as issuing certifications for the application for federal, state, municipal relevant agencies, bank and post office) by SBC's relevant departments (SHAMA, Education & Culture Department, etc.), and

left there temporarily and distributed to stakeholders from there.

16.3.3 Outline of Printed Materials

The Billings Lake residents are low in education and income level as explained in the public awareness survey. The residents would not understand the printed materials using abstruse technical terms from above facts. For that reason, SBC city prepared the materials using simplified expressions and figures which any people can understand. JICA study team made advice to SBC city regarding appropriateness of the contents and the accuracy of the expressions.

The materials are composed of brochure and pamphlet, the former targeted the residents with low education levels and prepared in the expressions easy to understand, the latter targeted all stakeholders and it contained basic information related the JICA study (e.g. background of the study, study area, etc.), on the other hand.

Each material is shown in **Figures 16.1.1** and **16.1.2**.

The outline of each material is shown as below;

Brochure:

- Importance of water
- Importance of environmental conservation of Billings Lake
- What is JICA
- Activity of JICA
- Member of steering committee
- Contact address

Pamphlet:

- Background of JICA Study
- Billings Lake basin
- What is JICA
- Activity of JICA
- Member of steering committee
- Contact address

Figure 16.1.1 Covering of SBC's Pamphlet

Figure 16.1.2 Contents of SBC's Pamphlet