

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

BRAZILIAN COOPERATION AGENCY (ABC)

STATE SECRETARIAT OF PLANNING AND ECONOMIC DEVELOPMENT

STATE OF RIO DE JANEIRO (RJ)

FEDERAL REPUBLIC OF BRAZIL


# THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RECIFE METROPOLITAN AREA IN THE FEDERATIVE REPUBLIC OF BRAZIL

## FINAL REPORT MAIN REPORT



JANUARY 2001

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

BRAZILIAN COOPERATION AGENCY (ABC),  
STATE SECRETARIAT OF PLANNING AND SOCIAL DEVELOPMENT,  
STATE OF PERNAMBUCO (SEPLANDES)  
FEDERATIVE REPUBLIC OF BRAZIL

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**THE STUDY ON  
STORMWATER DRAINAGE AND  
SEWERAGE MANAGEMENT PLAN  
FOR RECIFE METROPOLITAN AREA  
IN THE FEDERATIVE REPUBLIC OF BRAZIL**

**F I N A L R E P O R T  
M A I N R E P O R T**

JANUARY 2001

**PACIFIC CONSULTANTS INTERNATIONAL, TOKYO**

The cost estimate was made based on prevailing market price in July 2000 and expressed in US\$ according to the following exchange rate.

US\$1.00 = R\$ 1.80 = Yen 110.00  
(As of June 2000)



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## PREFACE

In response to a request from the Government of Federative Republic of Brazil, the Government of Japan decided to conduct a development Study on Stormwater Drainage and Sewerage Management Plan for Recife Metropolitan Area in the Federative Republic of Brazil and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Hajime Tanaka of Pacific Consultants International Co., Ltd. to Brazil, three times between October 1999 to January 2001. In addition, JICA set up an advisory committee headed by Shin'ichiro Uchida, Executive Adviser of Japan Sewerage Works Agency between October 1999 to January 2001, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Brazil, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Brazil for their close cooperation extended to the Team.

January 2001



Kunihiko Saito

President

Japan International Cooperation Agency



THE STUDY  
ON  
STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RECIFE  
METROPOLITAN AREA  
IN  
THE FRDERATIVE REPUBLIC OF BRAZIL

January, 2001

Mr. Kunihiko Saito  
President  
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

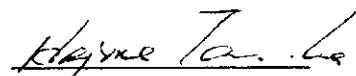
Dear Sir,

We are pleased to submit the final report entitled the" The Study on Stormwater Drainage and Sewerage Management Plan for Recife Metropolitan Area in the Federative Republic of Brazil". This report has been prepared by the Study Team in accordance with the contracts signed on October 1999 and May 2000 between the Japan International Cooperation Agency and Pacific Consultants International.

In the Study, the Study Team presents the Master Plan Study based on the analysis of the existing wastewater problems and Feasibility Study on the priority projects. The report consists of the Summary, Main Report, Supporting Report and Data Book.

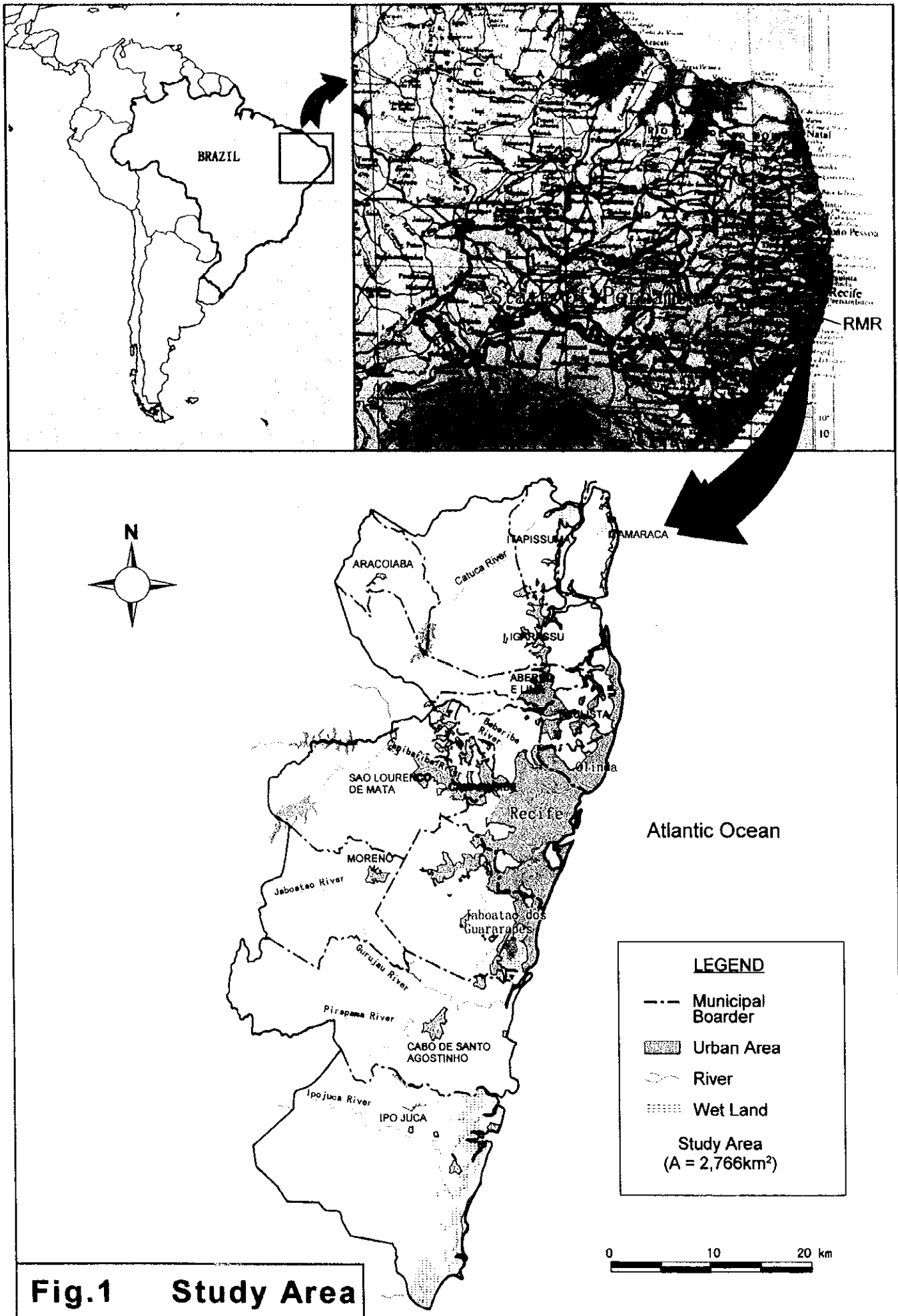
All members of the Study Team wish to express sincere appreciation to the personnel of your Agency, Advisory Committee, and the Embassy of Japan in Brazil, and also to the officials concerned of the Government of the Federative Republic of Brazil and the State Government of Pernambuco for their cooperation extended to the Study Team. The Study Team sincerely hopes that the results of the Study will contribute to the stormwater drainage and sewerage management for the Recife Metropolitan Region and also to the promotion of socio-economic development for the area.

Yours Faithfully



Hajime Tanaka

Team Leader of the Study Team



**Fig.1 Study Area**

## OUTLINE OF THE STUDY

### 1 Introduction

This Study has been conducted on the Master Plan of Stormwater drainage and sewerage management plan for Recife Metropolitan Area and the Feasibility Study on the priority projects identified in the Master Plan.

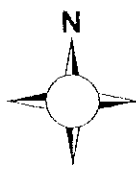
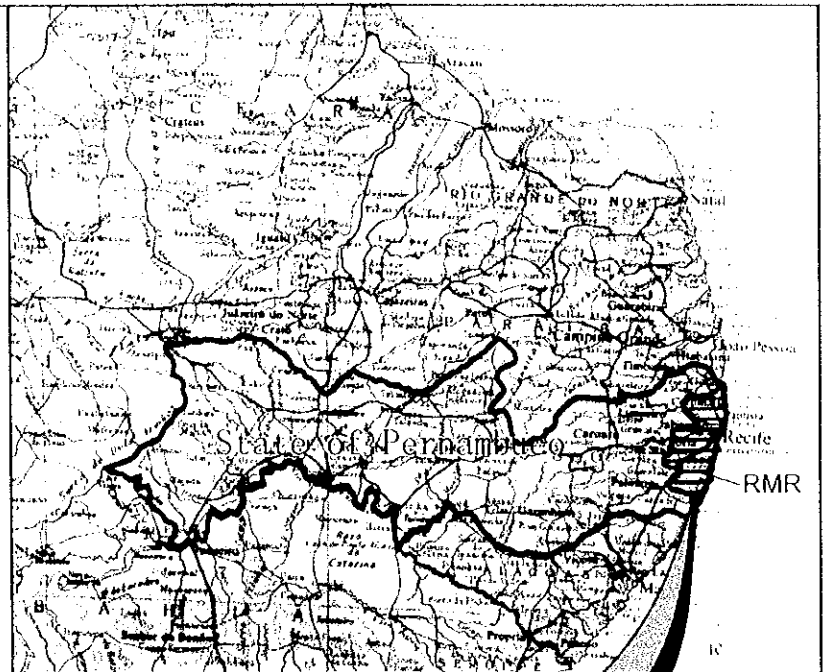
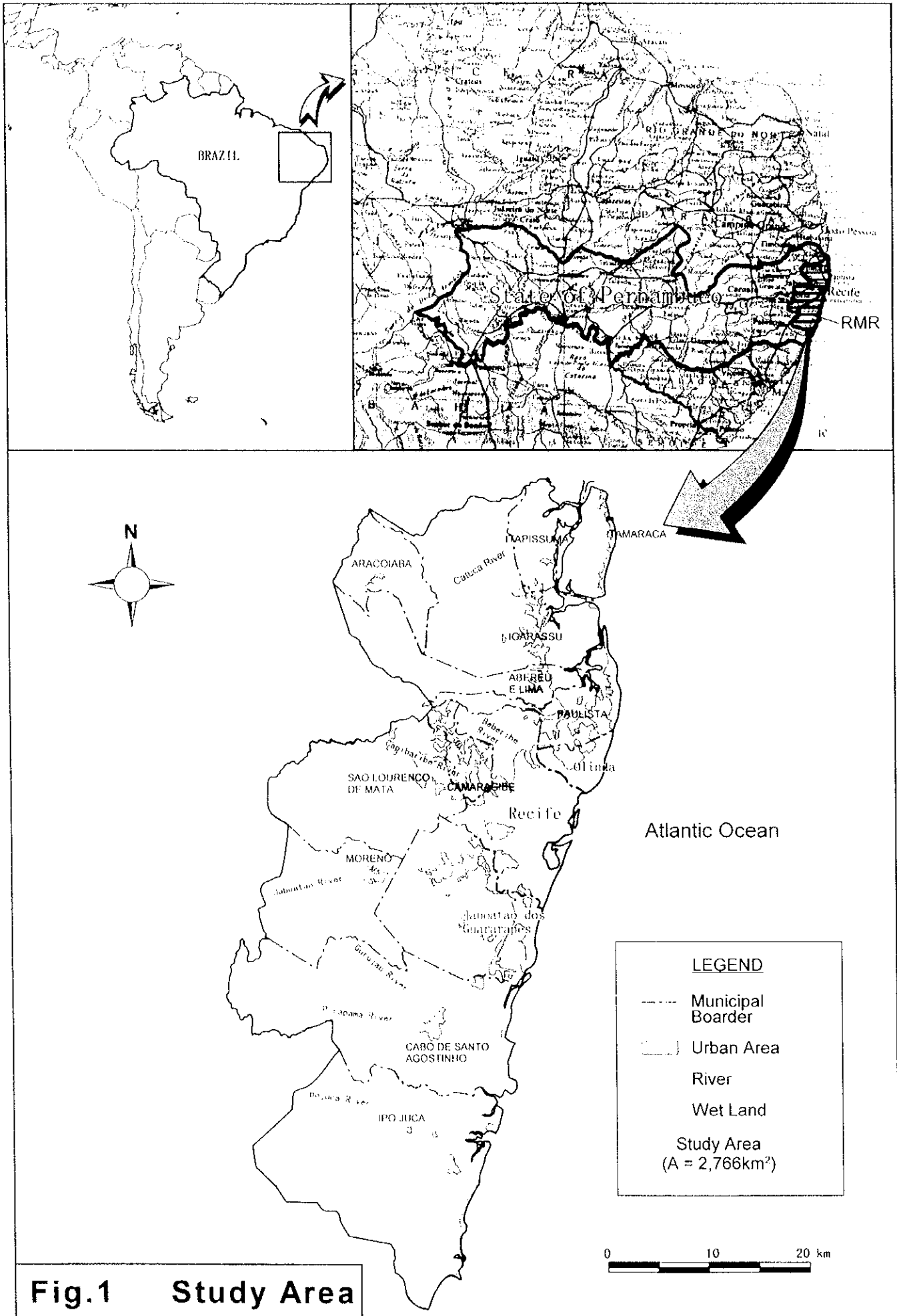
The Recife Metropolitan Region (RMR) had a population of 3.1 Million (in 1996), covering 2,766 km<sup>2</sup> which are composed of 11 major river basins. The RMR is rich in tourism resources such as beautiful beaches and historical towns and buildings. Once the RMR were developed on the basis of port activities, the sugar cane industry and an important agricultural production area of sugar, cotton, fruits, etc, but now the tourism is the leading industry of the State due to the sluggish of the agricultural sector. The RMR is characterized by a heavy concentration of population in the urban area, a wide distribution of the poverty areas or informal settlements and a scarcity of basic infrastructures such as sewerage systems and drainage systems.

The population of the RMR doubled between 1950 and 1970 and has been increasing ever since. According to the 1996 Census about 40% of the population (7.4 Million) of the State Pernambuco, were living in the RMR and 83% of the urban population of the RMR were living in the five municipalities in the central part of the RMR. The population in the poverty areas is estimated to be more than 40% of the urban population of the RMR and slums or informal settlements have been developed at the hilly areas and the low-lying areas along rivers and water bodies in the urban area. They are usually lack of basic infrastructure like drainage and sewerage facilities and accordingly accelerating the devastation of the urban environment.

The households connected to the sewer systems and to the sewage treatment plants are to be 36 % and 21 % respectively. Due to being superannuated and also poorly maintained, many of the existing sewerage facilities (sewer pipes, pumping facilities and sewage treatment facilities) are inactive. Accordingly the collected domestic wastewater of the RMR is mostly discharged directly or indirectly into the rivers or water bodies without proper treatment. As the results drainage channels are polluted, water bodies are eutrophicate, and river/coastal waters are polluted. Due to the Study 91 % of the total BOD pollution load was discharged into the five major rivers, i.e., the Capibaribe, Beberibe, Jaboatao, Tejipio and Timbo Rivers.

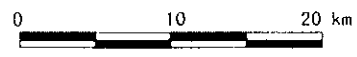
The incidence of water borne diseases and a high death rate, affected by living conditions in the neighborhoods, and also stagnation of the tourism industry, and the drainage and sewerage management is an urgent measure for the State Government to solve.





**LEGEND**

- Municipal Boarder
- Urban Area
- River
- Wet Land
- Study Area (A = 2,766km<sup>2</sup>)



**Fig.1 Study Area**

## OUTLINE OF THE STUDY

### 1 Introduction

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The Recife Metropolitan Region (RMR) had a population of 3.1 Million (in 1996), covering 2,766 km<sup>2</sup> which are composed of 11 major river basins. The RMR is rich in tourism resources such as beautiful beaches and historical towns and buildings. Once the RMR were developed on the basis of port activities, the sugar cane industry and an important agricultural production area of sugar, cotton, fruits, etc, but now the tourism is the leading industry of the State due to the sluggish of the agricultural sector. The RMR is characterized by a heavy concentration of population in the urban area, a wide distribution of the poverty areas or informal settlements and a scarcity of basic infrastructures such as sewerage systems and drainage systems.

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The incidence of water borne diseases and a high death rate, affected by living conditions in the neighborhoods, and also stagnation of the tourism industry, and the drainage and sewerage management is an urgent measure for the State Government to solve.

## **2. Master Plan for Stormwater Drainage and Sewerage Management**

### **2.1 Framework for the Target Year 2020**

The frameworks of urban population, urban area, Gross Regional Domestic Product (GRDP) for the target year 2020 were formulated as follows:

- Urban population: 3,635 thousand inhabitants
- Urbanized area: 364.25 square km
- GRDP of the State: R\$ 65 billion (at 1997 constant prices). This is 2.8 times of that of 1997 (R\$ 23.26 billion). The growth rate is expected to be 3.2 % in 2020, which is larger than the rate (2.7 %) in 1997.
- GRDP per capita: R\$ 7,600 at 1997 constant prices. This is 2.4 times of that of 1997 (R\$ 3,100). It is projected to be 79 % of the national average, which will have increased by 58 % since 1997.

### **2.2 Sewerage Facility Development Plan**

The 86 sewerage systems proposed for the RMR in the PQA were reviewed and 55 sewerage systems were selected for the Master Plan (Fig.2). For the 55 sewerage systems rehabilitation of existing sewerage facilities, development of new sewerage facilities and also strengthening of the implementation organization and the O&M organization are planned. By completion of the 55 sewerage systems the percentage of sewer population will be 91 %.

The Master Plan was planned to be executed in the following two phases:

- Phase 1(2001-2010) : Improvement of sewerage facilities for the 25 sewerage systems,
- Phase 2 (2011-2020): Improvement of sewerage facilities for 30 sewerage systems.

### **2.3 Stormwater Drainage Management Plan**

Currently flood and drainage problems in the RMR are identified locally at the low-lying areas along the rivers and water bodies in the municipalities of Olinda, Recife and Jaboatao.

In the past the major part of the urban area of the RMR were frequently affected by floods from the Capibaribe River, however, two dams (Carpina and Goita) were constructed in the river basin and the river channel were improved at the upper reach of the national road No.101. Since 1978 no big floods have been occurred in the central part of the RMR. The drainage facilities planned in the PQA for Olinda, Recife and Jaboatao are planned to be implemented for the time being. The preparation of basic hydrological and river data and the formulation of drainage and flood mitigation measures are proposed.

## 2.4 Project Cost

The project costs of the Master Plan are composed of direct cost (construction cost and rehabilitation cost, land acquisition and compensation cost) and indirect cost (administration cost, engineering cost, physical contingency) shown as follows:

### 1) Sewerage project

The project cost for the sewerage projects is estimated to be R\$ 852.7 Million (US\$ 448.8 Million) as detailed below:

#### Project Cost for the Sewerage Project (Unit: R\$ Million)

Item	Phase 1	Phase 2	Total
1 Direct cost	528.3	133.9	662.2
2 Indirect cost	151.5	39.0	190.5
Total	679.8	172.9	852.7

Note:

- 1) Price level is presented under the economic conditions that prevailed in November 1999. The exchange rates: R\$1.90 = US\$1.00 = ¥105.00.
- 2) The project cost includes the following items:
  - Direct cost : Construction cost, including rehabilitation cost, and land acquisition and compensation cost,
  - Indirect cost: 30 % of the direct construction cost,

### 2) Stormwater drainage project

#### Project Cost for the Stormwater Drainage project (Unit: R\$ Million)

Item	Phase 1
1 Direct cost	
1) Construction for Recife	0.80
2) Construction for Olinda	1.02
3) construction fir Jaboatao	2.34
Sub total	4.30
2 Indirect cost	0.84
Total	5.04

Note: The exchange rates and the composition of indirect cost are the same as the sewerage project.

### 3) The annual operation and maintenance costs (O&M costs) are estimated as follows:

- 1) Annual O&M cost for the sewerage project is estimated at R\$ 44 million, 7.0 % of the direct construction cost,

- 2) Annual O&M cost for the stormwater drainage is estimated at R\$ 0.12 million, 2.0 % of the direct construction cost.

## 2.5 Project Evaluation

The project was evaluated in their financial, economic, social and environmental terms as well as technical term.

The technical evaluation is to inspect the reduction effects of pollution loads by sewerage facilities and the financial and economic evaluation are to be conducted in accordance with the conventional methodology that is commonly applied in the evaluation of development programs in Brazil with finance from the World Bank and the other international agencies.

The financial evaluation is to inspect the proposed projects from the financial point of view, involving tests of earning capacity and financial efficiency. The economic evaluation is to examine the proposed project from the economic point of view, that is, viability of social investment in the national economy.

The benefits are quantifiable or tangible benefits of direct effects are quantified as project benefits. In this study, the following three benefits were chosen as tangible benefits

**Tangible Benefits with Sewerage Projects**

No.	Tangible Benefits	Quantified Benefits
1)	Sewage treatment saving benefits for inhabitants	Elimination of installation and O&M costs of other treatment systems and septic tanks outside the existing sewerage collection service areas
2)	Decrease of medical expenses and losses due to absence from work	Cost reduction of medical expenses for water borne diseases, and Reduction of losses from absence from work due to water borne diseases
3)	Elimination of tourism recession owing to maintenance of tourism resources	Maintaining tourist attractions and promotion of regional industries related to tourism in the RMR

Note: Detailed benefit structure is shown in Fig. 3.7-2 in the Main Report

The opportunity cost of capital is assumed to be between 10 % and 12 %, but 12 % seems commonly used in the projects by international financial agencies in Brazil.

The financial and economic evaluation indices of the entire project were calculated at 6.1% of FIRR and 14.4 % of EIRR as follows:

<b>FIRR and EIRR Evaluation Indices</b>			
	Description	FIRR	EIRR (%)
	Entire Projects	6.1	14.4
1.	Capibaribe River Basin	6.9	14.4
2.	Beberibe River Basin	7.4	18.9
3.	Jaboatão River Basin	4.7	13.0
4.	Tejipio River Basin	5.8	11.2
5.	Timbo River Basin	8.3	13.7
6.	Other River Basins	7.2	3.7

The proposed projects are evaluated as feasible in technical, financial, economic, social and environment as shown in Table 7. By the implementation of 55 sewage subsystems the master plan is expected to produce the following positive effects:

- It will expand the sewerage service area from 8,516 ha to 29,985 ha by 2020 and increase the sewage treatment level from no more than 21 % of the urban population in 1997 to about 90 % in 2020. By the expansion of sewerage service areas, living and sanitary conditions in the RMR will be improved.
- The FIRR is estimated at 6.1 %, which is lower than the 12% decisive factor. However, the projects could be manageable, if the state government procures financial sources with an interest rate of less than 6.1 %. The financial condition of the operational body will be further improved by increasing tariffs and by utilizing government the capital investment.
- The EIRR is estimated at 14.4 %, so the projects could be viable from the economic point of view.
- It will improve the sanitary conditions of the poverty areas by providing with sewerage facilities for some 885,000 inhabitants in these areas.
- The five major river basins (Capibaribe, Beberibe, Jaboatão, Tejipio and Timbo) are to have a high priority for early implementation.

## **2.6 Initial Environmental Examination (IEE)**

According to the Manual of Guidelines for Evaluation of Environmental Impacts by the CPRH, 1998 and the Environmental Guidelines by JICA, 1994, the IEE of the project covered "Physical Resources", "Ecological Impacts" and "Socio-economic Impacts".

No significant adverse impacts by the construction of the priority projects are to be expected on air quality, hydrological situation, ecological resources and water quality, however, further study on the impacts by the priority projects are proposed as follows:

- The sewage treatment facilities may give an offensive odor to the surrounding

settlement areas,

- The effluent discharge may cause adverse impacts on the river environment,
- The construction of the projects may have adverse impacts on ecology,

## 2.7 Priority Project

The Priority Projects for F/S were selected from the sewerage systems in the major river basins for restoration of the urban environment. The following sewerage systems have been selected as the priority projects for F/S.

### Priority Projects for F/S

System	River basin	Municipality	Service Population
1. Conceicao	Timbo	Paulista	62,440
2. Janga	Timbo	Paulista	322,450
3. Cabanga	Capibaribe	Recife	306,690
4. Boa Viagem	Tejipio	Recife	157,010
5. Cordeiro	Capibaribe	Recife	109,230
6. Prazeres	Jaboatao	Jaboatao dos Guararapes	233,400
7. Curcurana	Jaboatao	Jaboatao dos Guararapes	150,160
Total			1,341,380

Note: The priority projects do not include sewerage systems in the Beberibe River Basin because the Beberibe River Basin has already been selected for the Pro-Metropole Project (Project of Infrastructure in Low-income Areas of the RMR) financed by the World Bank, which includes the construction or improvement of drainage and sewerage systems.

## 2.8 Action Plan

The Master Plan planned to establish a Project Management Unit (PMU) and to implement the projects in two Phases by 2020. The tasks required in each phase are planned as follows:

### (1) Tasks Phase 1 (2001-2010)

#### (Sewerage)

- Implementation of the phase 1 projects (25 sewerage systems),
- Execution of routine O&M activities after completion of the Phase 1 projects,
- Promotion of environmental education as a non-structural measure,

#### (Drainage)

- Installation and observation of automatic rain gauges, and execution of basic river surveys,
- Implementation of the drainage projects in the PQA,

- Preparation of river improvement plan for the major reaches.

(2) Tasks in the Phase 2 (2011-2020)

(Sewerage)

- Implementation of the Phase 2 projects,
- Execution of routine O&M activities,

(Drainage)

- Establishment of design conditions,
- Formulation of stormwater drainage and river improvement plan for major rivers.

### 3 Feasibility Study on the Priority Projects

#### 3.1 Sewerage Facility Plan

The sewer networks and major facilities for the seven sewerage systems are planned based on the topographic maps (1:10,000) provided by FIDEM. The proposed facilities are summarized as follows:

- Trunk sewer: 125.4 km
- Pump stations: 81 stations (Construction: 43 stations, Rehabilitation: 38 stations),
- Sewage treatment stations: 7 stations (Construction: 5 stations, Rehabilitation: 2 stations)

Rehabilitation of the existing sewage treatment facilities is planned at Janga and Cabanga sewerage systems. Sewage treatment process is composed of biological treatment process, disinfection and sludge treatment processes as follows:

1) Biological treatment system

- "RAFA + Bio-filtration" process is applied for Cabanga and Cordeiro have a certain limitation for land space.
- "RAFA + Aerated lagoon + Polishing pond" process is applied for Conceicao, Janga, Boa Viagem Prazeres and Curcurana where have no limitation for land space.

2) Disinfection System

The chlorine process is the most advantageous in terms of economic efficiency. However, the residual chlorine and generated chlorine compounds might produce adverse impacts on the aquatic ecosystem.

Though a specific policy of disinfection method has not been established in the RMR yet, the ultra violet process is planned to be applied for the seven sewage treatment facilities to avoid any adverse effects on the aquatic ecosystem including mangroves growing along the rivers and also to consider future regulation by the CPRH.



### 3) Sludge Treatment Process

- A certain mechanical dehydration is applied for Cabanga, Boa Viagem and Cordeiro sewage treatment facilities which have a limited land space or be located in densely populated area.
- A natural drying bed is applied for Conceicao, Janga, Prazeres and Curcurana sewage treatment facilities, which have an enough land space or be not located in a densely populated area.
- Final disposal is to be disposal by sanitary landfill.

### 3.2 Project Cost

- (1) The project cost, consists of 1) Construction cost, 2) Land acquisition and compensation cost, 3) Engineering service cost, 3) Administration cost, and 4) Physical contingencies. The project cost is estimated to be R\$ 344.5 million (as shown in the following table:

Project Cost

Item	Conceicao	Janga	Cabanga	Boa Viagem	Cordeiro	Prazeres	Curcurana	Total
<b>I Direct cost</b>								
1 Construction cost								
1) Sewage treatment Plants	5,618	13,506	15,133	7,094	6,928	10,571	9,839	68,689
2) Trunk sewers and Pumping stations	3,452	18,009	12,605	10,060	5,714	12,131	6,483	68,454
3) Branch sewers, etc.	7,065	27,168	12,027	10,765	8,414	13,798	10,040	89,277
Sub total	16,135	58,683	39,765	27,919	21,056	36,500	26,362	226,420
2 Land acquisition cost	3,296	48	480	24,251	1,427	14,999	1,024	45,525
3 O&M equipment cost	649	711	711	649	649	649	649	4,667
<b>II Indirect cost</b>								
1 Engineering services cost	1,614	5,868	3,977	2,792	2,106	3,650	2,636	22,643
2 Government administration cost	897	2,934	1,988	1,396	1,053	1,825	1,318	11,321
3. Physical contingency	2,420	8,802	5,965	4,188	3,158	5,475	3,954	33,962
Total	24,921	77,046	52,886	61,195	29,449	63,098	35,943	344,538

Note: 1. Exchange rates: R\$1.80 = US\$1.0 = ¥110.00 (in July 2000),

2. Direct cost: Construction cost, including rehabilitation cost, land acquisition/compensation cost, procurement of O&M equipment
3. Indirect cost: Administration cost (5 % of the direct construction cost), Engineering cost (10 % of the direct construction cost) and physical contingency (15% of the direct construction cost)

**(2) O&M cost**

The annual cost for O&M was estimated to be R\$ 13 million, 6 % of the direct construction cost.

**(3) Construction schedule**

The priority project is to be completed within 7 years from 2001.

**3.3 Environmental Impact Assessment (EIA)**

(1) The impacts on the rivers caused by effluent discharge of the proposed sewage treatment facilities are evaluated to be insignificant as follows:

- The effluent discharge would not cause any significant adverse impacts on the river environment
- The wastewater treatment facilities would not give any significant offensive odor to the surrounding settlement areas except the Cabanga sewage treatment facility and the Cabanga STF could reduce the odor by installation of a green belt and other countermeasures.
- The construction of the projects would not have any significant adverse impacts on ecology, because there are no species of flora and fauna at risk of extinction in the project sites.

(2) Any new project shall be accorded environmental licenses by the state government in accordance with the procedures specified. The project is categorized under "Item 4: Wastewater Projects" under Environmental Licensing Manual, 1998 (CPRH). The project requires getting environmental licenses from the CPRH before implementation. There are three environmental licenses, namely "Preliminary license", "Installation license" and "Operation license" that are to be issued separately.

**3.4 Project Evaluation**

The financial and economic evaluation indices of the entire project were calculated at 7.9 % of EIRR and 13.1% of EIRR as follows:

**Financial and Economic Evaluation Indices**

Description	FIRR (%)	EIRR (%)
1. Conceição	3.1	12.6
2. Janga	9.9	12.8
3. Cabanga	15.0	15.5
4. Boa Viagem	4.1	11.7
5. Cordeiro	6.6	10.8
6. Prazeres	4.9	14.1
7. Curcurana	7.2	14.6
Entire Systems	7.9	13.1

The overall project evaluation based on urgency (total pollution loads in the basin), technical evaluation (reduction in amount of BOD (kg/day). financial/economic evaluation (values of FIRR/EIRR for the projects), social /environmental impact (total served population, and the served population in poverty areas). By the implementation of sewage systems the priority projects are expected to produce the following positive effects:

- It will expand the sewerage service area from 8,516 ha to 12,464 ha in 2010 and increase the sewage treatment level from no more than 21% of the urban population (in 1996) to about 37 % of that in 2010. By the expansion of sewerage service areas, living and sanitary conditions in the RMR will be improved.
- The FIRR is estimated at 7.9 %, which is lower than the 12% decisive factor. However, the projects could be manageable, if the State government procures financial sources with an interest rate of less than 7.9 %. The financial condition of the operational body will be further improved by increasing tariffs and by a subsidy by the State government.
- The EIRR is estimated at 13.1 %, so the projects could be viable from the economic point of view.
- It will improve the sanitary conditions of the poverty areas by developing the sewerage system to provide for some 324,000 inhabitants in these areas.

## Overall Evaluation of Priority Projects

System	River Basin	Generated BOD Load in the River Basin (kg/day)	Basic Conditions				Urgency		Technical Evaluation			Economic Evaluation		Financial Evaluation		Social Environmental impact		Impacts by Construction		Evaluation as a whole	
		(Ratio (%) of the total pollution load in the RMR)	Area (ha)	Population in 2020	BOD load (kg/day)	Construction cost (1000R\$)	Based on the river basin and location.		Based on the reduction amount of BOD load (kg/day), and reduction rate (%) of the total BOD load from the basin,			Based on the value of EIRR for the Sewerage System.		Based on the value of FIRR for the Sewerage System.		Based on the number of serviced population, and the served population in the poverty areas.					
Conceição	Timbo	25,874 (13.1%)	853	62,440	3,372	16,135	Urgent	B	Reduction amount of BOD: 3,035 kg/day, Reduction rate: 11.7%	C	12.6%	A	3.1%	B	Served population: 62,445 Served population in poverty area: No data.	C	Impacts unknown, but no significant impacts expected	B	Effective	B-	
Janga	Timbo	25,874 (13.1%)	3,954	322,450	17,423	58,683	Very urgent	A	Reduction amount of BOD: 15,681 kg/day, Reduction rate: 60.6%	A	12.8%	A	9.9%	A	Served population: 322,450 Served population in poverty area: No data.	A	No significant impacts expected.	A	Very effective	A	
Cabanga	Capibaribe	43,839 (22.2%)	2,671	306,690	17,443	39,765	Very urgent	A	Reduction amount of BOD: 15,699 kg/day, Reduction rate: 35.8%	A	15.5%	A	15.0%	A	Served population: 306,690, Served population in poverty areas: 72,869 (24%)	A	No significant impacts expected.	A	Very effective	A	
Boa Viagem	Tejipio	30,366 (15.4%)	1,203	157,010	8,525	27,919	Very urgent	A	Reduction amount of BOD: 7,673 kg/day, Reduction rate: 25.2%	B	11.7%	B	4.1%	B	Served population: 157,010, Served population in poverty area: 34,008 (22%)	A	Some impacts to the housing area nearby.	C	Effective	B+	
Cordeiro	Capibaribe	43,839 (22.2%)	1,054	109,230	5,898	21,056	Urgent	B	Reduction amount of BOD: 5,508 kg/day, Reduction rate: 12.1%	C	10.8%	B	6.6%	A	Served population: 109,230 Served population in poverty areas: 29,215 (29%)	B+	Some impacts to the surrounding poverty area nearby.	C	Effective	B+	
Frazeres	Jaboatao	35,139 (17.8%)	1,570	233,400	12,604	36,500	Very Urgent	A	Reduction amount of BOD: 11,344 kg/day, Reduction rate: 32.3%	A	14.1%	A	4.9%	B	Served population: 233,408, Served population in poverty areas: 138,204 (60%)	A	Impacts Unknown, but no significant impacts expected	B	Very effective	A-	
Curcurana	Jaboatao	35,139 (17.8%)	1,160	150,160	8,108	26,362	Urgent	B	Reduction amount of BOD: 7,297 kg/day, Reduction rate: 20.8%	B	14.5%	A	7.2%	A	Served population: 150,160, Served population in poverty area: 48,011 (32%)	B-	No significant impacts expected.	A	Very effective	A-	

## Evaluation Criteria

Evaluation Item	A	B	C
Technical evaluation (Reduction amount of BOD)	Above 10,000 kg/day	10,000~5,000 kg/day	Below 5,000 kg/day
Economic evaluation	Above 12.0 %	12.0 %~10.0%	Below 10.0 %
Financial evaluation	Above 5.0 %	5.0 %~2.0 %	Below 2.0 %
Social environmental evaluation	Very high	High	Low

### **3.5 Institutional Organization**

SEPLANDES as an umbrella agency for implementation of the project shall establish a PMU with a committee organized by the representatives from SEPLANDES, SEIN, SRH, COMPESA, CONDEPE, FIDEM, ITEP and CPRH. The PMU is to be established before the detailed design stage.

A preparation committee for the PMU should be organized immediately after the Study.

### **3.6 O&M Plan**

In the State of Pernambuco, the sewerage systems are to have been under COMPESA since 1971. COMPESA should start the routine O&M activities for the existing sewerage facilities. Detailed O&M plan should be prepared in the detailed design stage.

For the time being COMPESA is considered to be responsible for O&M of the sewerage systems in the State and the staff of COMPESA should be trained for the routine O&M activities required after the completion of the project.

### **3.7 Implementation Plan**

- (1) SEPLANDES as an umbrella agency or as a general coordination organization should establish a Project Management Unit (PMU) before the implementation of the projects.
- (2) The preparation of the detailed design (including tender documents) of the projects and the supervision of the construction works should be done by a team of consultants procured through a guideline of the financing agency.
- (3) The construction of the projects should be done by contractors procured through a guideline of the financing agency.
- (4) Human resources development should be done through On-the-Job-Training in principle through the detailed design and supervision.
  - Preparation of sewerage facility data base as a O&M tool is to be done in the detailed design stage,
  - Preparation of a O&M plan is to be done in the detailed design stage,
  - Preparation for O&M of the projects is to be done in the supervision stage
- (5) Immediately after the Study it is necessary for SEPLANDES to set up a preparation committee for implementation of the project. The committee consists of some of the

counterpart personnel and representatives of the agencies concerned in addition to the executive secretariat.

### Implementation Plan for Priority Projects

Sewerage System	Work Item	Phase 1									
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Conceicao	Preparation/Arrangement	■	■								
	Designing and Tender		■	■							
	Construction and Supervision				■	■	■				
	Operation and Maintenance							■	■	■	■
Janga	Preparation/Arrangement	■	■								
	Designing and Tender		■	■							
	Construction and Supervision				■	■	■	■			
	Operation and Maintenance	////	////	////	////	////	////	////	■	■	■
Cabanga	Preparation/Arrangement	■	■								
	Designing and Tender		■	■							
	Construction and Supervision				■	■	■	■			
	Operation and Maintenance	////	////	////	////	////	////	////	■	■	■
Boa Viagem	Preparation/Arrangement	■	■								
	Designing and Tender		■	■							
	Construction and Supervision				■	■	■	■			
	Operation and Maintenance								■	■	■
Cordeiro	Preparation/Arrangement	■	■								
	Designing and Tender		■	■							
	Construction and Supervision				■	■	■	■			
	Operation and Maintenance								■	■	■
Prazeres	Preparation/Arrangement	■	■								
	Designing and Tender		■	■							
	Construction and Supervision				■	■	■	■			
	Operation and Maintenance								■	■	■
Curcurana	Preparation/Arrangement	■	■								
	Designing and Tender		■	■							
	Construction and Supervision				■	■	■	■			
	Operation and Maintenance								■	■	■

### Disbursement Schedule of Priority Projects (Unit: 1,000)

Sewerage System	Project Cost	Period					
		2002	2003	2004	2005	2006	2007
Conceicao	24,921	3,344	2,294	4,500	8,167	6,616	—
Janga	77,046	5,796	1,980	11,639	20,807	20,807	16,017
Cabanga	52,886	4,152	1,566	9,037	9,037	16,401	12,693
Boa Viagem	61,195	14,872	13,055	5,537	9,900	9,900	7,931
Cordeiro	29,449	2,924	1,555	5,874	10,659	8,437	—
Prazeres	63,098	11,092	8,716	7,240	12,941	12,941	10,168
Curcurana	35,943	3,277	1,566	7,354	13,346	10,400	—
<b>Total</b>	<b>344,538</b>	<b>45,457</b>	<b>30,732</b>	<b>51,181</b>	<b>84,857</b>	<b>85,502</b>	<b>46,809</b>

#### **4. Conclusion and Recommendation**

In the RMR the water quality of the rivers and drainage channels has been polluted and the water environment is deteriorated. The restoration of the river environmental conditions, especially water quality, is an urgent measure for the RMR to meet.

The proposed Master Plan for Stormwater Drainage and Sewerage Management for the RMR is feasible in technical, economic, financial, social and environmental terms. By implementation of the proposed projects, the water quality in the RMR will be improved and the water environment will be restored.

It is recommended for the State Government of Pernambuco to take immediate actions for implementation of the following:

- (1) For early restoration of the urban environment of the RMR, it is very important for the State Government to take immediate actions to implement the seven sewerage systems identified as priority projects and the water environment will be restored.
- (2) Also it is important to take necessary actions to implement the stormwater drainage facilities proposed in the PQA from technical aspects.
- (3) For smooth implementation of the Master Plan and the Priority Projects, it is necessary for the State Government and SEPLANDES to organize a preparation committee for PMU immediately after the Study and to establish a PMU before the detailed design stage. Also SEPLANDES is to take necessary actions to develop the human resources in order to strengthen the related organizations.
- (4) For strengthening the O&M activities COMPESA shall prepare basic data of the existing sewerage facilities and their conditions, including the examination of the existing sewer networks.
- (5) For implementation of successful condominial sewerage systems the State Government should support COMPESA to take systematic and continuous actions to guide the communities through all the stages (planning, implementation and O&M stages).
- (6) For preparation of optimum measures for stormwater drainage and flood control of the RMR in future, it is necessary for the RMR to install automatic rain gauges in the urban area, at least at Olinda, Recife and Jaboatao dos Guararapes, in order to collect rainfall data of short duration, and it is also necessary to conduct river surveys for the major rivers in order to prepare optimum flood control measures.

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- 3 Minutes of Meeting on Inception Report on October 21, 1999,
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## ABBREVIATIONS

ABC	<b>Brazilian Cooperation Agency</b> (Agência Brasileira de Cooperação)
AID	<b>International Development Association - IDA</b> (Associação Internacional de Desenvolvimento)
APM	<b>Water Catchment Protection Area</b> (Área de Proteção de Mananciais)
ARPE	<b>State Agency for the Regulation of Delegated Public Services in the State of Pernambuco</b> (Agencia Estadual de regulação dos Serviços Públicos Delegados do Estado de Pernambuco)
BC	<b>Central Bank of Brazil</b> (Banco Central do Brasil)
B/C	<b>Benefit Cost Ratio</b> (Custo-benefício)
BID	<b>Inter-American Development Bank – IDB</b> (Banco Interamericano de Desenvolvimento)
BNB	<b>Bank of the Northeast of Brazil</b> (Banco do Nordeste do Brasil)
BIRD	<b>International Bank for Reconstruction and Development – IBRD</b> (Banco Internacional de Reconstrução e Desenvolvimento)
BNDES	<b>National Bank of Economic and Social Development</b> (Banco Nacional de Desenvolvimento Econômico e Social)
BOD	<b>Biological Oxygen Demand</b> (Demanda Biológica de Oxigênio)
CAESB	<b>Water and Sewage Company of Brasilia</b> (Companhia de Água e Esgotos de Brasília)
CDRU	<b>Concession of Existing Use Rights</b> (Concessão dos Direitos de Uso Atual)
CEF	<b>Federal Savings Bank</b> (Caixa Econômica Federal)
CELPE	<b>Electricity Company of Pernambuco</b> (Companhia de Eletricidade de Pernambuco)
CFI	<b>International Finance Corporation</b> (Corporação Financeira Internacional)
CHESF	<b>Hydroelectric Company of São Francisco</b> (Companhia Hidroelétrica do São Francisco)
CIM/FIDEM	<b>Metropolitan Information Center – FIDEM</b> (Centro de Informação Metropolitana (da Fundação de Desenvolvimento Municipal))
CMMAS	<b>Metropolitan Chamber of the Environment and Sanitation</b> (Câmara Metropolitana de Meio Ambiente e Saneamento)
CMN	<b>National Monetary Council</b> (Conselho Monetário Nacional)
CNPQ	<b>National Council of Scientific and Technological Development</b> (Conselho Nacional de Desenvolvimento Científico e Tecnológico)
CODECIPE	<b>Civil Defense Board of Pernambuco</b> (Coordenadoria de Defesa Civil de Pernambuco)
COFIEEX	<b>External Finance Commission</b> (Comissão de Financiamentos Externos)
COFINS	<b>Tax for Social Security Financing (in place of Finsocial)</b> (Contribuição para o Financiamento da Seguridade Social Substituta do Finsocial)
COHAB	<b>State Housing Company</b> (Companhia de Habitação)
COMPESA	<b>Sanitation Company of Pernambuco</b> (Companhia Pernambucana de Saneamento)
COMUL	<b>Commission of Urbanization and Legalization</b> (Comissão de Urbanização e Legalização)
CONAMA	<b>National Environmental Council</b> (Conselho Nacional do Meio Ambiente)
CONDEPE	<b>Pernambuco Planning Institute</b> (Instituto de Planejamento de Pernambuco)

CONDERM	<b>Recife Metropolitan Region Development Council</b> (Conselho de Desenvolvimento da Região Metropolitana do Recife)
CONSEMA	<b>Environmental Council of the State of Pernambuco</b> (Conselho Estadual do Meio Ambiente)
C/P	<b>Counterpart</b> (Contraparte)
CODERTRENS	<b>Pernambuco State Metropolitan Trains Company</b> (Companhia Pernambucana de Trens)
CPRH	<b>Environment Company of Pernambuco</b> (Companhia Pernambucana do Meio Ambiente)
CPRM	<b>Mineral Resources Research Company</b> (Companhia de Pesquisa de Recursos Minerais)
DBO	<b>Biological Oxygen Demand</b> (Demanda Biológica de Oxigênio)
D/D	<b>Detailed Design</b>
DEZ	<b>Specific Guideline Zones</b> (Zonas de Diretrizes Específicas)
DIRES	<b>Health Management Region</b> (Diretória Regional de Saúde)
DO	<b>Oxygen demand</b> (Demanda de Oxigênio)
DS	<b>Sanitary Districts</b> (Distritos Sanitários)
EBAPE	<b>Supplies and Rural Development Company of the State of Pernambuco</b> (Empresa de Abastecimento e Extensão Rural do Estado de Pernambuco)
EE	<b>Pumping Station</b> (Estação Elevatória)
EIA	<b>Environmental Impact Assessment</b> (Estudo de Impacto Ambiental)
EIRR	<b>Economic Internal Rate of Return</b>
ELO	<b>Local Bureaux</b> (Escritórios Locais)
EMHAPE	<b>Pernambuco State Housing Company (former COHAB)</b> (Empresa Habitacional de Pernambuco)
EMLURB	<b>Municipal Maintenance and Cleaning Company</b> (Empresa para Manutenção e Limpeza Urbana)
BMPETUR	<b>Pernambuco Tourism Company</b> (Empresa de Turismo de Pernambuco)
ENDEJA	<b>Jaboatão dos Guararapes Development Company</b> (Empresa de Desenvolvimento de Jaboatão dos Guararapes)
ETA	<b>Water Treatment Plant</b> (Estação de Tratamento de Água)
ETE	<b>Wastewater Treatment Plant</b> (Estação de Tratamento de Água)
FERH	<b>State Water Resources Fund</b> (Fundo Estadual para Recursos Hídricos)
FGV	<b>Getúlio Vargas Foundation</b> (Fundação Instituto Getúlio Vargas)
FIDEM	<b>RMR Development Foundation</b> (Fundação de Desenvolvimento da Região Metropolitana do Recife)
FNS	<b>National Health Foundation</b> (Fundação Nacional de Saúde)
F/S	<b>Feasibility Study</b>
GOB	<b>Government of Brazil</b> (Governo do Brasil)
GOJ	<b>Government of Japan</b> (Governo do Japão)
GDP	<b>Gross Domestic Product</b>
GRDP	<b>Gross Regional Domestic Product</b>

GEPE	<b>Government of the State of Pernambuco</b> (Governo do Estado de Pernambuco)
GME	<b>Department of Sewerage and Sanitation</b> (Gerência Metropolitana de Esgotos)
GTZ	<b>GTZ – German Society for Technical Cooperation</b> (Sociedade Alemã de Cooperação Técnica)
IBRD	<b>International Bank for Reconstruction and Development</b>
IBAMA	<b>Brazilian Institute of the Environment and Renewable Natural Resources</b> (Instituto Brasileiro do Meio Ambiente e Recursos Renováveis)
IBGE	<b>Brazilian Institute of Geography and Statistics Foundation</b> (Fundação Instituto Brasileiro de Geografia e Estatística)
ICMS	<b>Circulation of Goods and Services Tax</b> (Imposto sobre Circulação de Mercadorias e Serviços)
IDB	<b>Inter-American Development Bank</b>
IEE	<b>Initial Environmental Examination</b>
INESC	<b>Institute of Socio-Economic Studies</b> (Instituto de Estudos Sócio-Econômicos)
INMET	<b>National Institute of Meteorology</b> (Instituto Nacional de Meteorologia)
INMETRO	<b>National Institute of Metrology, Standardization and Industrial Quality</b> (Instituto Nacional de Metrologia, Normalização e Qualidade Industrial)
INPC	<b>National Consumer Price Index</b> (Índice Nacional de Preços ao Consumidor)
IPEA	<b>Institute of Applied Economics Research</b> (Fundação Instituto de Pesquisa Econômica Aplicada)
IPEM	<b>Institute of Weights and Measures</b> (Instituto de Pesos e Medidas)
IRR	<b>Internal Rate of Return</b>
ITEP	<b>Technological Institute of Pernambuco</b> (Fundação Instituto Tecnológico do Estado de Pernambuco)
JICA	<b>Japan International Cooperation Agency</b> (Agência de Cooperação Internacional do Japão)
KWF	<b>German Development Bank</b> (Kreditanstalt Für Wiedraufbau)
MMA	<b>Ministry of the Environment, Water Resources and the Legal Amazon</b> (Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal)
MPO	<b>Ministry of Planning and Finance</b> (Ministério do Planejamento e Orçamento)
MRE	<b>Ministry of Foreign Affairs</b> (Ministério das Relações Exteriores)
MW	<b>Minimum Wage</b> (Salário Mínimo)
NPV	<b>Net Present Value</b>
NUAMPO	<b>Catholic University Supporting Nucleus Community Movements</b> (Núcleo de Apoio ao Movimento Popular da Universidade Católica)
OGU	<b>Federal General Budget</b> (Orçamento Geral da União)
O&M	<b>Operation and Maintenance</b> (Operação e Manutenção)
PBA	<b>Brazil in Action Program</b> (Programa Brasil em Ação)
PAI	<b>Integrated Actions Plan</b> (Plano de Ações Integradas)
PASS	<b>Social Action Program on Sanitation</b> (Programa de Ação Social em Saneamento)
PE	<b>Pernambuco [State]</b> (Pernambuco)
PCR	<b>Recife City Council</b> (Prefeitura da Cidade do Recife)

PDAA	<b>Water Supply Master Plan for the RMR</b> (Plano Diretor de Abastecimento de Água da RMR)
PDCR	<b>Recife City Master Plan</b> (Plano Diretor da Cidade do Recife)
PDES	<b>Sewerage Master Plan</b> (Plano Diretor de Esgotamento Sanitário)
PDM	<b>Metropolitan Master Plan</b> (Plano Diretor Metropolitano)
PDMD	<b>Macrodrainage Master Plan</b> (Plano Diretor de Macro drenagem)
PGAI	<b>Project for Integrated Management of the Environment</b> (Projeto de Gestão Ambiental Integrada)
PIB	<b>Gross Domestic Product</b> (Produto Interno Bruto)
PLANASA	<b>National Plan of Sanitation</b> (Plano Nacional de Saneamento)
PNAD	<b>National Research by House Unit Sampling</b> (Pesquisa Nacional por Amostragem de Domicílio)
PMJG	<b>Jaboatão dos Guararapes City Council</b> (Prefeitura Municipal de Jaboaão dos Guararapes)
PMO	<b>Olinda City Council</b> (Prefeitura Municipal de Olinda)
PMSS	<b>Modernization Plan for the Sanitation Sector [of the Ministry of Planning]</b> (Plano de Modernização do Setor de Saneamento (do Ministério do Planejamento))
PMU	<b>Project Management Unit</b> (Unidade de Gerenciamento de Projeto)
PND	<b>National Program for Privatization</b> (Programa Nacional de Desestatização)
POER	<b>Plan for the Organization of the Recife Sewerage System</b> (Plano de Ordenamento do Sistema de Esgotos do Recife)
POT	<b>Territorial Organization Plan</b> (Plano de Organização Territorial (Fidem))
PPA	<b>Four-Year Plan</b> (Plano Plurianual)
PQA	<b>Water Pollution Control and Water Quality Program</b> (Projeto de Qualidade das Águas e Controle da Poluição Hídrica (das Bacias dos Rios Beberibe, Capibaribe e Jaboaão).
PQA-PE	<b>PQA-Pernambuco State. Study of Sewerage and Drainage in RMR for preparation of Investment Program in Beberibe, Capibaribe, Jaboaato and Ipojuca Basins</b> (Estudos de Consolidacao e Complementacao de Diagnostico Sobre a Qualidade das Aguas, Relativos ao Programa de Investimentos nas Bacias dos Rios Beberibe, Capibaribe, Jaboaato e Ipojuca)
PQA-RD	<b>Three volumes (RD-1: 2 volumes and RD-2). Study of Macro Drainage in RMR</b> (Estudos Sobre o Sistema de Macro drenagem da RMR)
PQA-RE	<b>Ten volumes (RE-1: 2, RE-2: 3 and RE-3: 5 volumes). Study of Sewerage System in RMR</b> (Estudos de Concepcão do Sistema de Esgotos Metropolitano)
PQA-Final Report	<b>Sanitation Environment in RMR, Document for Investment Strategy, Final Report</b> (Sistema de Saneamento Ambiental da Metropolitana do Recife, Documento Estratégico de Investimentos, Relatório Final)
PREZEIS	<b>Plan of ZEIS Regularization</b> (Plano de Regularização das ZEIS)
PRO-INFRA	<b>Urban Infrastructure Program</b> (Programa de Infra-Estrutura Urbana)
PROMATA	<b>Execution of Actions of the Program for the Sustainable Development of the Zona da Mata</b> (Programa de Execução de Ações para o Desenvolvimento Sustentado da Zona da Mata)
PRODETUR/NE	<b>Tourism Development Program / Northeast</b> (Programa de Desenvolvimento do Turismo /Nordeste)
PRÓ-METRÓPOLE	<b>Integrated Action Project for Low Income Areas of the RMR</b> (Projeto de Ação Integrada em Áreas de Baixa Renda na RMR)
PRO-MORADIA	<b>Alternative Housing Program for the Low-Income Population</b> (Programa de Alternativas Habitacionais para População de Menor Renda)

PROSANEAR	<b>Sanitation Program for Low Income Population</b> (Programa de Saneamento para Áreas de Baixa Renda)
PRO-RENDA	<b>Program for Providing Work Opportunities for Low-Income Populations</b> (Programa de Viabilização de Espaços Econômicos para a População de Baixa Renda)
RAFA	<b>Up-flow Anaerobic Sludge Blanket – UASB</b> (Reatores Anaeróbios de Fluxo Ascendente)
RE	<b>Sewerage Report</b> (Relatório de Esgotamento Sanitário)
RD	<b>Stormwater Drainage Report</b> (Relatório de Drenagem de Águas Pluviais)
RIMA	<b>Environmental Assessment Report</b> (Relatório de Impacto Ambiental)
RMR	<b>Metropolitan Region of Recife</b> (Região Metropolitana do Recife)
SABESP	<b>Basic Sanitation Company of the State of São Paulo</b> (Empresa de Saneamento Básico do Estado de São Paulo)
SANEPAR	<b>Sanitation Company of the State of Paraná</b> (Empresa de Saneamento do Estado do Paraná)
SCF	<b>Standard Conversion Factor</b>
SECTMA	<b>Secretariat of Science, Technology and the Environment</b> (Secretaria de Ciência, Tecnologia e Meio Ambiente)
SEIN	<b>State Secretariat of Infrastructure</b> (Secretaria de Infra-Estrutura do Estado)
SEMAM	<b>Secretariat of the Environment</b> (Secretariado do Meio Ambiente)
SEPLAN	<b>State Secretariat of Planning</b> (Secretaria de Planejamento do Estado)
SEPLANDES	<b>Secretariat of Planning and Social Development</b> (Secretaria do Planejamento e Desenvolvimento Social)
SEPURB	<b>Urban Policies Secretariat</b> (Secretaria de Política Urbana)
SERPRO	<b>Federal Data Processing Service</b> (Serviço Federal de Processamento de Dados)
SIIC	<b>Integrated System of Commercial Information</b> (Sistema Integrado de Informações Comerciais)
SISNAMA	<b>National Environmental System</b> (Sistema Nacional do Meio Ambiente)
SME	<b>Small and Medium Sized Companies</b> (Empresas de Pequeno e Médio Portes)
SMSA	<b>Metropolitan System of Environmental Sanitation</b> (Sistema Metropolitano de Saneamento Ambiental)
SPRRN	<b>Sub-program on Natural Resource Policy</b> (Subprograma da Política de Recursos Naturais)
SRH	<b>Secretariat of Water Resources</b> (Secretaria de Recursos Hídricos)
SS	<b>Suspended Solids</b> (Sólidos Suspensos)
STAS	<b>Secretariat of Employment and Social Welfare</b> (Secretaria do Trabalho e da Assistência Social)
SUAPE	<b>Suape Port and Industrial Complex</b> (Complexo Industrial Portuário do Suape)
SUDENE	<b>Northeast Development Bureau</b> (Superintendência do Desenvolvimento do Nordeste)
SUS	<b>Unified Health System</b> (Sistema Único de Saúde)
TOR	<b>Terms of Reference</b>
UE	<b>Sewerage Unit</b> (Unidade de Esgotamento)
UC	<b>Collection Unit</b> (Unidade de Coleta)



UFPE	<b>Federal University of Pernambuco</b> (Universidade Federal de Pernambuco)
UGP	<b>Project Management Unit</b> (Unidade de Gerenciamento de Projeto)
UHI	<b>Homogeneous Unit of Density</b> (Unidade Homogênea de Densidade)
URB-Recife	<b>Municipal Urban Development Company of Recife</b> (Empresa de Urbanização da Cidade do Recife)
URB – DIUR	<b>URB – Department of Urban Integration</b> (Diretoria de Integração Urbana)
URB – DO – DOS	<b>URB – Department of Civil Works – Sanitation Works Division</b> (Diretoria de Obras – Divisão de Obras Sanitárias – URB)
SCF	<b>Sewage Collection Facilities</b>
STF	<b>Sewage Treatment Facilities</b>
ZDE	<b>Specific Guideline Zone</b> (Zona de Diretrizes Específicas)
ZEE	<b>Ecological-Economic Zoning</b> (Zoneamento Ecológico-Econômico)
ZEIS	<b>Special Zone of Social Interest</b> (Zona Especial de Interesse Social)
ZEPA	<b>Special Zone of Environmental Protection</b> (Zona Especial de Proteção Ambiental)
ZEPH	<b>Special Zone for the Preservation of Historic and Cultural Heritage</b> (Zona Especial de Preservação do Patrimônio Histórico Cultural)
ZUM	<b>Zone for Urban Development of the Hills</b> (Zona de Urbanização de Morros)
ZUP	<b>Preferential Urban Development Zone</b> (Zona de Urbanização Preferencial)
ZUP1	<b>Preferential Urbanization Zone with High Potential for Construction</b> (Zona de Urbanização Preferencial de Alto Potencial Construtivo)
ZUP2	<b>Preferential Urbanization Zone with Medium Potential for Construction</b> (Zona de Urbanização Preferencial de Médio Potencial Construtivo)
ZUR	<b>Restricted Urban Development Zone</b> (Zona de Urbanização Restrita)

***CHAPTER 1***  
***INTRODUCTION***

## **CHAPTER 1 INTRODUCTION**

### **1.1 Background**

This is the Final Report for "the Study on Stormwater Drainage and Sewerage Management Plan for Recife Metropolitan Area in the Federative Republic of Brazil" (hereinafter referred to as "the Study"). This report presents the results of the Study prepared in accordance with the Scope of Work and the Minutes of Meeting agreed upon between the State Secretariat of Planning and Social Development, State of Pernambuco (hereinafter referred to as "SEPLANDES"), the Brazilian Cooperation Agency (hereinafter referred to as "ABC"), as the legal intervention agency on behalf of the Government of Brazil (hereinafter referred to as "GOB") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on March 3, 1999.

The Study Area, the Recife Metropolitan Area (RMR) of the State of Pernambuco, consists of 14 municipalities, covering an area of 2,766 km<sup>2</sup> with a population of about 3.1 million in 1996. The RMR is the fourth largest metropolitan area in Brazil. The area was developed on the basis of port activities and the sugar cane industry, but now the tourism is the leading industry of the State, because the RMR is rich in tourism resources such as the beautiful beach and old historical buildings

The population of the RMR doubled between 1950 and 1970 and has been increasing ever since, resulting in the expansion of poverty areas or informal settlements. The rapid increase and expansion of the urban population and the low income or informal settlement area has caused a shortage of basic infrastructure such as drainage and sewerage systems. This has resulted in the deterioration of the urban environment, especially of the water quality of the rivers and water bodies in the urban area, due to the heavy pollution loads from the urban areas. More than 80 % of the urban sewage is discharged directly or indirectly into the rivers without proper treatment. This causes a great impact on the lives of people in the RMR as well as on the tourism industry.

In order to cope with the deterioration of the urban environment, SEPLANDES has prepared the "Program for Water Quality Improvement and Water Pollution Control (PQA)" financed by the International Bank for Reconstruction and Development (IBRD). In the PQA various measures have been studied for solving the environmental problems in the RMR, but most of the proposed measures have not been implemented and the environmental problems still remain unsolved.

The GOB realized the necessity for the preparation of a program for the early implementation of urgent measures to improve the urban environment and requested the Government of Japan (GOJ) to conduct a development study through the technical cooperation program. In response to the request of the GOB, the GOJ has decided to conduct "The Study on Stormwater Drainage and Sewerage Management Plan for Recife Metropolitan Area" through JICA, the official agency responsible for the technical cooperation program, in accordance with the Basic Agreement on Technical Cooperation between the GOB and the GOJ, signed on September 22, 1970. JICA dispatched the Preparatory Study Team headed by Mr. Shinichiro UCHIDA to Brazil to discuss the Scope of Work with SEPLANDES and ABC in February 1999.

The Study was commenced in mid-October 1999. The Master Plan and the priority projects for F/S were presented in the Interim Report (March 2000, and the Feasibility Study on the priority projects were conducted from May to November 2000. The results of the Study have been presented in the Draft Final Report (November 2000).

## **1.2 Objectives of the Study**

The objectives of the Study are:

- 1) to formulate a Master Plan for Stormwater Drainage and Sewerage Management Plan in Recife Metropolitan Area (RMR) for the target year of 2020 in order to improve the urban environment,
- 2) to conduct a Feasibility Study (F/S) on the urgent and /or priority project(s), which will be selected from the Master Plan and,
- 3) to carry out technology transfer to the counterpart personnel in the course of the Study.

## **1.3 Study Area**

The study area covers about 2,766 km<sup>2</sup> of the RMR, which is shown in Fig. 1.

## **1.4 Study Schedule**

The Study has been conducted in two phases and six stages as follows:

### **1) Phase - 1 (From October 1999 through March 2000)**

The task was to formulate a Master Plan and to select priority projects for F/S, conducted in the following two stages:

- Stage-1: Work in Brazil from October 1999 through January 2000

Findings and preliminary issues during the fieldwork were presented in the Progress Report-1 (January 2000).

- Stage-2: Work in Japan from February 2000 through March 2000

Based on the data and information a Master Plan for stormwater drainage and sewerage management plan was formulated for the RMR and priority projects for F/S were selected, and presented in the Interim Report (March 2000).

### **2) Phase - 2 (From May 2000 through January 2001)**

The task was to conduct a Feasibility Study on the Priority Projects identified in the Master Plan, conducted in the following 4 stages:

- Stage-3: Work in Brazil from mid-May to mid-September 2000

After presentation of the Master Plan and the Priority Projects, supplementary field works for the Feasibility Study were conducted. Also the technology transfer seminar-1 was held on May 23. The findings and issues during the fieldwork were presented in the Progress Report-2 (August 2000).

- Stage -4: Work in Japan from mid-September to mid-November 2000

Based on the findings a Feasibility Study on the priority projects was conducted and the results of the Study are presented in the Draft Final Report (November 2000).

- Stage -5: Work in Brazil from November 26 to December 10, 2000

The Draft Final Report (November 2000) was presented and the technology transfer seminar

(2) was held on December 5 2000.

- Stage -6: Work in Japan from December 2000 to January 2001

After incorporation of the comments on Draft Final Report from the GOB, the Final Report (January 2001) was prepared and submitted to the GOB through JICA.

## **1.5 Study Approach and Methodology**

In order to formulate an optimum plan for the management of stormwater drainage and sewerage systems of the RMR, the Study was conducted with due consideration of the following:

- 1) The existing urban environmental conditions i.e., sanitary conditions, flood conditions, service areas of water supply and sewerage systems etc., were studied on the bases of the available data,
- 2) The existing pollution sources and the sanitary conditions of the urban areas were studied through fieldwork in order to supplement the collected data and information.
- 3) The flood areas, existing stormwater drainage facilities and existing sewerage facilities through fieldwork, were identified to provide basic information for planning.
- 4) The master plan and priority projects were prepared after reviewing the PQA and other related projects.
- 5) Periodical technical meetings with the GOB staff / CP Team were held for effective technology transfer and also for optimum planning.

## **1.6 Composition of Reports**

The report presents all results of the technical studies conducted from mid-October 1999 to November 2000. The report consists of the following:

1. Summary Report
2. Main Report
3. Supporting Report
  - A Sewerage System and Facility Plan
  - B Sewage Treatment Facility Plan
  - C Drainage
  - D Socio-economy
  - E Social Issues
  - F Environment
  - G Cost Estimation
  - H Economic and Financial Evaluation
  - I Institutional Organization
  - J Condominial Sewerage System
  - K Technical Specifications for Field Surveys
4. Data Book

## **1.7 Execution of the Study**

The Study Team composed of the consultants selected by JICA has conducted the Study; JICA Advisory Team organized by JICA, the Counterpart Team and the Steering Committee organized by SEPLANDES for the Study. Members of the Study Team, JICA Advisory Team, Counterpart Team and Steering Committee are listed in the following Annex-1, -2, -3.

## **Annex-1 JICA Study Team and JICA Advisory Committee**

### **Study Team**

<b>Team Leader:</b>	<b>Hajime TANAKA</b>
<b>Wastewater Treatment Engineer:</b>	<b>Katsuhisa WTANABE</b>
<b>Storm water Drainage Engineer:</b>	<b>Hiroyuki SHIRAIWA</b>
<b>Sewerage Facility Planning (1):</b>	<b>Tadashi SHOJI</b>
<b>Sewerage Facility Planning (2):</b>	<b>Shimao HIDAKA</b>
<b>Sewerage Facility Designing:</b>	<b>Masashi OKAMURA</b>
<b>Environment and Water Quality:</b>	<b>Takeshi ARAKAKI</b>
<b>Construction planning / Cost Estimation:</b>	<b>Masaru OHNO</b>
<b>Economical/Financial Analysis</b>	
<b>Institution /Organization:</b>	<b>Tatsuo TASHINO</b>
<b>Social Issue:</b>	<b>Ione Marisa KOSEKI</b> <b>CORNEJO</b>
<b>Interpreter/Translator:</b>	<b>Keiko MITSUNAGA</b>
<b>Supporting Staff:</b>	<b>Naoki YASUDA</b>

### **JICA Advisory Committee:**

<b>Chairman:</b>	<b>Shinichiro UCHIDA</b> <b>(Executive Advisor</b> <b>Japan Sewerage Works Agency)</b>
<b>Member:</b>	<b>Makoto SHIRASAKI</b> <b>(Senior Research Engineer</b> <b>Water Quality Control Dept.</b> <b>Public Works Research Institute,</b> <b>Ministry of Construction)</b>





### **COMPESA**

- Angela Sotero Bacelar
- Guilherme Tavares
- Ieda Kozmhinski Alves
  
- Maria Edite Pinheiro da Costa

Director Advisor  
Chief Executive Director  
Director Advisor of Sewerage  
South Division  
Director Advisor  
(Until January 2000)

### **SEIN**

- Dilene Aguiar Souto Maior
  
- Nilce Helena Gondim

Manager of Resources Procurement  
Department  
Executive Director of Sanitation

### **CODECIPE**

- Major P.M. Helder
- Cleber Rolim Milet

Chief of Operations Division  
Technical Advisor

### **Annex-3 Steering Committee for the Study**

#### **SEPLANDES**

- Berta Levina Soares Maia Director of Regional Program
- Roberto Salomao do A. Melo Executive Director of Regional Program
- Luciene Maria P. de Lima Department Manager, (Until January 2000)
- Thereza Regina F. Pereira G. da Mata Department Manager

#### **FIDEM**

- Francisco Roberto R. Aguiar Technician (Until January 2000)
- Barbara kreuzig Executive Director

#### **CONDEPE**

- Sheilla Pincovsky de Albuquerque Director of Information System

#### **CPRH**

- Aldir Pimentel Director of Water Resources

#### **ITEP**

- Claudia Cunha Director of Research and Development

#### **SRH**

- Ligia Maria S. Barros de Oliveira Director of Planning

#### **COMPESA**

- Guilherme Tavares Chief Executive Director

#### **SEIN**

- Nilce Helena Gondim Executive Director of Sanitation

#### **CONDECIPE**

- Major P.M. Helder Chief of Operations Division

