PART A

FRAMEWORK OF THE STUDY

PART A FRAMEWORK OF THE STUDY

A1 Introduction

A1.1 Background of the Study

(1) Dispatching JICA Study Team

In the Solomon Islands (hereinafter referred to as "Solomon"), Solomon Islands Water Authority (hereinafter referred to as "SIWA") is responsible for the management and development of urban water supply and sewerage services.

In general, SIWA's infrastructures are old, in a very poor condition, costly to maintain and operate, and mostly surpassed their design life and capacity to cater adequately the present and future demands.

Due to the above situation, ratio of non-revenue water (hereinafter referred to as "NRW") for water supply system in Honiara City, the capital of Solomon, is believed to reach more than 50% and therefore management condition of SIWA is not in good condition. Causes of the high NRW ratio remain uncertain and appropriate counter-measures have not yet been taken.

SIWA has other difficulties in management of some main surface water sources, which are located in customary lands. SIWA, therefore, has desires to shift the water sources from surface water to groundwater.

SIWA is also responsible for sewerage system. However sewerage system covers only some part of Honiara City and no sewerage system exists in other cities, where on-site treatment is applied. Therefore, this situation is believed to lead to pollution of water sources and environment.

On the other hand, ethnic tension occurred in Solomon from the year 2000 to 2003. Due to the disputes, the facilities which were constructed in 1998 under the previous Japan's grant aid project for improvement of water supply facilities in Honiara have been much damaged. Therefore, the rehabilitation of these facilities is an urgent issue for the Solomon side.

In those circumstances, the Government of Solomon requested a development study to the Government of Japan in order to implement follow-up project for the above-mentioned damaged facilities and formulate a facility improvement plan (target year 2010) for the water supply and sewerage systems for Honiara and other provincial centers (Noro, Auki and Tulagi).

In response to the request, JICA dispatched a mission for the Preparatory Evaluation Study in November 2004, and the mission held discussions and exchanged the signed S/W with SIWA under the Ministry of Natural Resources.

Then, JICA sent the Study Team (hereinafter referred to as "the Team") to conduct the Study for Rehabilitation and Improvement of Solomon Islands Water Authority's Water Supply and Sewerage Systems (hereinafter referred to as "the Study").

(2) Foreign Donor's Activities in Solomon

For the facility improvement plan for water supply and sewerage systems, AusAID gave technical assistance to Solomon and the feasibility study (F/S) report was prepared in 2000. The present Study utilized some data and information in the AusAID report.

In February 2005, the World Bank and the Solomon Islands Government (SIG) initiated a project to prepare a financial restructuring plan for the Solomon Islands Electricity Authority (SIEA) and to formulate various private sector participation (PSP) options for SIEA. The PSP study was to review the industry structure and PSP options including the potential for a multi-utility PSP option involving SIEA and SIWA, recommend a PSP option and develop an implementation plan for that option. The World Bank consultants concluded that there were substantial efficiency gains to be realized by operating a single electricity and water authority, and also recommended that a five year management contract be implemented for both SIEA and SIWA.

The Government has agreed to the provision of ADB's technical assistance co-financed by the

Government of Australia to examine PSP options for the nation's State-Owned Enterprises (SOE). SIG has 17 SOEs including SIWA. The purpose of this assistance is to improve the SOE ownership arrangements, accountability and performance with the goal of improving the environment for the private sector and rehabilitating the economy. It consists of a total of 24 person months with both international and domestic consultants, and will be implemented over 24 months until February 2007 from March 2005. A steering committee will be established with selected senior officers from relevant government departments to help build consensus and drive the reform process.

A1.2 Objectives of the Study

The objectives of the Study were;

1. To formulate an urgent rehabilitation plan for Honiara and urgent restoration plan for Auki or Tulagi.
2. To formulate a facility improvement plan for the water supply and sewerage systems of Honiara, Noro, Auki and Tulagi for the target year 2010; and
3. To formulate an action plan for supporting capacity development of SIWA to strengthen its management.

A1.3 Study Area

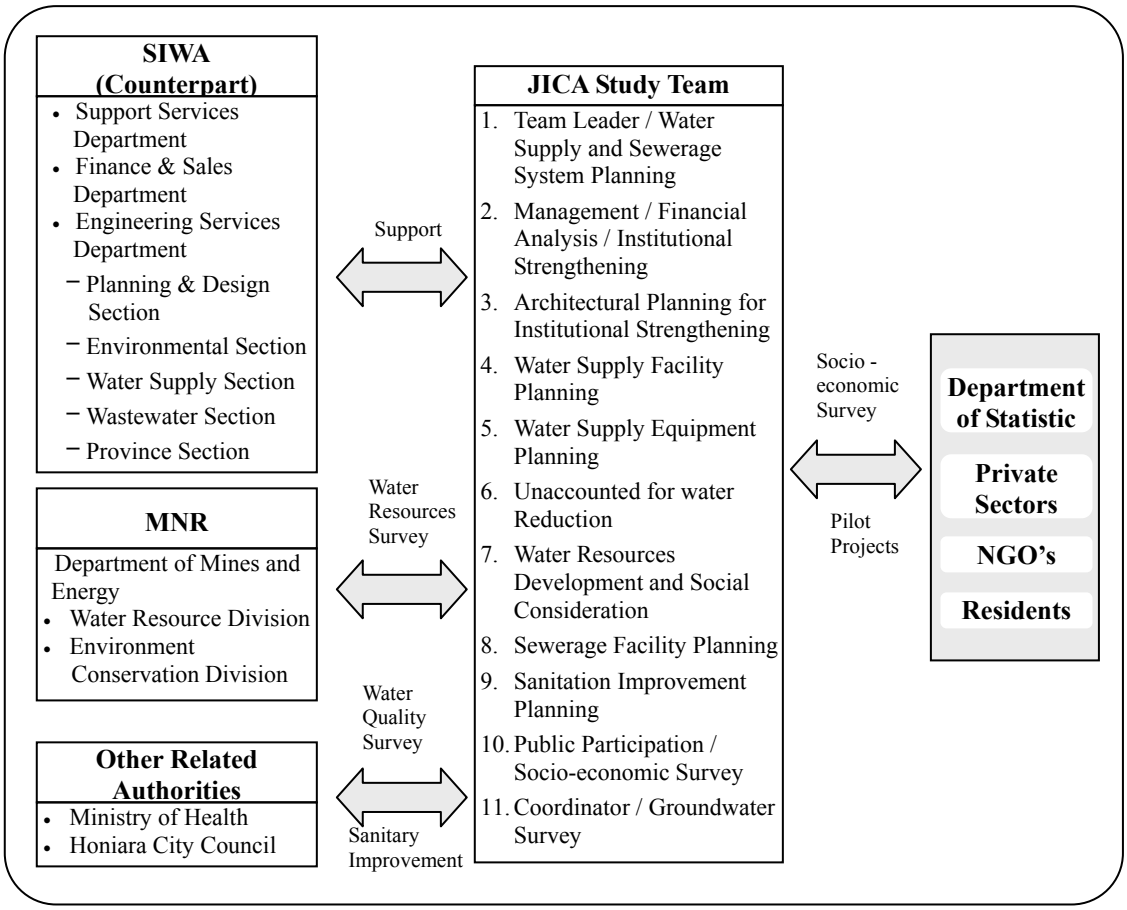
The Study covered Honiara, the capital of the Solomon Islands, and three provincial centers of Noro, Auki and Tulagi as shown in the map attached to the opening page of this report.

A1.4 Organization and Staffing of the Study

The Study Team consists of eleven (11) members. The role of each member is shown in Figure A1-1. The Study has been implemented with the cooperation of SIWA as a counterpart, Department of Mines & Energy in the Ministry of Natural Resources (MNR), Ministry of Health and Honiara City Council.

Socio-economic Survey has been executed with the support of Department of Statistics, NGO and the residents of survey areas. Pilot projects were conducted with the cooperation of private sections and the residents of the project site.

Figure A1-1 shows the relations among the Study Team, the related authorities, NGO and the residents of the project site.



Source : JICA Study Team

Figure A1-1 Implementation Organization of the Study

A1.5 Organizations Related to the Study

(1) General

Organizations in Solomon related to the Study and their roles are as follows.

Table A1-1 Organizations in Solomon Related to the Study

Name of Organization	Role
Ministry of Natural Resources (MNR)	
Department of Mines and Energy	Responsible for mineral resources, water resources, energy and environment. SIWA is under this department.
Department of Forestry, Environment and Conservation	Responsible for environment assessment
Ministry of Health	Water supply in rural areas and supervision of sanitary conditions in the whole Solomon.
Ministry of Provincial Government and Constituency Development	Responsible for water supply in the provincial centers except the city where SIWA is operating.
Ministry of Agriculture and Land	Responsible for executing contract with the landowners for the water right.
Honiara City Council	
Health Division	Responsible for collection and disposal of sewage and sludge from septic tank of ordinary households.

Source : SIWA

(2) Organization for Groundwater Development

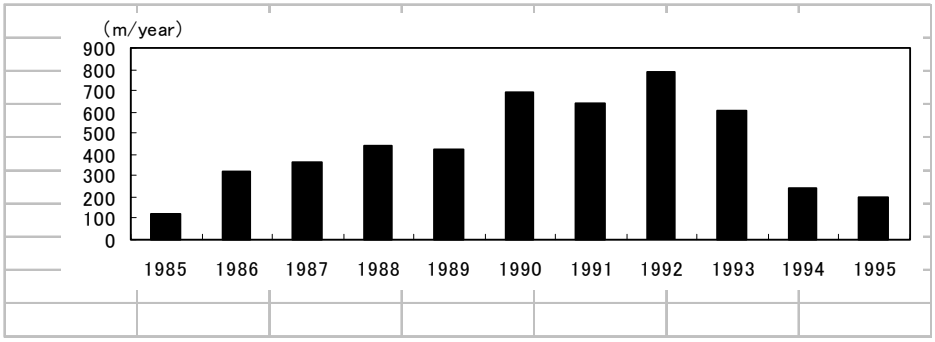
Before ethnic tension, Ministry of Natural Resources (MNR) undertook all the drilling works in Solomon Islands. Geological Survey Division of MNR was in charge of drilling. This division undertook drilling works and geological survey from the Government and private sectors. MNR still keeps three drilling machines that were provided by Australian Government. List of the machines is shown in Table A1-2.

Table A1-2 Drilling Machines of MNR

Name	Number	Year of Provision	Type of Drilling	Capacity	Drilling Speed	Purpose
BOURNEDRILL C300	2	• Before 1981 • 1989	Cable percussion	• ϕ <10inch • Depth <100m	1～5m/day	For drilling production borehole
GEMCO 210B	1	1989	Rotary	• ϕ <5inch • Depth<100m	7～10m/day	For geological survey and monitoring drilling borehole

Source : MNR

It took much time to drill bores by existing drilling machines because old cable percussion machines was slow to drill and needed frequent repair. It took more than two month to complete one bore. Drilling depth by the MNR from 1985 to 1995 is shown in Figure A1-2.



Source: MNR

Figure A1-2 Drilling Depth for Bore and Geological Survey

In late 1990s, MNR tried to privatize drilling section. However, the ethnic tension took place in 1998 and drilling section was abolished in 1999 without privatization. MNR still keeps old three drilling machines without drilling team. Drilling machines are so old and badly broken that they cannot be repaired. Currently there is only one private drilling company in Solomon Island. However, this company can drill only small domestic borehole and his activity is not regular.

(3) Organization for Water Supply and Sewerage System

Water supply and sewerage system in major cities are operated by Solomon Islands Water Authority (SIWA). At present in 2005, SIWA is responsible for the operation and maintenance in four major cities - Honiara, Noro, Auki and Tulagi.

SIWA was established in 1992 under the SIWA Act and commenced his operation from 1994. Summary of water supply and sewerage operation by SIWA in 2005 is as shown in Table A1-3.

Table A1-3 Summary of Water Supply and Sewerage Operation by SIWA

City	Population in 2005	Water Production*[1] (m^3/day)	Sewage Discharged into Sewerage System*[2] (m^3/day)
Honiara	60,365	25,719	2,490
Noro	4,109	2,019	There is existing sewerage system but exclusively for private company.
Auki	4,747	468	There was a sewerage system but not in operation.
Tulagi	1,573	545	No sewerage system
Total	70,794	28,751	2,490

Note : 1. This figure means the water demand and includes water losses (apparent and real losses).
2. This figure does not include the sewage treated by septic tanks.
Source : SIWA

Organization and staff of SIWA are described in PART D of this report.

A1.6 Structure of Reports

The Final Report of the Study is composed of three volumes, that is, Summary, Main Report and Supporting Report as shown in Table A1-4.

Table A1-4 Final Reports of the Study

Report	Contents
Summary	Summary of the Report
Main Report	◆ Framework of the Study ◆ Existing conditions of water supply and sewerage from Honiara ◆ Mid-term facility improvement plan for water supply and sewerage for Honiara ◆ Existing conditions of provincial centers water supply and sewerage for provincial center ◆ Mid-term facility improvement plan for provincial centers water supply ◆ Conditions of water supply and sewerage management by SIWA ◆ Building Plan for Institutional Strengthening of SIWA ◆ Contents and results of pilot projects ◆ Action plan for tariff collection improvement, expansion of income resources, reduction of operation and maintenance cost, strengthening of organization and human resources, and upgrading of existing water supply and sewerage system ◆ Environmental and social considerations ◆ Urgent rehabilitation plan for water supply system for Honiara
Supporting Report	◆ Survey data, related data and documents ◆ Records of pilot projects

Source : JICA Study Team

A2 Framework of the Study

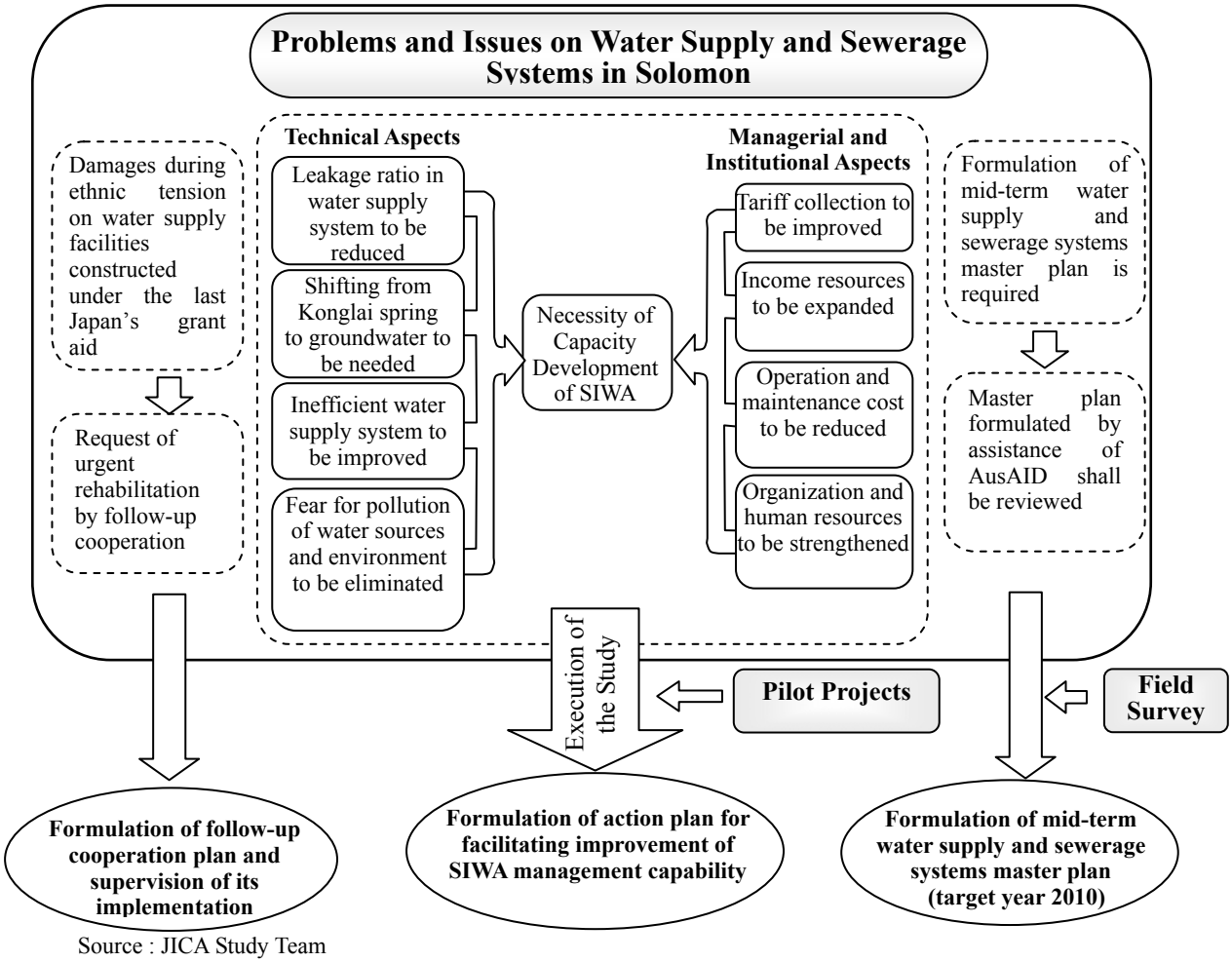
A2.1 Important Aspects of the Study

In this Study, it has been recognized that the capacity development of SIWA is the most important aspect. The Study, therefore, put emphasis on formulating Action Plan, which will facilitate strengthening of the management of SIWA, through implementation of pilot projects, etc.

Formulation of the improvement plan for water supply and sewerage facilities in the Study areas is considered one of the important aspects for the capacity development of SIWA. The facility improvement plan for the target year 2010 was prepared based on the results of field surveys in the Study and using the study reports as a reference prepared under the assistance of Australian Agency for International Development (hereinafter referred to as "AusAID").

Formulation of the follow-up cooperation plan and the supervision of the implementation are also one of the important aspects. The follow-up cooperation has been done for rehabilitating the water supply facilities in Honiara constructed under the Japan's Grant Aid in 1998 and damaged during the ethnic tension from 2000 to 2003.

The important aspects of the Study are shown in Figure A2-1.



Source : JICA Study Team

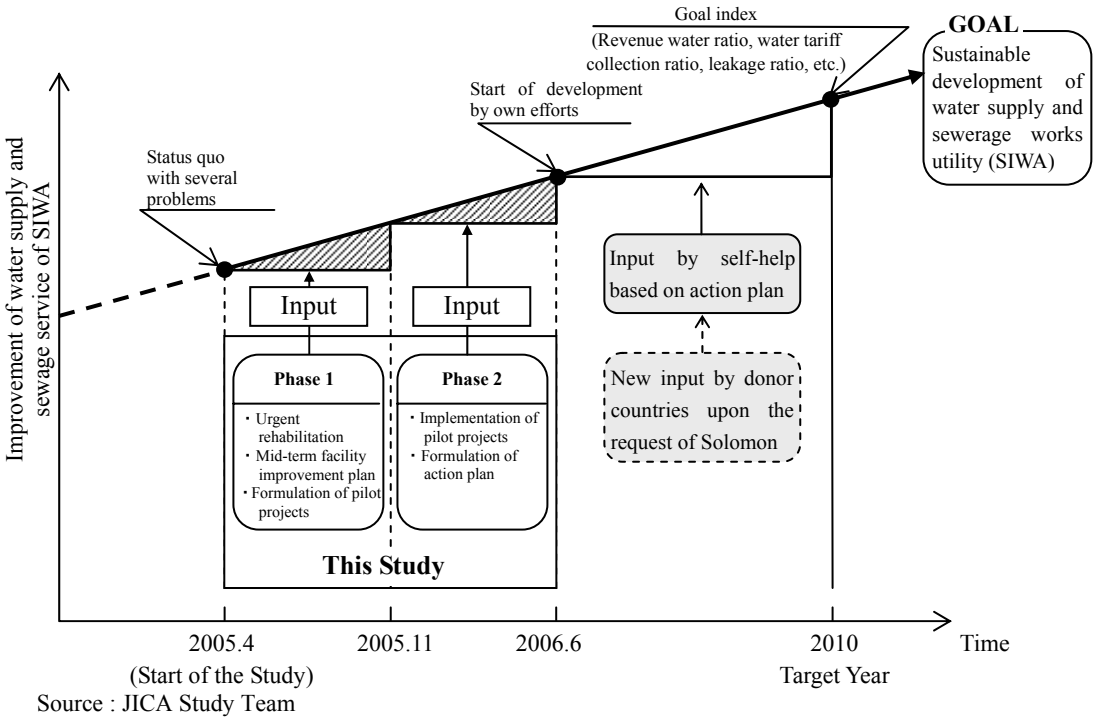
Figure A2-1 Important Aspects of the Study

A2.2 Position of the Study

It is understood that the relation between the Study for capacity development of SIWA's water supply and sewerage services and improvement of SIWA's management capacity is as shown in Figure A2-2.

It is expected that, as shown in Figure A2-2, SIWA's management capacity will improve up to the level of starting development by his own efforts through Follow-up Cooperation, implementation of Pilot Projects and formulation of Action Plan in the Study.

It is also anticipated that improvement will continue until the target year 2010 according to the plans formulated in the Study and beyond the target year sustainable development of SIWA will be realized.

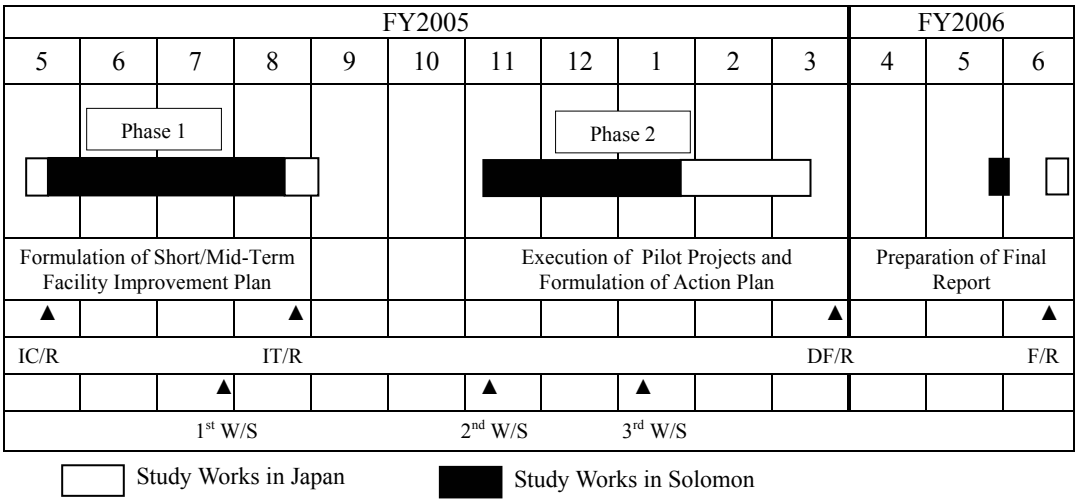


Source : JICA Study Team

Figure A2-2 Position of the Study

A2.3 Overall Work Flow of the Study

The Study was commenced from the middle of May 2005 and finished in June 2006. The Study has been implemented over two phases (Phase 1 and Phase 2) in the fiscal year (FY) 2005. Figure A2-3 shows the overall implementation schedule of the Study, while Table A2-1 indicates the contents the Study phases.



Note : IC/R: Inception Report, IT/R: Interim Report, DF/R: Draft Final Report, F/R: Final Report, W/S: Workshop

Source : JICA Study Team

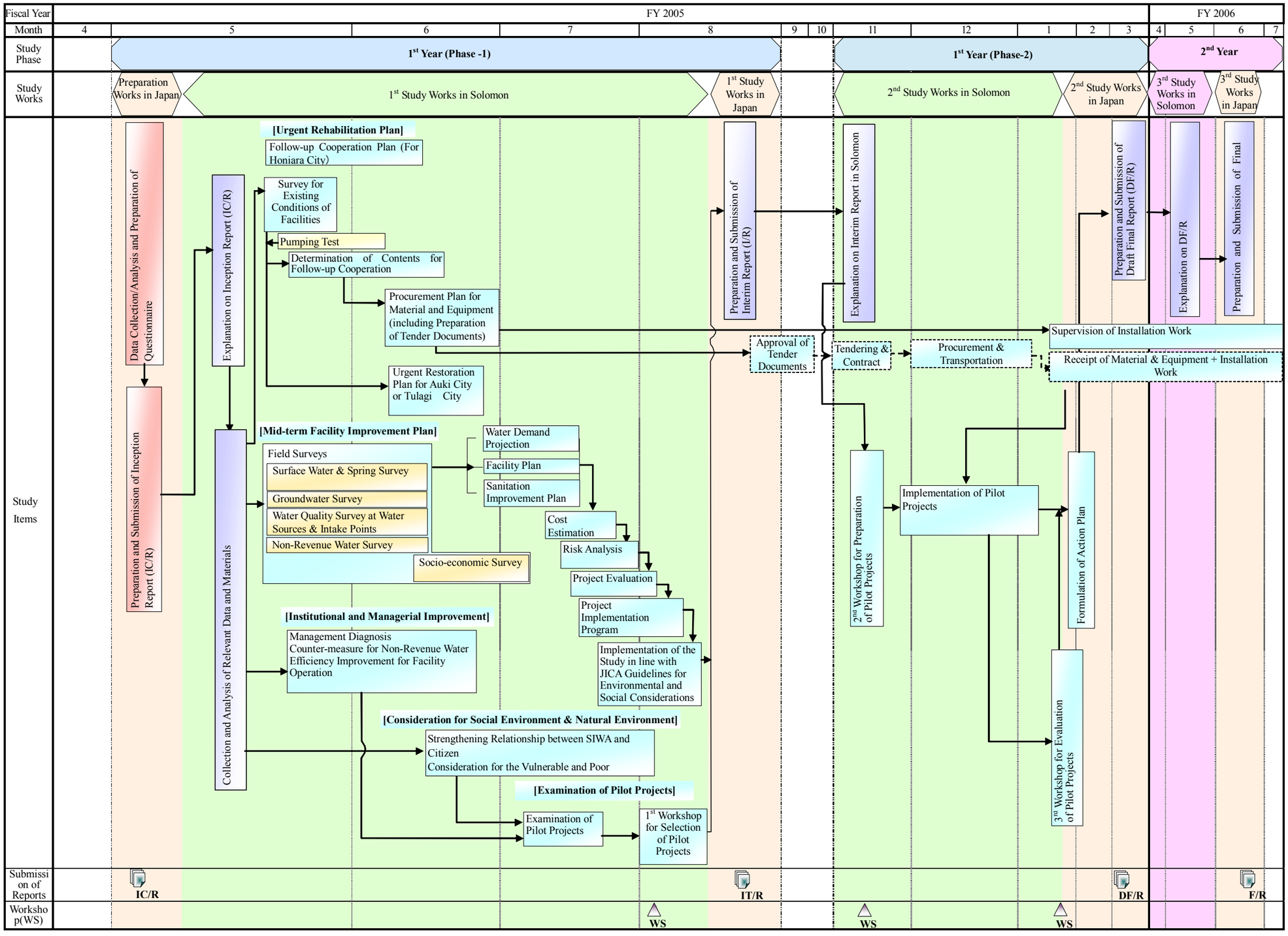
Figure A2-3 Study Schedule

Table A2-1 Contents of Study Phases

Fiscal Year	Study Phase	Study Period
FY2005	1st Fiscal Year - Phase 1: ◆ Preparation Works in Japan	Beginning of May 2005
	◆ Formulation of Urgent Rehabilitation Plan and Mid-term Facility Improvement Plan ◆ Selection of pilot projects ◆ Preparation and submission of IT/R	Middle of May 2005 to the end of August 2005
	1st Fiscal Year - Phase 2: ◆ Explanation of IT/R ◆ Supervision work on Follow-up Project ◆ Execution of Pilot Projects ◆ Preparation and submission of Draft Final Report (DF/R)	November 2005 to March 2006
FY2006	2nd Fiscal Year ◆ Explanation of DF/R ◆ Preparation and submission of Final Report	Middle of May to the end of June 2006

Source : JICA Study Team

The Study has been implemented over 14 months in line with the contents indicated in Table A2-1. Figure A2-4 shows the overall work flow of the Study.



Source : JICA Study Team

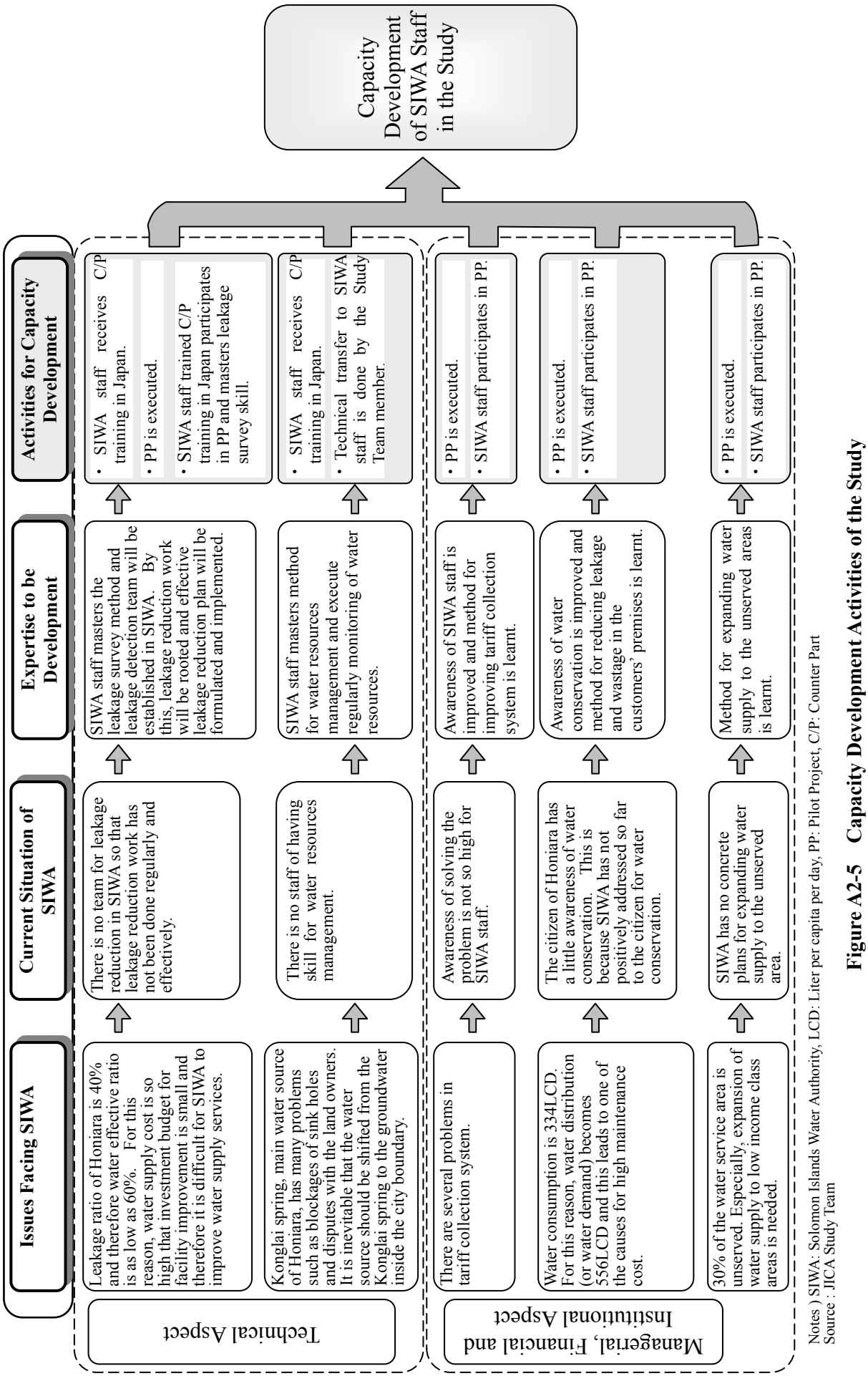
Figure A2-4 Overall Work Flow of the Study

A2.4 Capacity Development Activities of the Study

Items for capacity development activities conducted in the Study were determined after examination of the following points;

- Items should lead to solve problems faced with SIWA for strengthening management of SIWA.
- Counterpart training in Japan can be utilized in some items.
- Items can be implemented in the pilot projects.

The capacities to be developed under the Study and the capacity development activities of the Study are shown in Figure A2-5.

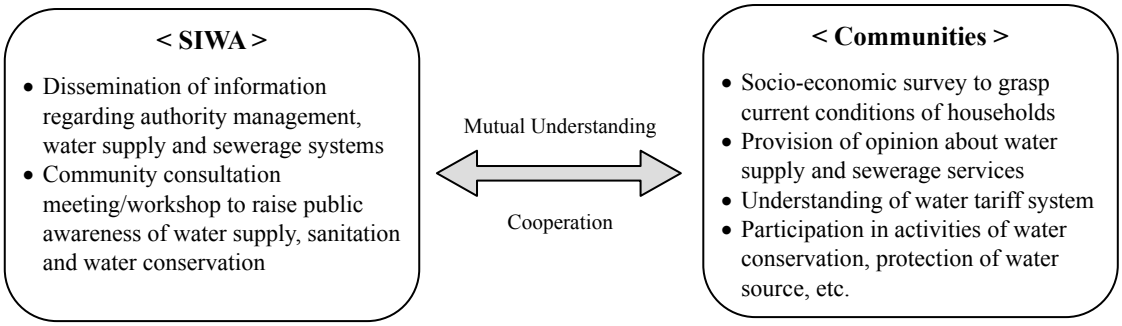


Notes) SIWA: Solomon Islands Water Authority, LCD: Liter per capita per day, PP: Pilot Project, C/P: Counter Part
Source : JICA Study Team

Figure A2-5 Capacity Development Activities of the Study

A2.5 Public Relations/Participation Activities of the Study

Relation between SIWA and the communities is not good due to the problems of water quality, water bills, meter reading, etc. In order to establish good relation with the communities, SIWA should provide water supply services efficiently and disseminate information regarding authority management, water supply and sewerage systems based on better management of the authority. On the other hand, the communities should understand user pay system which is a policy implemented by SIWA as beneficiaries of water supply services, and participate in the activities of water conservation and protection of water sources (see Figure A2-6). Based on those points, public relations/participation activities of the Study are formulated and carried out.



Source : JICA Study Team

Figure A2-6 Establishment of Good Relation between SIWA and the Communities

Under the Project, the following activities were carried out in order to grasp current conditions of households, disseminate information regarding water supply and sewerage systems, raise public awareness of water conservation, and enhance public participation in formulation of mid-term facility improvement plan and action plans for SIWA and preparation of pilot projects.

- Socio-economic survey
  - ① Interview survey
  - ② RRA workshop

- Water Conservation Campaign (Pilot Project-3)
  - ✧ Repair of leaking taps, showers and toilet at home, school and hospital
  - ✧ Questionnaire survey on water conservation
  - ✧ Community Workshop at Kaibia, Fulisango and Burns Creek
  - ✧ Medium Programme (Newspaper and radio)
  - ✧ Distribution of leaflets

- Construction of Shared Standing Pipe (Pilot Project-4)
  - ✧ Construction of shared standing pipe
  - ✧ Survey on current living conditions of residents before and after the project
  - ✧ Community Workshop at Burns Creek

PART B

HONIARA WATER SUPPLY AND SEWERAGE

PART B HONIARA WATER SUPPLY AND SEWERAGE

B1 Existing Conditions

B1.1 Natural Conditions

(1) Topography

Honiara is located in the narrow coastal plain and hills in the inland side. Hills are originated from the coastal terrace with flat plain in the top, which is dissected in many places by valleys with steep slope. Altitude of the terrace plains is different in accordance with geological age of its formation. It is classified into three plains. Altitude of each terrace plain is as shown in Table B1.1-1.

Table B1.1-1 Classification of Terrace Plain

Terrace plain	Altitude of terrace plain
1) Mount Austen	270~300m, 400m
2) Galloping Horse Skyline	150~170m
3) Mbumburu-Kolaa Ridge	45~95m

Source : JICA Study Team

Commercial and industrial areas of Honiara are located in the coastal plain. Residential area is located in the top/slope of hills and bottom of valleys. Water conveyance pipes of SIWA from Konglai Spring is running eastward on Galloping Horse Skyline in the west of Mataniko River, and running on Mbumburu-Kolaa Ridge in the east of Mataniko River.

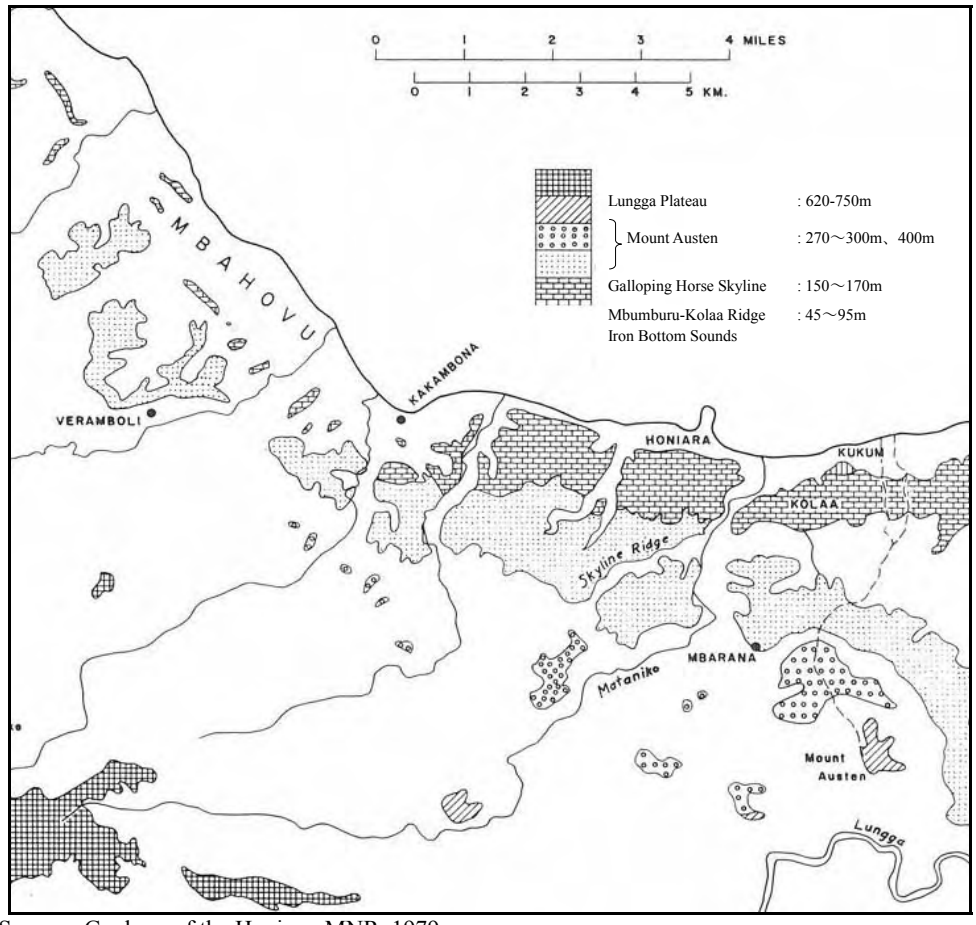
Main water reservoir tanks of SIWA are located in the above terrace plains. The current water supply system is laid down over complicated hilly topography with highly undulating ground surface. Following the complicated topography, SIWA utilizes gravity and pumping-up system for water distribution. Topographical classification is shown in Figure B1.1-1.

Rivers system in Honiara consists of i) White River, ii) Rove Creek, iii) Mataniko River, and iv) Kombito Creek, as shown in Figure B1.1-2. They flow from the south to the north into Iron Bottom Sounds. Mataniko River Basin has the biggest area of above 4 rivers basins that occupy 70% of the total river basin area. Area of each river basin is shown in Table B1.1-2. Lungga River flows in the south of Honiara from the east to the west, which forms the hydrological boundary of the Study Area.

Table B1.1-2 Area of River Basin in the Study Area

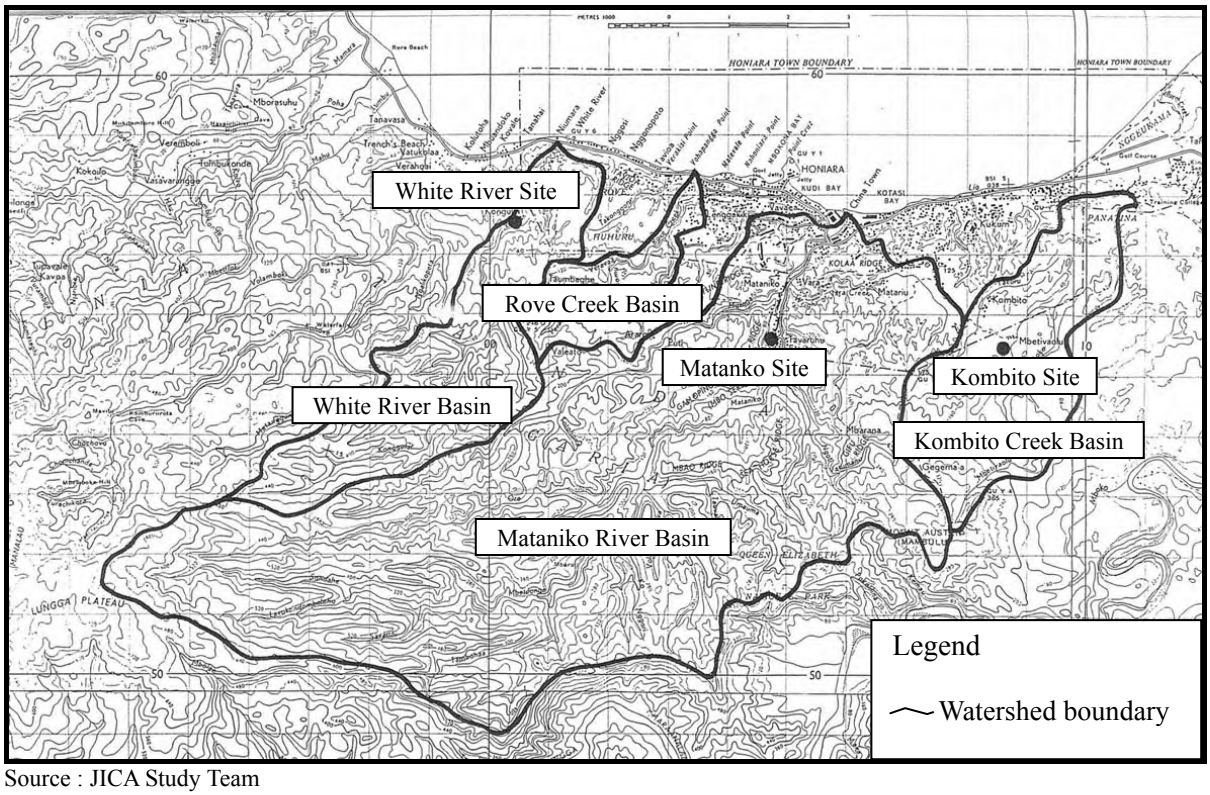
River basin	Area of basin (km^2)
White River	10.2
Rove Creek	4.8
Mataniko River	57.8
Kombito Creek	10.7

Source : JICA Study Team



Source : Geology of the Honiara, MNR, 1979

Figure B1.1-1 Topographical Classification of Honiara City



Source : JICA Study Team

Figure B1.1-2 River Basin of Honiara Area

(2) Climate

The Solomon Islands are located in the south-west of Pacific Ocean showing tropical ocean climate with high temperature and humidity throughout the year. Rainy season is from October to May, and dry season is from June to September. However, there is considerable rainfall throughout the year. Climate of Honiara (at the airport) for the past twenty years is summarized as follows.

Precipitation

Precipitation of Honiara area is the smallest of in Guadalcanal Island, with average annual precipitation of 1,868mm. Annual precipitation varies year by year from 1,265mm to 2,629mm during the past 20 years. Monthly precipitation is the maximum in February, with average of 281mm, and it is the minimum in July with average of 83mm. Amount of precipitation is proportional to elevation of area in Guadalcanal Island. Annual precipitation drastically increases from 1,700mm to 10,000mm from the shoreline to the top of mountains. Average annual precipitation of river basins of the Study Area is 2,500mm.

Temperature

Average annual temperature is 27.4℃, which is almost constant throughout the year. Monthly temperature is the maximum in April with 27.6℃, and the minimum in August with 27.0℃. Fluctuation in average monthly temperature is small. and that of daily temperature is 7 to 8℃. It goes up to 32℃ in daytime, and it goes down to 23℃ at night time.

Humidity

Average annual humidity is 82%. Monthly average humidity is the maximum in February, March and May with humidity of 87%, and it is the minimum in October and November with humidity of 79%. Humidity is usually high in Honiara throughout the year.

Evaporation

Evaporation by Class-A pan is 4.9mm/day and 1,789mm/year. Evaporation is the maximum in October with 171mm/month, and it is the minimum in June with 126mm/month.

Sunshine hours

Average sunshine hours are 6.6hr/day. It is the maximum in November with 7.6hours, and it is the minimum in February with 6.0hr/day.

B1.2 Socio-economic Conditions

B1.2.1 Population

According to the national census conducted in 1999, the population and household of Honiara within the city boundary was as shown in Table B1.2-1.

In the master plan study ("Development of the Solomon Islands Urban Water & Sewerage Infrastructure - Project Design Study") conducted under AusAID (hereinafter referred to as "the AusAID report"), this population is used as the base for the projection of future population.

Table B1.2-1 Population inside Honiara City Boundary in 1999

Population	Household	Number of Family Member
49,107	7,404	7.1

Source : National Census by the Department of Statistics

The annual population growth rate was estimated as 2.8% for the whole nation in the 1999 census.

B1.2.2 General Information

The 1999 population census enumerated a total of 409,042 people living in Solomon Islands. Melanesians comprised 96% of the population, followed by Polynesians with 3% and Micronesian with just over 1% and the remaining 1% for all other population. Males made up slightly more than half (51.7%) of the population whilst females constituted 48.3% of the population.

The majority of the people (84%) live in the rural areas, in small and widely dispersed settlement, mostly along the coasts.

Honiara is the capital of the Solomon Islands and located in northern part of Guadalcanal Island. Population of Honiara is about 49,000 and it accounts for 12% of the total population of the country. Major industry is fishing and agriculture but there are medium and small size industries such as food processing, beer, furniture, construction materials, etc.

1999 census report noted that households with 4-6persons are most common in the Solomon Islands and they represent over one quarter of all households. The average household size of Honiara was 7.1 in 1999. As for the employment status of those who are engaged in paid work, 78% are working for wage, compared with 12% for self-employed.

Piped water is the major source (89%) for the households in Honiara. Public sewerage system is only developed in Honiara, where 11% of the population discharges sewage into sewer pipe. Other 89% of the people discharge sewage into septic tanks. In other provincial centers, there is no sewerage system and septic tank is applied in general.

B1.3 Field Surveys

B1.3.1 Non Revenue Water Survey

(1) Non Revenue Water

According to International Water Association (IWA), water distribution volume is categorized as shown in Table B1.3-1. Non-revenue water (NRW) is defined as the volume obtained by subtracting the revenue water from the system input volume (or water distribution volume).

NRW is comprised of unbilled authorized consumption, apparent losses and real losses. The real losses (or physical losses) are obtained through leakage survey. The remaining volume excluding the real losses from NRW is the unbilled authorized consumption and the apparent losses.

Table B1.3-1 Contents of Water Distribution Volume

<table>
<tr><td rowspan="8">RAW WATER</td><td rowspan="7">System Input Volume (or Water Distribution Volume)</td><td rowspan="3">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption (Including water exported)</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="5">Non-Revenue Water (NRW)</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="4">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Metering Inaccuracies</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and/or Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer metering</td></tr>
<tr><td colspan="4">Treatment Losses (Backwash, etc.)
Evaporation</td></tr>
</table>

Source : International Water Association (IWA)

NRW in the year 2004 is shown in Table B1.3-2. As shown in the table, NRW ratio in 2004 is 42.6%. NRW before 2003 is not available because of the confusion under ethnic tension.

Table B1.3-2 NRW Ratio in 2004

(Unit : m^3/year)

Customer's Name	Customer	Metered Vol.	%
Domestic	5,434	**2,533,267**	47.0
Commercial	617	**1,602,312**	29.7
Governments	198	**716,450**	13.3
Major customers	261	**540,977**	10.0
- Police		13,894	
- SICHE		126,435	
- Telekom		19,687	
- Solbrew		43,765	
- Honiara Soltaiyo		1,743	
- Solgreen		15,278	
- NBSI		6,894	
- SIEA		6,190	
- HCC		9,297	
- HCC School Institutions		74,222	
- Hotels		141,117	
- Motels		20,350	
- NPF		62,105	
Metered Volume - Total	6,510	**5,393,006**	100.0
Water Distributed (or Demand)		**9,387,360**	
Revenue Water Ratio		57.4	%
NRW Ratio		42.6	%

SICHE = Solomon Islands College of High Education
NBSI = National Bank of Solomon Islands
SIEA = Solomon Islands Electric Authority
HCC = Honiara City Council
NPF = National Provident Fund

Source : SIWA

Number of customer and contents of revenue water in 2005 are shown in Figure B1.3-1 and B1.3.1-2 respectively.

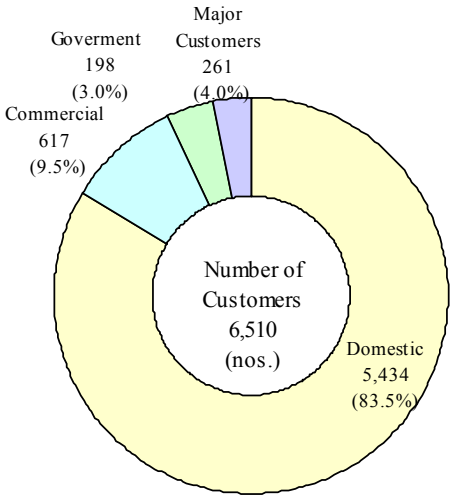
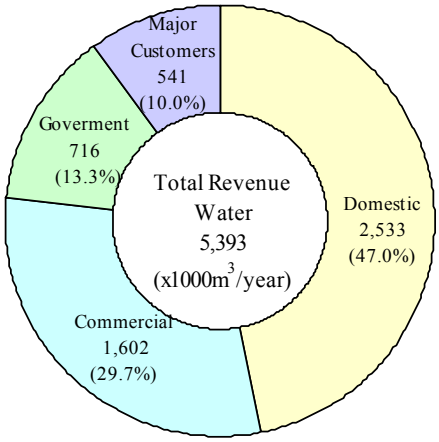


Figure B1.3-1 Number of Customers in 2005



Source : SIWA

Figure B1.3-2 Contents of Revenued Water Volume in 2005

(2) Leakage Survey

The leakage survey was executed to find out the real loss or physical loss ratio in Honiara. The survey was done according to the following procedures:

- Examination of the existing water distribution system
- Field survey of the proposed model blocks
- Selection of 10 model blocks
- Selection of the location of flow measuring point
- Excavation of the flow measuring point and installation of flow meter in the selected model block
- Measurement of flow meter for 24 hours for the model block
- Identification of the major leakage point and observation of the leakage conditions
- Analysis of water leakage ratio and water distribution conditions in the model block

(3) Selection of Model Block for Leakage Survey

The model blocks for leakage survey were selected in such a way that one model block is represented from each existing water distribution area in Honiara. The selected 10 model blocks are shown in Figure B1.3-3.

(4) Results of Leakage Survey

The results of the leakage survey are compiled in S-X of Supporting Report. As shown in Table B1.3-3 (results of the survey), it is found that the leakage ratio in Honiara is 47.4% in average. However, the realistic leakage ratio has been set as 40% taking into account the unexpected usage by the residents in the area during the surveying period and/or unknown water flow from the outside of the model block.

Table B1.3-3 Results of Leakage Survey

Model Area	Total Flow (m^3/day)	Water Loss (m^3/day)	Leakage ratio (%)
Tasahe	226.40	102.62	45.3%
Ngossi	597.71	315.61	52.8%
Lengakiki	624.21	248.89	39.9%
Point Cruz	160.94	56.80	35.3%
Mbokonavera	122.45	75.83	61.9%
Mataniko	155.44	41.09	26.4%
Tanuri	472.21	315.07	66.7%
Naha	582.12	290.13	49.8%
Vura	457.02	211.33	46.2%
King George	194.94	45.95	23.6%
Total	3,593.44	1,703.32	47.4%

Source : JICA Study Team

(5) Countermeasures for NRW

In order to reduce NRW, following countermeasures are considered. In Honiara, NRW consists, for the most part, of real loss (or leakage in the water supply system). Therefore, the countermeasures are considered as follows:

1. Making precise measurement of the distribution volume from the pump station or reservoir to the water distribution district.
2. Making leakage survey on a regular basis to identify the pipeline with much leakage.
3. Replacing distribution pipelines where much leakage is found frequently.
4. Repairing the water reservoirs with much leakage.
5. Stabilizing the water pressure of the whole water distribution districts by dividing into independent water distribution blocks.

For implementing items 1 to 4 above, SIWA should establish a leakage reduction unit or team(s) as soon as possible.

For item 5 above, optimum plan will be proposed in section B2 “Mid-term Facility Improvement Plan”.

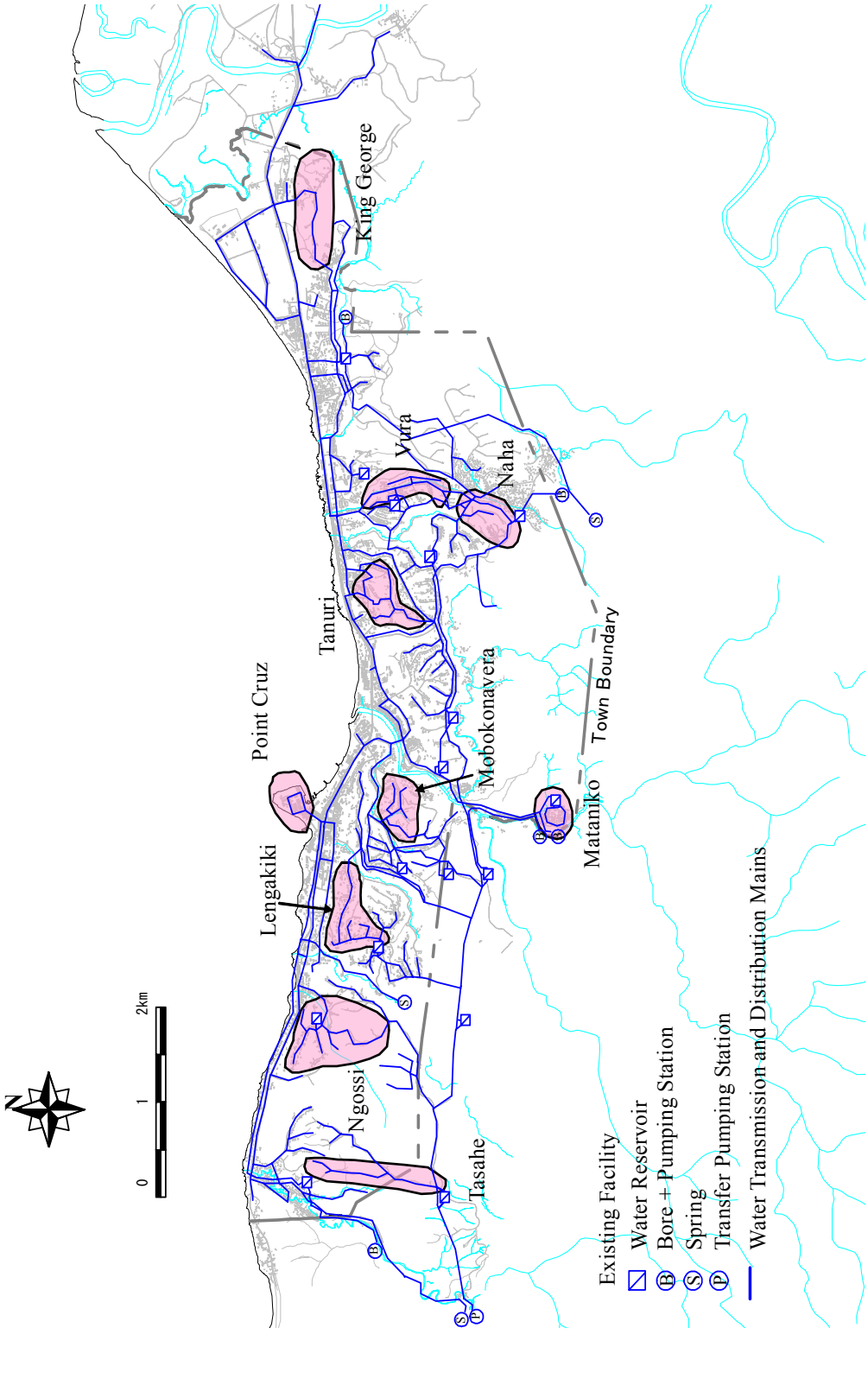


Figure B1.3-3 Location of Model Block for Leakage Survey in Honiara

B1.3.2 Surface Water and Spring

Discharge measurements were carried out in June 2005 during dry season, November and December 2005 during rainy season.

In Honiara, 16 survey points on rivers and 5 spring points are selected in view of the status of each river basins and water flow volume. The measurement point of discharge is shown in Figure B1.3-5. Characteristics of the surveyed rivers in Honiara area are shown in Table B1.3-4 and Figure B1.3-4. In the Figure B1.3-4, result of the discharge measurement of December is shown as rainy season.

Table B1.3-4 Characteristics of Surveyed Rivers in Honiara

Name of Basin	Area of Basin (km^2)	Length (km)	July. 2005		December. 2005	
			Maximum Flow (m^3/s)	Specific Flow ($m^3/s/km^2$)	Maximum Flow (m^3/s)	Specific Flow ($m^3/s/km^2$)
White River	10.2	10.0	0.16	0.016	0.034	0.003
Rove Creek	4.8	3.5	0.076	0.016	0.016	0.003
Mataniko River	57.8	15.0	1.272	0.022	1.852	0.032
Kombito Creek	10.7(4.0)	9.0	0.055	0.005(0.014)	0.028	0.003(0.007)
Lunnga River	377.0	50.0	16.0	0.042	29.6	0.078

Note: Figure in ( ) means the values of the river basin at the flow survey measurement.
Source : JICA Study Team

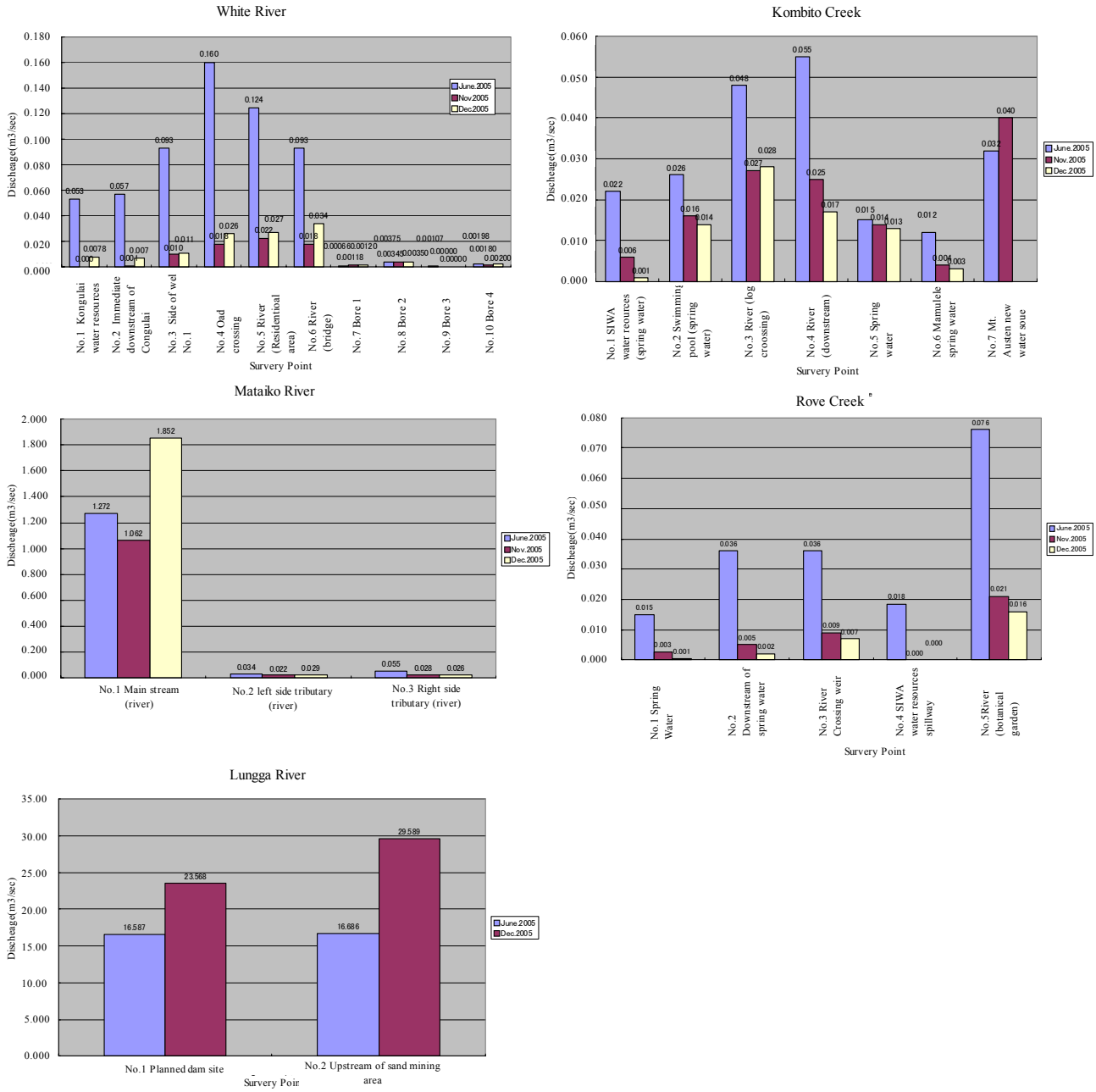
The summary of the survey results are described as follows;

- For Mataniko River and Lungga River, having large catchment area in the mountain side and large precipitation in the rainy season, it was confirmed that discharge of the dry season is less than that of the rainy season.
- For the rivers having small catchment area such as White River, Rove Creek and Kombito Creek, it was confirmed that discharge of the rainy season is less than that of the dry season. The reasons are given as follows;
  - In White River, most of the water from Konglai Spring is supplied from Kovi Sinkhole where surface water goes into a cave that extends to the intake point of Konglai Spring. Kovi Sinkhole has been blocked since October 2005. Therefore, it is considered that the discharge in the rainy season (November and December) was less than that of the dry season (June).
  - In Rove Creek, it rained before the surveying day. It is considered that this is the reasons for the discharge in the rainy season being less than that in the dry season.
  - In Kombito Creek, it is uncertain that it rained before the surveying day. It can be considered that the influence of the rainfall is found in the measurement results for Kombito Creek as well as Rove Creek.
- Discharge property is different in each river basin and has annual variation caused by annual fluctuation of precipitation, area of the catchment and the property of groundwater recharge. Therefore, river discharge in the rainy season and dry season varies every year. In this Study, the discharge measured in the dry season was larger than that in the rainy season. This is because influence due to the rain was remarkable for the small catchment area.
- In consideration of the discharge measurement results and situation above, it can be concluded that the discharge measured in June 2005 is the base flow of each river.

Table B1.3-5 Results of Water Discharge in Honiara

Area	No	Name	Jun.2005		Nov.2005		Dec.2005	
			Water flow m^3/s	Survey Date	Water flow m^3/s	Survey Date	Water flow m^3/s	Survey Date
White River	No.1	Kongulai water resources	0.053	1,jun,2005	No over flow	10.11.2005	0.0078	29.11.2005
	No.2	immediate down area of Conglulai	0.057	1,jun,2005	0.001	10.11.2005	0.007	29.11.2005
	No.3	Side of wel NO.1	0.093	11,jun,2005	0.010	10.11.2005	0.011	29.11.2005
	No.4	Road crossing	0.160	1,jun,2005	0.018	10.11.2005	0.026	29.11.2005
	No.5	River(Residentioal area)	0.124	1,jun,2005	0.022	10.11.2005	0.027	29.11.2005
	No.6	River(bridge)	0.093	1,jun,2005	0.018	11.11.2005	0.034	29.11.2005
	No.7	Wel 1	0.00066	11,jun,2005	0.00118	10.11.2005	0.00120	29.11.2005
	No.8	wel2	0.00375	11,jun,2005	0.00345	10.11.2005	0.00350	29.11.2005
	No.9	wel3	0.00107	11,jun,2005	No over flow	10.11.2005	No over flow	
	No.10	wel4	0.00198	11,jun,2005	0.00180	11.11.2005	0.00200	29.11.2005
Rove Creek	No.1	Spring Water	0.015	1,jun,2005	0.003	11.11.2005	0.001	30.11.2005
	No.2	Down area of spring water	0.036	1,jun,2005	0.005	11.11.2005	0.002	30.11.2005
	No.3	River Crossing Weir	0.036	1,jun,2005	0.009	11.11.2005	0.007	30.11.2005
	No.4	SIWA water resources spillway	0.018	1,jun,2005	No over flow	11.11.2005	No over flow	30.11.2005
	No.5	River (Botanical garden)	0.076	1,jun,2005	0.021	11.11.2005	0.016	30.11.2005
Mataniko	No.1	Main (river)	1.272	2,jun,2005	1.062	14.112005	1.852	05.12.2005
	No.2	left side tributary(river)	0.034	2,jun,2005	0.022	15.11.2005	0.029	06.12.2005
	No.3	ringt side tributary(river)	0.055	2,jun,2005	0.028	14.11.2005	0.026	06.12.2005
Kombito Creek	No.1	SIWA water resources (spring water)	0.022	2,jun,2005	0.006	16.11.2005	0.001	06.12.2005
	No.2	Swimming pool(spring water)	0.026	2,jun,2005	0.016	16.11.2005	0.014	06.12.2005
	No.3	river (log csossing)	0.048	2,jun,2005	0.027	16.11.2005	0.028	06.12.2005
	No.4	river (down)	0.055	2,jun,2005	0.025	16.11.2005	0.017	06.12.2005
	No.5	Spring Water	0.015	2,jun,2005	0.014	16.11.2005	0.013	06.12.2005
	No.6	wel No.1(k-1)	-		-	16.11.2005	-	
	No.7	Mamulele spring water	0.012	20,jun,2005	0.004	18.11.2005	0.003	06.12.2005
	No.8	Mt.Austen new water soue	0.032		0.040	19.11.2005	-	
	No.9	well No.2	-		-	16.11.2005	-	
	No.10	EU well	-		0.002	16.11.2005	0.0018	06.12.2005
Lungga river	No.1	Planned dam site	16.587	4,jun,2005	23.568	02.12.2005	23.568	02.12.2005
	No.2	Up area of sand mining area	16.686	4,jun,2005	29.589	02.12.2005	29.589	02.12.2005

Source : JICA Study Team



Source : JICA Study Team

Figure B1.3-4 Results of Discharge Measurement in Honiara Area Rivers

(a) White River

In White River basin, one spring point which is located uppermost of river course and five (5) survey points in the main stream were selected. Little water flow in the tributaries was identified during this study, where water flow can be seen only after rainfall.

White River is one of the small rivers in Honiara area, with its basin area of 10.2km^2 and length of approx.10km. Origin of the river flow is Konglai Spring, which is the main water source of SIWA water supply sources. Pipeline of 250mm diameter is installed in the intake water points and about 0.13m^3/s water flow was withdrawn to meet the domestic demand in Honiara area as of June 2005.

Although water flow as of June 2005 was from 0.057m^3/s to 0.160m^3/s, water flow as of December 2005 was from 0.007 m^3/s to 0.034 m^3/s, the water flow became less than that in June 2005. It is considered that this is caused by discharge decrease of Konglai Spring. The decrease was brought by

the blockage of Kovi Sinkhole where surface water flows into the intake point of Konglai Spring. The blockage was caused by a flood.

Specific discharge was approx.0.016m^3/s/km^2 in June 2005 and 0.003m^3/s/km^2 in December 2005.

For the utilization of river water, any activity was not found along the river. On the other hand, wastewater flows into the river, so that high turbidity and bad smell were identified near the residential areas. White River is seemed to be too small for self-purification capacity against pollutant in the river.

(b) Rove Creek

In Rove Creek, survey was carried out at following four (4) points : No.1 is a spring at uppermost area, No.2 is on the drop structure, No.3 is the spilt-out flow point from SIWA water source, No.4 is the up area of Botanic garden which is located at the outlet of river valley at the down area.

Rove Creek is one of the small rivers in Honiara area, whose basin area is about 4.8km^2 and the length is 3.5km.

River flow is approx.0.036m^3/s at upper reach and approx.0.076m^3/s at the down area point in June 2005 and approx.0.002m^3/s at upper reach and approx.0.016m^3/s at down area in December 2005. Specific flow is estimated as approx.0.016m^3/s/km^2 in June2005 and 0.003m^3/s/km^2 in December 2005.

Water Volume of the spring was about 0.015m^3/s and spilt-out flow from SIWA source was about 0.018m^3/s. Those flows ran into the main stream in June 2005. However, there was no spilt-out flow from SIWA source in November 2005.

For the utilization of river water, residents living around the creek use water of the creek for bathing and washing at the up area and down area. Spring water is used as a drinking water. However, pollution of river water is progressing in the residential area.

(c) Mataniko River

Mataniko River is one of the large rivers with its basin area of 57.8km^2 and length of approx.15km.

In Mataniko River, water flow survey was carried out at three points. One is on the main stream and other two are on the tributary.

River flow of main stream was about 1.272m^3/s in June 2005 and 1.852 m^3/s in December 2005, the river width is 13.6m and maximum depth is 0.68m at survey cross line. Tributary flow on the left side of the river was 0.034m^3/s in June 2005 and 0.029m^3/s in December 2005. The width is 2.4m and maximum depth is 0.18m. While tributary discharge on the right side was about 0.055m^3/s in June 2005 and 0.026m^3/s in December 2005. The river width is 2.5m and maximum depth is 0.25m at the survey point. Specific flow of main stream was 0.022m^3/s/km^2 in June 2005 and 0.032m^3/s/km^2 in December 2005.

For the utilization of river water, washing and bathing for the residents, and seaway of small boat were identified at the main stream. In tributaries, any water use was not identified except drainage of domestic wastewater. However, there are many small springs along the tributary, which are used for washing, bathing and drinking water for the residents.

(d) Kombito Creek

River basin area of Kombito creek is 10.7km^2 and length of the river identified at Kombito creek is 9.0km. Water is pouring into the swamp spreading at the down area, and then, flows into Lungga River. However, confluence to the Lungga River was not identified because of no access to the point there.

Origins of the Kombito creek are two springs at the up area. OOne spring is used as one of SIWA sources, whose spilt-out flow was 0.022m^3/s in June 2005 and 0.001m^3/s in December 2005. Spilt-out

flow of another spring, which is called as swimming pool, was 0.026m^3/s in June 2005 and 0.014m^3/s in December 2005. Water intake of this spring was not carried out.

Water flow was 0.048m^3/s in June 2005 and 0.028m^3/s in December 2005 at the middle reach of the creek. Water flow at No.4 was 0.055m^3/s in June 2005 and 0.017m^3/s in December 2005. The river width is 2.10m, and maximum depth is 0.31m at down area. Spring water volume at the down areapoint ranged from 0.013 to 0.015m^3/s. However, turbidity of spring water becomes high at the down areapoint, and it smells bad due to the inflow of domestic wastewater. Further more, since there is a small hog farm at the middle reach (up area of survey point No.3) remarkable contamination was identified at survey point No.3.

Spilt-out flow from SIWA water source is used for drinking water, bathing and washing. Specific flow of main stream was 0.005m^3/s/km^2in June 2005 and 0.003m^3/s/km^2 in December 2005.

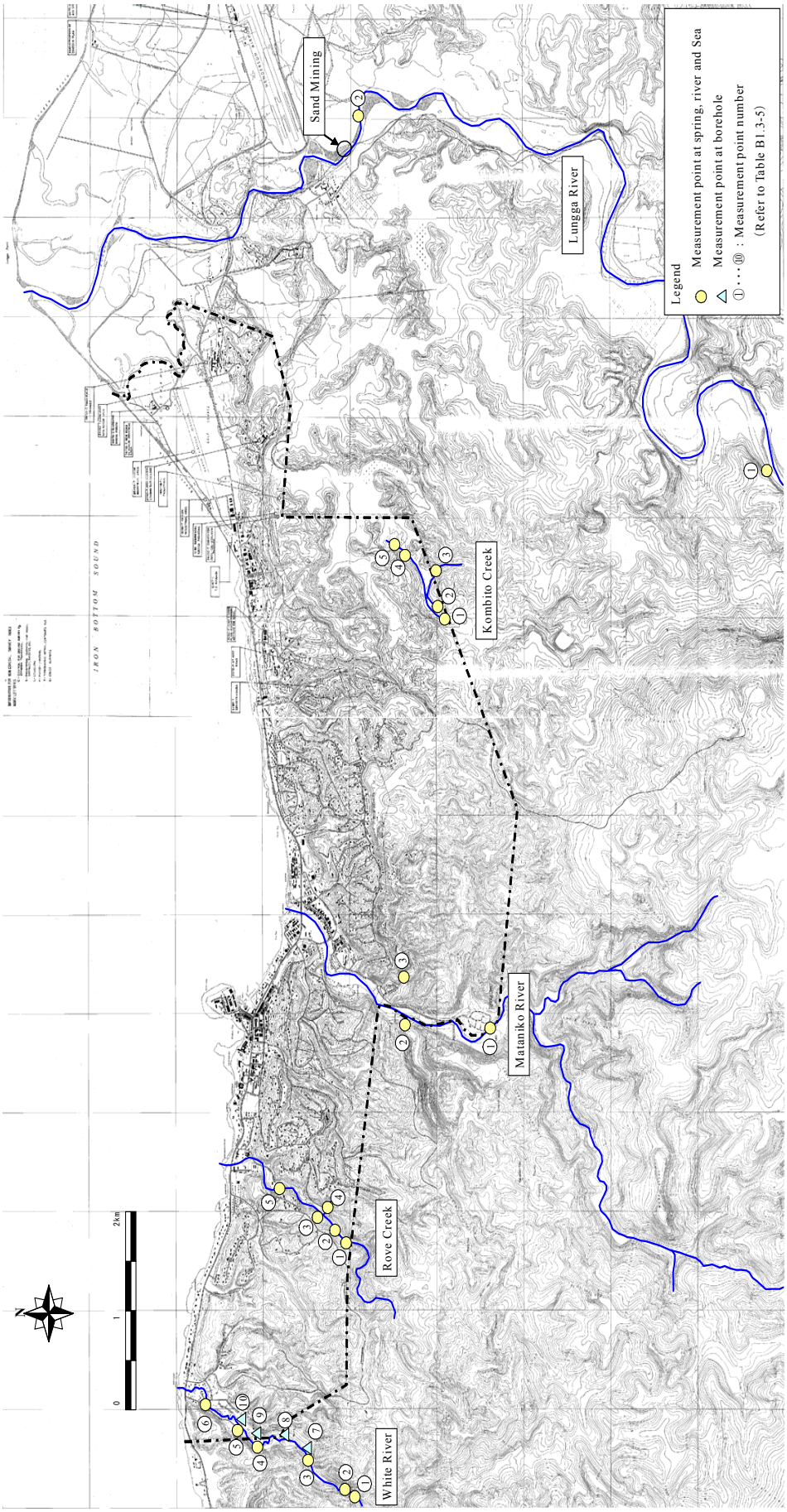
(e) Lungga River

Lungga River is the largest river in Honiara area. The river basin area is about 377km^2 and the length is about 50km. River flow surveys were carried out at two points. One is located at just up area of sand mining area in down area and the other is located at the middle reach of the river, which is used to be the planned dam site.

River flow of No.1 was about Q=16.587m^3/s in June 2005 and Q=23.568m^3/s in December 2005. River flow of NO.2 was about Q＝16.686m^3/s in June 2005 and Q=29.589m^3/s in December 2005.

Specific flow was 0.042m^3/s/km^2in June 2005 and 0.078m^3/s/km^2 in December 2005.

Utilization of the river was not seen on the up area because the river is far away from the residential areas. However swimming and car washing were seen at the downstream point.



Source : JICA Study Team

Figure B1.3-5 Water Discharge Measurement Points of Surface Water and Spring in Honiara