PART A FRAMEWORK OF THE STUDY

A1 Introduction

A1.1 Background of the Study

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

SIWA has many difficulties in the aspects of infrastructures, financial situation and human resources. Therefore, SIWA is desirous of improving water supply and sewerage facilities, and capacity development related to management and organization.

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 facilities damaged under the ethnic tension 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").

The Study has been conducted for about 13 months from May 2005 to May 2006 based on the S/W.

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

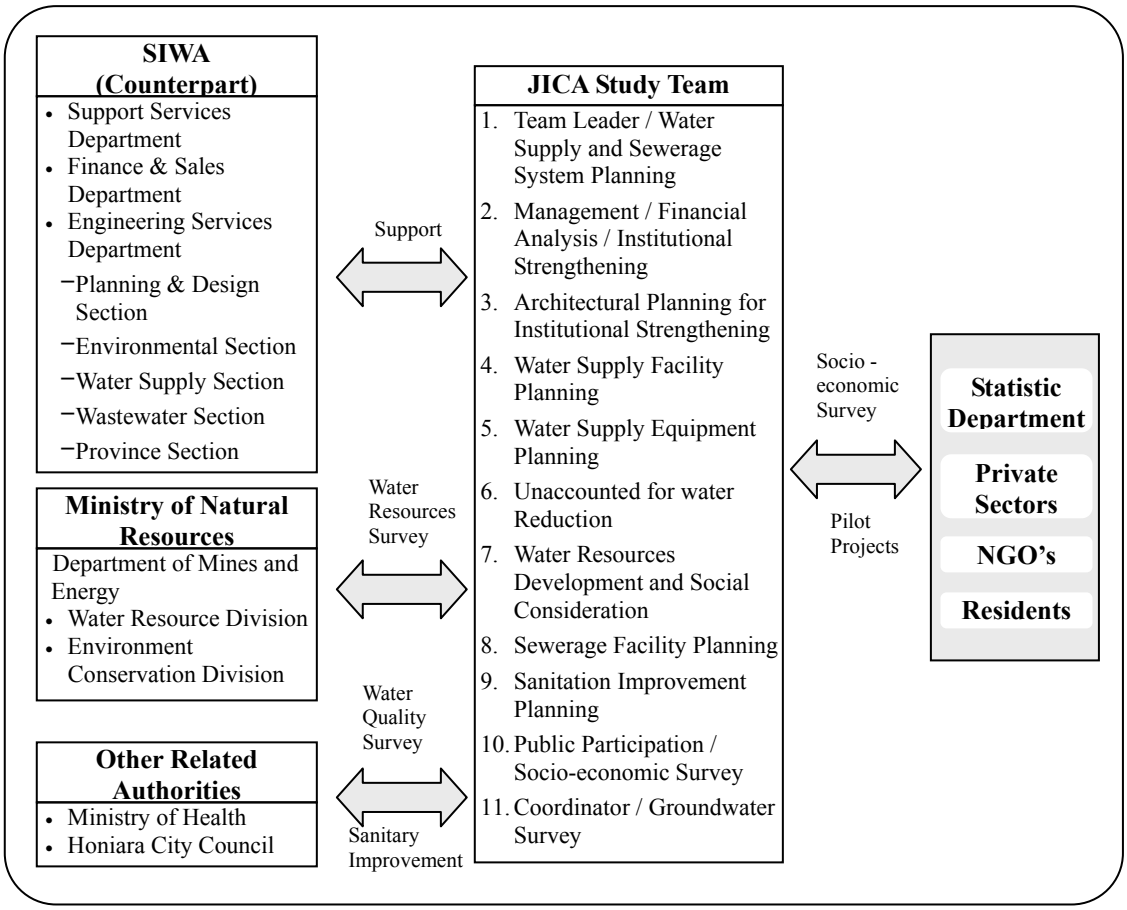
The Study covered Honiara, the capital of the Solomon Islands, and three provincial centers of Noro, Auki and Tulagi as shown in the map attached to the opening page of this report.

A1.4 Organization and Staffing of the Study

The Study Team consists of eleven (11) members. The Study has been implemented with the cooperation of SIWA as a counterpart, Department of Mines & Energy in the Ministry of Natural Resources, Ministry of Health and Honiara City Council.

Socio-economic Survey have and pilot projects been executed in the Study with the cooperation of Department of Statistics, NGO, private companies and the residents of survey areas.

Figure A1-1 shows the relations among all the parties concerned.



Source : JICA Study Team

Figure A1-1 Implementation Organization of the Study

A2 Framework of the Study

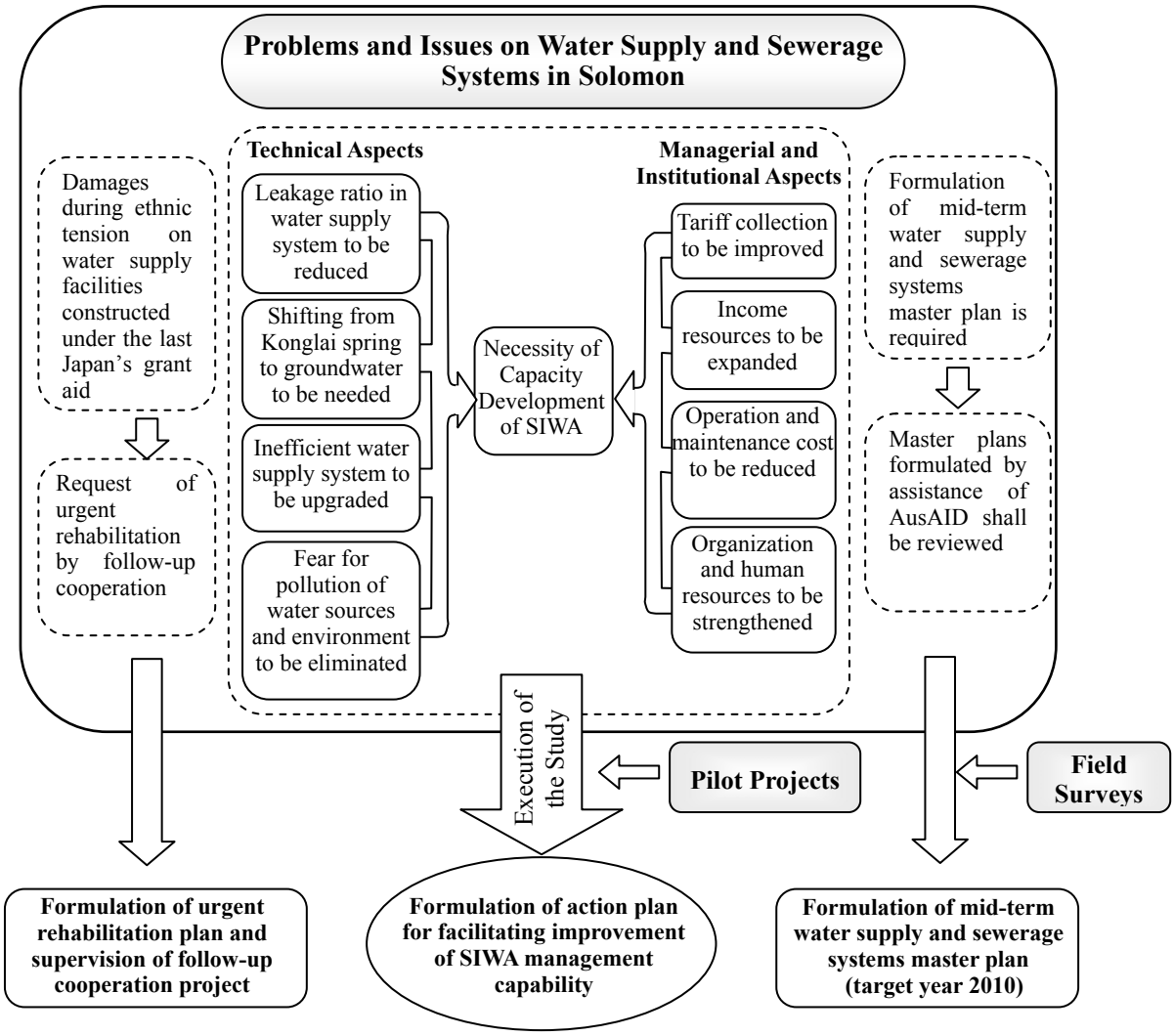
A2.1 Basic Policy of the Study

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 urgent rehabilitation plan for Honiara water supply system and the supervision of the follow-up cooperation project based on the plan are also considered as 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 the Figure A2-1.



Source : JICA Study Team

Figure A2-1 Important Aspects of the Study

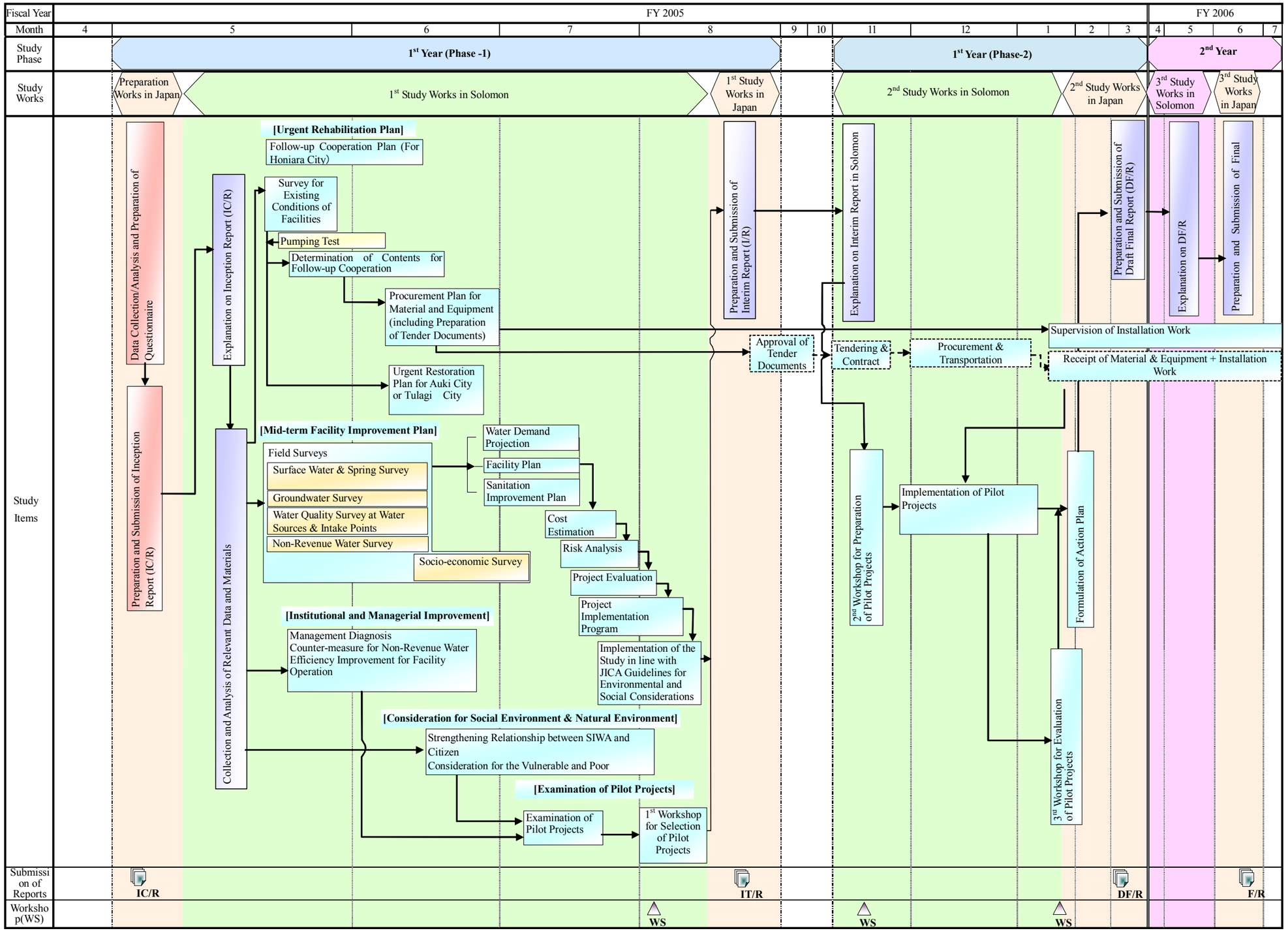
A2.2 Overall Work Flow of the Study

The Study has been started 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 as shown in Table A2-1. The overall implementation schedule of the Study is as shown in Figure A2-2.

Table A2-1 Study Phases

Fiscal Year	Study Phase	Study Period
FY2005	1st Fiscal Year - Phase 1:Preparation 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



Source : JICA Study Team

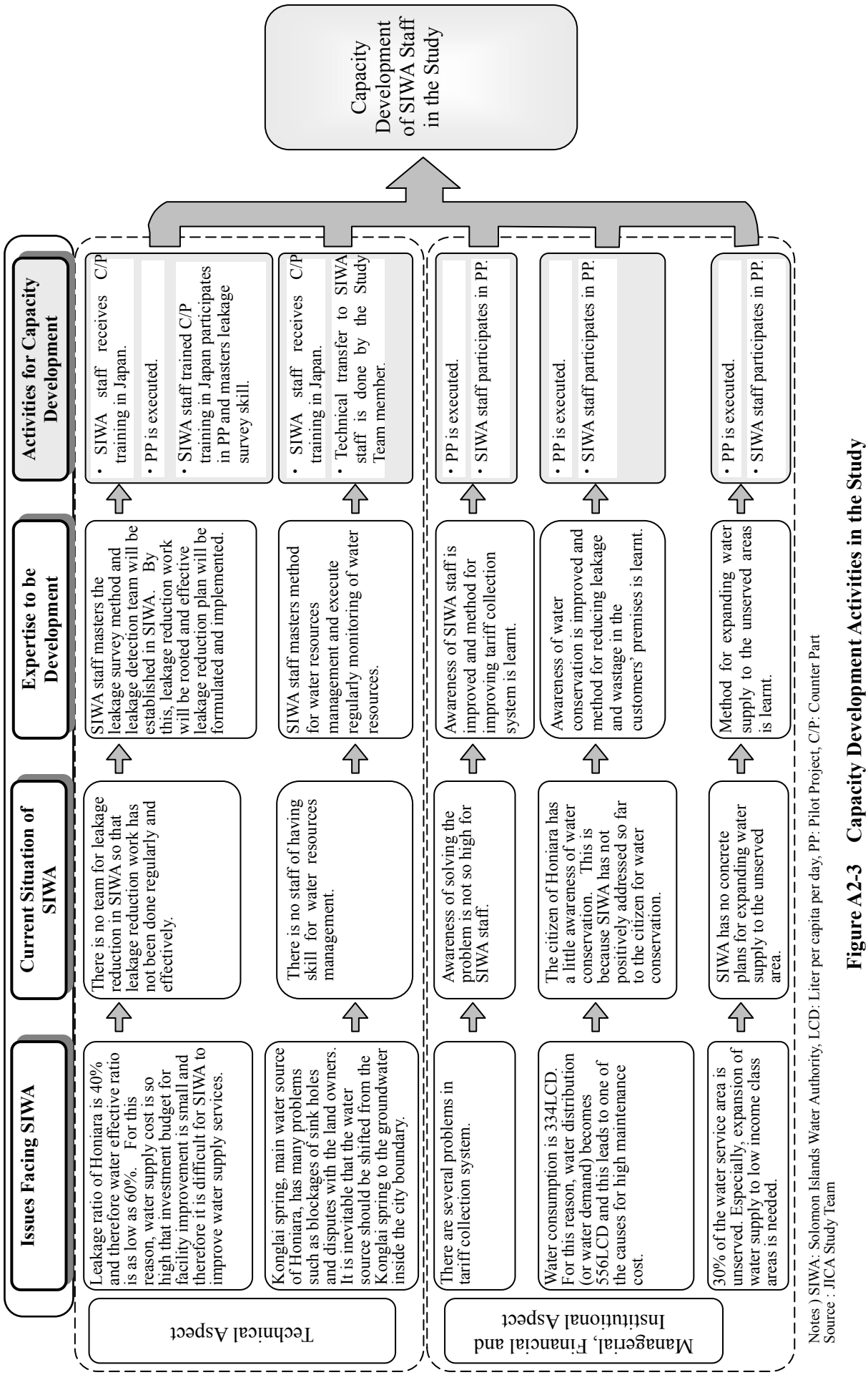
Figure A2-2 Overall Work Flow of the Study

A2.3 Capacity Development Activities in the Study

Items for capacity development activities done 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 developed under the Study and the capacity development activities of the Study are shown in Figure A2-3.

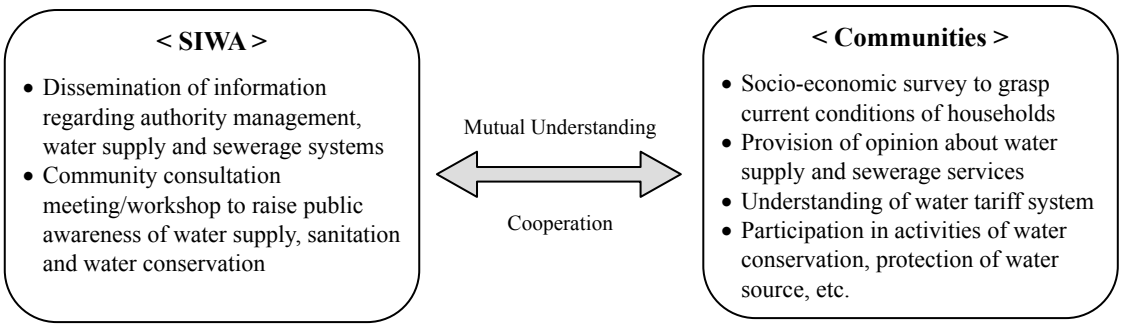


Notes) SIWA: Solomon Islands Water Authority, LCD: Liter per capita per day, PP: Pilot Project, C/P: Counter Part
Source : JICA Study Team

Figure A2-3 Capacity Development Activities in the Study

A2.4 Public Relations/Participation Activities in 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 A2-4). Based on those points, public relations/participation activities of the Study are formulated and carried out.



Source : JICA Study Team

Figure A2-4 Establishment of Good Relations between SIWA and the Communities

Under the Study, 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 Workshop for Rapid Rural Appraisal (RRA)

- Water conservation campaign (Pilot Project-3)
  - ① Repair of leaking taps, showers and toilet at home, school and hospital
  - ② Questionnaire survey on water conservation
  - ③ Community workshop at Kaibia, Fulisango and Burns Creek
  - ④ Medium programme (newspaper and radio)
  - ⑤ Distribution of leaflets

- Construction of shared standing pipe (Pilot Project-4)
  - ① Construction of shared standing pipe
  - ② Survey on current living conditions of residents before and after the project
  - ③ Community workshop at Burns Creek

PART B HONIARA WATER SUPPLY AND SEWERAGE

B1 Existing Conditions

B1.1 Natural Conditions

B1.1.1 Topography

Honiara city is located in the narrow coastal plain and hills in the inland side. Altitude of the terrace plains is different in accordance with geological age of its formation. It is classified into three plains.

Commercial and industrial areas of Honiara city are located in the coastal plain. Residential area is located in the top/slope of hills and bottom of valleys.

Rivers system in Honiara city consists of i) White River, ii) Rove Creek, iii) Mataniko River, and iv) Kombito Creek. They flow from the south to the north into Iron Bottom Sounds. **(Refer to Annex-1)**

B1.1.2 Climate

(1) Precipitation

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.

(2) Temperature

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

B1.2 Socio-economic Conditions

According to the national census conducted in 1999, the population was 49,107 and household was 7404 within Honiara town boundary. The population growth rate was estimated as 2.8% for the whole nation in the 1999 census.

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 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. As for the employment status of those who are engaged in paid work, 78% are working for wage, compared with 12% for self-employed.

B1.3 Field Surveys

B1.3.1 Non Revenue Water Survey

(1) Non Revenue Water (NRW)

NRW is comprised of unbilled authorized consumption, apparent losses and real losses. The real losses (or physical losses) are considered as leakage which is obtained through leakage survey. The remaining volume excluding the real losses from NRW is the unbilled authorized consumption and the apparent losses. NRW ratio in 2004 was found as about 43%.

(2) Leakage Survey

The leakage survey was executed to find out the real loss or leakage ratio in Honiara. The survey was done in 10 model blocks selected from the whole area of Honiara city.

(3) Results of Leakage Survey

It is found that the leakage ratio in Honiara is 47.4% in average. However, the actual leakage ratio is set as 40% taking into account the unexpected usage by the residents in the area during the surveying period.

B1.3.2 Surface Water and Spring

Discharge measurements were carried out in June 2005 as dry season, November and December 2005 as rainy season. **(Refer to Annex-2)**

In the Table B1-1, Result of the discharge measurement of December is shown as rainy season.

Table B1-1 Characteristics of Objective River 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	0.160	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	16.000	0.042	29.600	0.078

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

Outlines 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 dry season is less than that of rainy season.
- For 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 by the flood occurred in October 2005. Therefore, it is considered that the discharge in the rainy season (November and December) was less than the discharge of the dry season (June).
  - In Rove Creek, it rained before the surveying day. It is considered that this is the reason 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 was found in the measurement results of 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 catchments 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 rain was remarkable for the small catchment area.
- In consideration of the discharge measurement results and situations above, it can be concluded that the discharge measurement results of June 2005 are the base flow of each river.

B1.3.3 Groundwater Survey

(1) Geology

Rock formation in Honiara consists of limestone, calcareous sandstone/mudstone of Miocene to the recent, which overlies the basement rock, diorite of Oligocene. Stratigraphic classification of Honiara city area is shown in Table B1-2.

Table B1-2 Stratigraphic Classification of Honiara City Area

Age		Formation	Rock facies	Thickness of formation	Distribution in Honiara City
Quaternary	Holocene	Alluvium	Sand, clay, gravel	<30m	Distributed in the coastal plain and bottom of valleys
	Pleistocene	Honiara Coral Reef Limestone	Coral Limestone	<60m	Distributed upper half of Marine terrace
Tertiary	Pliocene~Pleistocene	Honiara Beds	Calcareous sandstone, mudstone, conglomerate, limestone	<200m	Outcropping in the foot of marine terrace and can be encountered shallower than 200m from the ground surface.
	Former~middle Miocene	Mbonehe Limestone	Limestone	<100m	Not outcropping in Honiara City and encountered deeper than 100m from the ground surface.
	Late Oligocene	Poha Diorite	Fine Diorite	-	Not outcropping in Honiara City and encountered deeper than 200m from the ground surface.

Source : Geology of the Honiara, MNR, 1979

(2) Hydrogeology

1) Aquifer classification

Aquifer of Honiara ground water basin is summarized shown as Table B1-3.

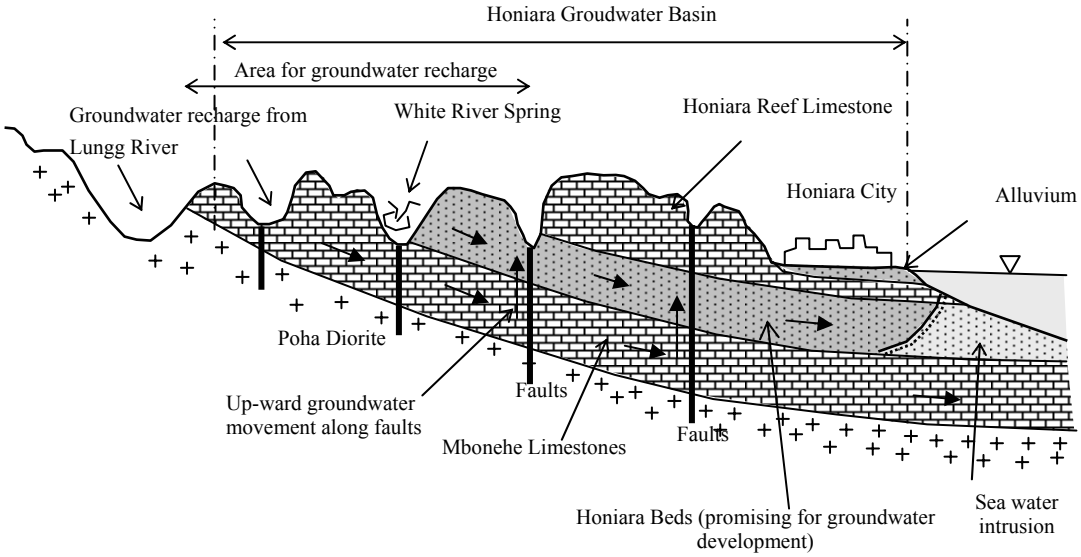
Table B1-3 Aquifer in Honiara Groundwater Basin

Formation	Groundwater	Merit and demerit in groundwater development
Alluvium	Sand and gravel layer store the groundwater.	Area of aquifer distribution, size of aquifer and recharge area is too narrow. It is subject to sea water intrusion.
Honiara Coral reef limestone	Limestone has much porosity suitable for groundwater storage. The Groundwater occurs as perched water.	Limestone is distributed only in upper half of terrace, and size of this aquifer is small. Recharge area is also small. So this aquifer is not suitable for large groundwater development. In addition, there is a risk of groundwater contamination from town area.
Honiara Beds	This formation comprises sandstone and limestone forming good aquifer. Water from Kombito Spring and Panatina Borefield comes from this formation.	Sandstone and limestone form confined aquifer in the depth of less than 100m. All the boreholes that were drilled so far are taking groundwater from Honiara Beds.
Mbonehe Limestone	This formation keeps huge amount of groundwater within in cave system, which has large recharge area. White River spring originates from this formation.	This aquifer exists deeper than GL-100m over the study area. Limestone is compact with poor porosity. Cave system with the groundwater is locally developed. It is not easy to detect the groundwater of this aquifer because of deep occurrence of groundwater. This aquifer can not be direct target of groundwater development
Poha Diorite	Groundwater occurs as fissure water.	This formation exists too deep in the ground of the study to be target for groundwater development.

Source : SIWA, MNR, JICA

2) Hydrogeology of Honiara Groundwater Basin

Hydrogeological structure of the Honiara can be simplified as shown in Figure B1-1. Aquifers in Honiara can be considered independent from the other groundwater basins.



Source : JICA Study Team

Figure B1-1 Hydrogeological Structure of Honiara Groundwater Basin

3) Recharge to Honiara Groundwater Basin

Honiara Beds is distributed in the south of Honiara, where the aquifer is recharged by rainfall and rivers. It is assumed that Mbonehe limestone provides groundwater to the overlaying Honiara beds through fracture zones. In addition to this, down-ward groundwater recharge from Honiara Reef Limestone to Honiara Beds is also expected through fracture zones. Honiara Beds has good condition to get groundwater recharge.

(3) Electric Resistivity Prospecting

1) Outline of survey

Electric resistivity survey was carried out in Honiara. The survey was done at 20 measuring points within Honiara town boundary. **(Refer to Annex-3)**

2) Results of resistivity prospecting

Results of the survey are summarized as follows;

- Electric resistivity structure of Honiara groundwater basin has homogeneous structure over the entire city.
- There are promising aquifers in the entire city between 20m to 100m in depth.
- Judging from the capacity of the existing boreholes, required water yield for the target year can be secured by the boreholes to be newly developed.
- Success ratio for drilling boreholes within Honiara town boundary will be high.

3) Sea water intrusion

Electric resistivity prospecting was carried out in the area of Honiara beds in this Study. According to its results, it has become clear that seawater intrusion is not taken place in aquifer which is located farther than 300m to 500m from the seashore.

B1.3.4 Water Quality Survey

(1) Contents of Water Quality Analysis

Water quality survey in Honiara consists of field water quality survey at site and water quality analysis in laboratory. Purposes for the survey are as follows;

- Field observation using water quality checker was carried out along rivers to confirm the current situation of contamination by sewage.
- Water sampling was carried out at sites to confirm water quality of water, the samples of which were taken from water sources and taps. The water quality analysis was done in SIWA laboratory.

Results of field water quality survey at site are shown in Section B.1.5.3 and results of water quality analysis in laboratory are shown in TableB1-11 and Section B.1.6.2. **(Refer to Annex-4 and 5)**

(2) Water Quality Standard in Solomon

WHO water quality guideline is applied as the water quality standard in Solomon. SIWA can analyze one (1) item of "Bacteria", 12 items of "naturally occurring chemicals", four (4) items of "chemicals used in water treatment or from materials in contact with drinking water, one (1) item of "chemicals from industrial sources and human dwellings", three (3) items of "chemicals from agricultural activities".

SIWA is regularly checking Faecal coliform, taste, color, odor, turbidity, magnesium (Mg), water temperature and conductivity.

As for the standard for water quality of public water bodies, there is no standard in Solomon Islands.

B1.3.5 Ownership and Water Right of Water Sources

(1) Current Situation of Ownership and Water Right of Water Sources

According to Ministry of Water Resources, river/river water and groundwater belong to the Government, and use of water resources in large scale must be approved by the Ministry of Water Resources. To the contrary, it is also widely recognized that river and river water belong to

land-owners. Land-owners usually request payment for water right of river water if taken by SIWA. Then, the Government pays it to the land-owners. On the other hand, in the past there was no case that payment for water light of the groundwater was claimed by land-owners.

(2) Current Situation of Payment for Water Right

Current situation of payment by the Government/SIWA for water right in Honiara is summarized in Table B1-4.

Table B1-4 Current Situation of Payment for Water Right

Water source/facilities		Water right	Land lease	Note
1.	White River Spring	25% of total sales of water from Konglai Spring. It is around S$3,600,000/year.	SI$32,000/year	• White River Spring is located within customary land. • Contract period for water right with customary landowners is from 1981-2055 for 75 years. The contract is reviewed every 5 years.
2.	White River: Borehole W-1and W-2, pipe-line	—	SI$8,000/year	W-1 and W-2 are located within customary land.
3.	White River: Borehole W-4	—	SIWA is now under negotiation with the current lease-holder who has leased the area from the Government.	W4 is located within Honiara
4.	Skyline reservoir	—	SI$2000/year	The reservoir is located within Honiara.

Source : JICA Study Team

Contract on Konglai Spring is until year 2055. Following the contract, payment for land lease will be continued until 2055. On the other hand, payment for water right is proportional to water usage by SIWA. Therefore, payment for water right will be reduced if water usage is reduced.

B1.3.6 Socio-economic Survey

Socio-economic survey was carried out through interview with the sample households (414 samples) from July to August 2005 not only in Honiara but also in Noro, Auki and Tulagi. Researchers visited the sample households and asked questions in line with the questionnaire sheet. Sampling for the survey was done in cooperation with the Department of Statistics that has census information conducted in 1999. Due to no information such as address of household necessary to sample, households were selected by cluster sampling treating an area as a sampling unit, which considers an area as representative of all areas within the target area based on enumeration maps and dwelling number of the 1999 census.

(1) Results of Survey

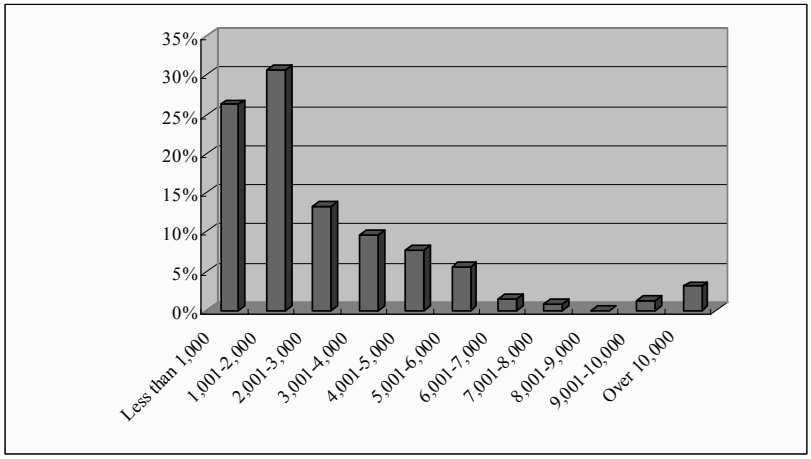
Table B1-5 shows an average household size and the number of paid workers per household. 1999 census reported the average household size was 7.1 in Honiara, while the survey result shows that it is 8.6 persons. It seems that influx from provincial areas to Honiara is increasing after ethnic tension.

Table B1-5 Average Household Size and Number of Paid Workers per Household

Item	Survey Result
Average household size	8.6
Number of paid workers per household	2.1

Source : JICA Study Team

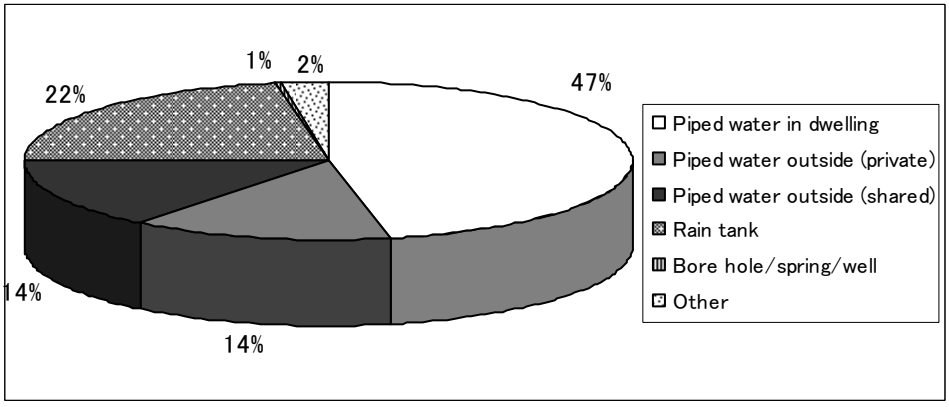
The average monthly income per household is SI$3,553 in Honiara. By income level, it is SI$4,456 for the high-income area and SI$2,007 for the low-income area. As shown in Figure B1-2, SI$1,001 to SI$2,000 group accounts 31%, followed by less than SI$1,000 group (27%) and SI$2,001- SI$3,000 group (13%).



Source : JICA Study Team

Figure B1-2 Average Monthly Income per Household (Honiara)

Households use four major types of water supply in Solomon: piped water, rain tank, bore hole/spring, and river/stream. As shown in Figure B1-3, piped water and rain water tanks are the main sources of drinking water. Low-income households are more dependent on the piped water than high-income households. 1999 census noted that piped water is the major source (89%) for the households in Honiara. However, the percentage obtained from this survey was lower (75%) because the high-income households use rain water tanks for the source of dinking water.



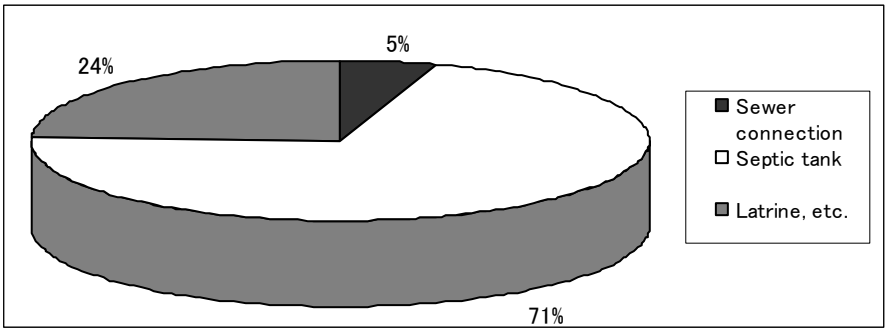
Source : JICA Study Team

Figure B1-3 Sources of Drinking Water

78% of the households are satisfied with water volume in Honiara. Meanwhile, many people are not satisfied with water charge. This is because many of the households do not have a post office box to

which the bill is delivered from SIWA. Therefore, it is strongly recommended that SIWA deliver water bills to residences or households. Half of the respondents in Honiara think that water is the most important among them for improving their living condition.

Major type of toilet is flush type in Honiara, accounting for 70 percent. As shown in Figure B1-4, major sewage discharge is mainly done by septic tank. It is considered that protection of water sources from contamination is as important as the water supply to the customers. Direct contamination of water sources includes people's wrong use of streams, rivers, bush and beaches for recreation spots or as toilets. Prevention of water contamination is responsibility to be partly taken by the people in Honiara. Therefore, people should understand the causes of water contamination and some penalties should be applied when people cause water pollution in Honiara. Almost half of the respondents have the experiences of water-borne disease. Over 90% of households think that water source should be conserved in order to avoid contamination of water.



Source : JICA Study Team

Figure B1-4 Sewerage Discharge System in Honiara

(2) Findings from Socio-Economic Survey

87% of the respondents pointed out the problems of water supply and sewerage systems. The most common opinion about water supply is poor water quality and necessity of filtration. Half of the respondents noted that water was contaminated and not safe for drinking after rain or filtration system should be installed to purify water. Unreliable billing system/meter reading and low water pressure are also their major concerns about water supply.

SIWA conducted a customer satisfaction survey in Honiara in April 1998. The customer services with which customers were satisfied least were meter reading, followed by field staffs. Although meter readers are the most visible among SIWA's staffs, the public perception of meter readers is the worst of all and has not been improved since this customer survey.

More than 2,000 meters do not work properly at moment because most of them are used over 35 years. SIWA applies fixed rate of SI$41.04 to the customers for the broken meters. It accounts one-third of the domestic users. Some customers said that the water charge was suddenly increased after replacement of meter and they doubted meter readers might estimate the amount. Less information leads to unreliability of meter reading and billing system.

There are households sharing a meter but having separate account for each household. In that case, those households pay the same amount of water charge because monthly water consumption is divided by the number of households sharing the meter. However, the number of family and actual water use differs from one to another. Those households feel that this billing system is unfair. This system also caused less reliability of meter reading and billing system.

In order to improve consumer services and perception of the public, and to establish better relationship with the public, the following actions should be taken by SIWA;

- Improvement of reliability/the public perception of meter reading
- Dissemination of information (Public relations)
- Community education/public awareness

- Improvement of billing system
- Consideration on the low-income households

(3) Willingness to Pay (WTP)

As shown in Table B1-6, monthly water charge averages SI$138.22 for Honiara, SI$147.16 for the high-income group (more than the average) and SI$128.80 for the low-income group (not more than the average). Based on data gained from the socio-economic survey, average marginal willingness to pay (MWTP) for better water supply is SI$56.53 per month for Honiara, SI$71.94 for high-income group and SI$38.34 for the low-income group (MWTP, Table B1-6). WTP is the sum of monthly water bill and MWTP. It is total monthly amount which they are prepared to pay for better water supply.

Table B1-6 Monthly Water Charge and Willingness to Pay in Honiara

(SI$/month)

Area	Monthly water charge (A)	MWTP [1] (B)	WTP [2] (A+B)
High-income group	147.16	71.94	219.10
Low-income group	128.80	38.34	167.14
Average	138.22	56.53	194.75

Notes: 1 Willingness to pay for the better water supply services
2 Sum of monthly bill (A) and WTP (B)
Source : JICA Study Team

The water tariff should be set at the rates less than the amount of ability to pay (ATP). ATP is calculated by the statistics of income and distribution of household expenditure. After summing up monthly water bill and WTP, it is not affordable for the respondents to pay for water supply.

Table B1-7 Monthly Water Charge, WTP and ATP in Honiara

Income Group	Monthly water bill	WTP	ATP
High-income group	147.16 (3.3%)	219.10 (4.9%)	178.24
Low-income group	128.80 (6.4%)	167.14 (8.3%)	80.28
Average	138.22 (3.9%)	194.75 (5.9%)	142.12

Note 1: Percentage in blackest is an expenditure ratio of water supply to the average income.
2: Highlighted cells mean over 4% of expenditure ratio of water supply.
3: Monthly water bill for high and low-income groups of Honiara is an average after eliminating the extremely high values
Source : JICA Study Team

Suppose that the household which monthly income is lower than average monthly income are categorised as low-income group, 73 % of the households in Honiara belong to low-income group and 27 % to high-income group. Based on the OECD's measuring method of poverty line which is 50 % of median income, poverty line in Honiara is calculated as SI$1,000 per month and 26% of the respondents are categorised as poverty. In this case, ATP for water supply is SI$40 per month for the households on and under the poverty line.

Based on these results, it seems difficult for SIWA to increase the water rates due to less affordability of the customers unless countermeasures for improving customer service level are carried out.

B1.4 Water Supply System

(1) Current Situation

As a result of the field surveys and analysis of collected data, conditions of water supply system have been confirmed as follows;

- About 50% of the water source depends on Konglai Spring which is vulnerable to reduction of water intake volume by blockage of the inflow point (or sinkhole) of the source by heavy rain and vandalism.
- About 25% of the population in Honiara water distribution districts is suffering from low pressure so that the residents cannot get water during the day time.
- Water transmission pipeline and distribution pipeline are not separated so that the water distribution reservoir cannot work with its original functions such as absorbing peak demand, supplementing water supply in emergency case, etc.
- Pipe diameters are too small to transfer the required water to customers. Inadequate pipe diameter is also the cause of low water pressure.
- Capacity of the existing water reservoir is only about 5 hour-volume of daily maximum water demand.
- Water from spring sources is often contaminated with high turbidity after heavy rain in the catchment area of the sources.
- Unserved ratio is estimated as 30%. There are unserved areas not only outside the city boundary but also inside the city boundary. Especially, in Kombito area where a spring and borefield as water sources are located, the residents (estimated as 6,000) are not served. Getting water directly from the spring or river every day is a burden of the household wives and children.

(2) Data for Water Supply Service

Basic data for water supply service for Honiara in 2005 were confirmed as follows:

Table B1-8 Basic Data for Water Supply Service for Honiara in 2005

Code	Item	Unit	Data
A	Population inside town boundary	person	60,365
B	Population outside town boundary	person	6,037
C	Population in water supply service districts [A + B]	person	66,402
D	Served population	person	46,221
E	Served ratio [(D/C) x 100]	%	70
F	Revenue water ratio	%	57
G	Non-revenue water ratio	%	43
H	Leakage ratio	%	40
I	Effective water ratio [100－H]	%	60
J	Effective water consumption (distributed water－leakage)	m^3/day	15,431
	- Domestic	m^3/day	7,596
	- Commercial	m^3/day	4,390
	- Government	m^3/day	1,963
	- Major customers (hotel, school, hospitals, etc.)	m^3/day	1,482
K	Per capita water consumption for domestic customers	LCD	164
L	Per capita water demand for domestic customers	LCD	274
M	Maximum daily water demand	m^3/day	25,719

Note : Revenue water ratio =
[(Billed metered consumption + Billed Unmetered consumption)/water distributed] x 100
Non revenue water ratio =
[(Water distributed – Billed authorized consumption)/Water distributed] x 100

Source : JICA Study Team

B1.5 Water Source

B1.5.1 Existing Sources

The existing water sources for the current water supply by SIWA are classified into springs and boreholes as shown in Table B1-9 and Table B1-10.

Table B1-9 Spring Sources for Water Supply by SIWA

Spring		Water intake volume(m^3/day)	Geology of spring point
Site	Name		
White River	Konglai spring	12,430	Honiara beds
Rove	Rove spring	1,780	Honiara coral reef limestone
Kombito	Kombito spring	2,600	Kombito marl

Source: SIWA (average volume of June 2005)

Table B1-10 Groundwater Sources for Water Supply by SIWA in Honiara

Borehole No.		Diameter (inch)	Depth (m)	Yield*[1] (m^3/day)	S.W.L*[2] (GL-m)	D.W.L*[3] (GL-m)	Aquifer	Current use*[4]
White River	W-1	8	80	(880)	-0.7	9.0	• Sandstone of Honiara Beds	
	W-2	8	80	(880)	-0.8	8.0		
	W-3	8	80	(880)	-0.5	6.0		
	W-4	8	80	(880)	-0.5	16.0		
Mataniko	M-1	8	100	703	6.0	8.0	• Sandstone of Honiara Beds • Mbonehe Limestone	○
	M-2	8	100	850	7.0	12.0		○
	M-3	8	100	1160	5.2	9.0		○
	M-4	8	100	0	6.1	-		
	M-5	8	50	1380	4.7	9.0		○
	No.1	6	48	720	2.0	24.5	• Sandstone of Honiara Beds • Mbonehe Limestone	○
	No.2	6	90	0		26.7		
	No.3	6	99	0		-		
Kombito	K-1	8	80	1,020	6.5	17.0	Sandstone and limestone of Honiara Beds	○
	K-2	8	80	750	2.3	18.0		○
	No.1	10	20	0	2.8	-		
	No.2	10	60	0	Flowing bore	-		
Panatina	No.1	6	64	2350	5.0	20.5	Sandstone of Honiara Beds	○
	No.2	6	64	680		40.5		○
	No.3	6	48	670		20.2		○
Ndondo Creek	-	5	15	130	2.0	5.9	Alluvial sand	

Note : 1. Water intake volume is from SIWA showing average value of June 2005
2. S.W.L stands for Static Water Level.
3. D.W.L stands for Dynamic Water Level.
4. ○ means "in use"

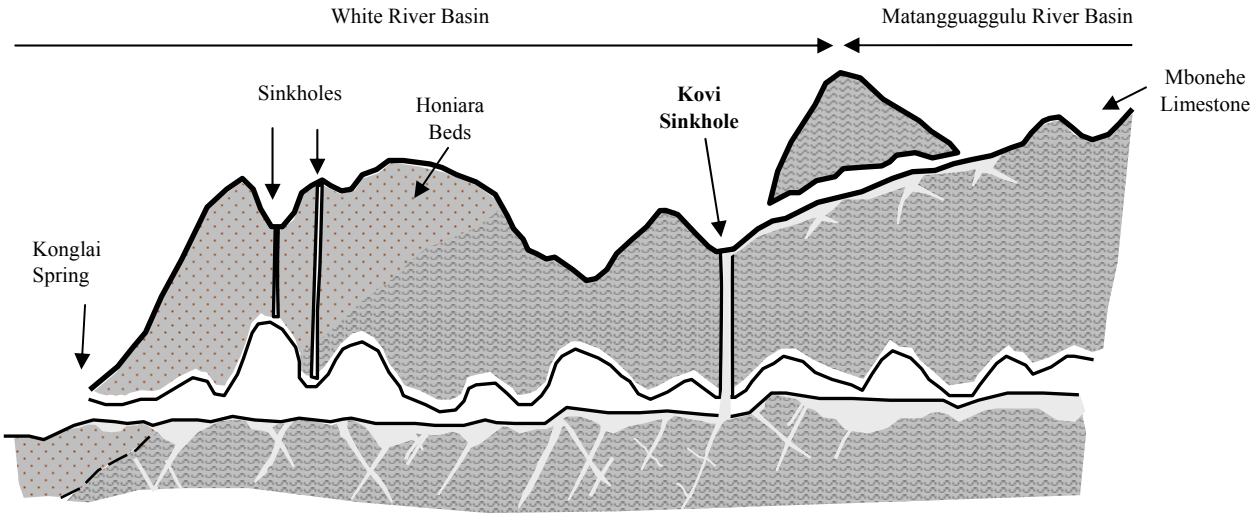
Source : SIWA

B1.5.2 Reduction of Discharge from Konglai Spring

Amount of discharge from Konglai Spring has seriously been reduced by the blockage of sinkhole since October 2005. Amount of discharge has not yet recovered as of June 2006. Characteristics of Konglai Spring and reduction of discharge are summarized below;

(1) Geological Structure of Konglai Spring

It is said that water falling into Kovi sinkhole, which is located in the middle-reach of White River, is the main water source of Konglai Spring (see Figure B1-5). It is assumed that water from Matangguaggulu River appears at immediate upper-reach of Kovi sinkhole crossing water-shed.



Source : JICA Study Team

Figure B1-5 Image of Cave System of Konglai Spring to Kovi Sinkhole

(2) Blockage of Sinkhole in Konglai Spring

In the past 10 years, there were six (6) serious blockages in Konglai Spring, and discharge from the spring was much reduced. SIWA and Ministry of Natural Resources carried out field survey, and they got conclusion that reduction in Konglai Spring water was caused by blockage of Kovi Sinkhole.

(3) Current Discharge from Konglai Spring

Even after reduction of discharge, Konglai Spring still produces constantly 40% (5000m^3/day) of the water intake volume in normal condition, all the volume of which is currently taken by SIWA. After heavy rainfall, spring water increases immediately and sometimes recovers to 100% of the normal water intake volume. But it is temporary recovery. It should be noticed that spring water after heavy rainfall has high turbidity.

(4) Future Use of Konglai Spring

Konglai Spring has two problems as follows;

(1) Kovi Sinkhole is vulnerable to blockage in flooding.
(2) It is restricted by landowner for SIWA to get access to Kovi sinkhole to remove blockage.

Maintenance of Konglai Spring is difficult because it is vulnerable to heavy rainfall, and its restoration depends on landowner. Sedimentation in the Kovi sinkhole becomes more serious year by year, and it will be more difficult to restore from the blockage year by year. Therefore, water from Konglai Spring should be gradually replaced by groundwater from boreholes to be newly developed.

B1.5.3 Results of Water Quality Analysis for Water Source and Tap Water

The results of water quality analysis for water sources and tap water are shown in Table B1-11.

Table B1-11 Results of Water Quality Analysis

Item		Nitrate (mg/L)	Nitrite (mg/L)	Ammonium nitrogen (mg/L)	Mn (mg/L)	Cl_2 (mg/L)	Cl (mg/L)	Cr (VI) (mg/L)	Total Coliform (MPN/mL)
WHO Guidline		**50**	**3**	**-**	**0.4**	**-**	**5**	**0.05**	
Water Sources (springs and boreholes)	White River Well W-1	0.02	0.002	0	0	0	0.047	0.021	over 200
	White River Well W-2	0.03	0.002	0	0	0	0.011	0.024	0
	White River Well W-3	0.02	0.002	0	0.001	0	0.035	0.020	4
	White River Well W-4	0.09	0.005	0	0.003	0	0.043	0.038	0
	Mataniko Well M-2	0.03	0.010	0.015	0.540	0	0.023	0.100	over 200
	Mataniko Well M-4	0.03	0.037	0.018	0.540	0	0.035	0.100	200
	Mataniko Well No.1	0.03	0.010	0.152	0.510		0.012	0.031	0
	Kombito Well K-1	0.01	0	0	0	0	0.061	0.057	5
	Kombito Well K-2	0.04	0	0	0.021	0	0.055	0.057	17
	Panatina Well No.1	0.03	0.001	0	0.005	0	0.026	0.016	
	Panatina Well No.2	0.04	0.005	0	0.003	0	0.022	0.018	0
	Panatina Well No.3	0.04	0.005	0.006	0.003	0		0.018	0
	Panatina Tank	0.05	0.002	0	0.004	0	0.026	0.016	
	White River Kongulai Spring	0.17	0.006	0.600	0.020	0	0.001	0.021	over 200
	Rove Creek Rove Spring	0.90	0.600	1.030	0	0	0.037	0.024	over 200
	Kombito Spring-1	1.07	0.046	0.960	0.041		0.042	0.012	0
	Kombito Spring-2	1.38	0.096	0.044	0.038	0	0.057	0.047	over 200
	Mt.Austen new Spring Source	0.93	0.046	0.062	0.011	0	0.003	0.033	over 200
	Mamulele new Spring Source	1.50	0.009	0.005	3.330	0	5.000	0.009	0
Tap water	White River High Level System	0.18	0.006	0.011	0.500	0.3	0.810	0.023	0
	White River Gravity System	0.18	0.005	0.024	0.530	0.6	0.790	0.023	0
	Rove Gravity System	0.90	0.600	1.030	0	0	0.037	0.024	0
	Mataniko Skyline System	0.04	0.010	0.093	0.044	0.4	0.012	0.031	0
	Mataniko SIWA System	0.02	0.002	0.062	0.061	0.3	0.017	0.022	
	Kombito K-1,K-2 System	0.04	0.009	0.008	0.017	0	6.300	0.100	78
	Kombito Spring System	0.93	0.087	0.063	0.038	0.3	0.057	0.042	over 200
	Panatina System	0.05	0.002	0	0.004	0	0.026	0.016	0

Source : JICA Study Team

- Water samples for water quality analysis of water sources were taken from Konglai Spring and W-1 to W-4 in White River area. According to the results of analysis, water quality of water sources satisfied WHO guideline values except for total coliform in W-1 and W-3. On the other hand, tap water did not have any problem in water quality.

- Water samples for water quality analysis of water sources were taken from Rove Spring in Rove Creek area. According to result of analysis, water quality of Rove Spring satisfied WHO guideline values except for total coliform. On the other hand, tap water did not have any problem in water quality.

- Water samples for water quality analysis of water sources were taken from Well M-2/M-4 and SIWA No.1 in Mataniko river area. According to the result of analysis, water quality of water sources exceeded WHO guideline values in total coliform and manganese. On the other hand, tap water did not have any problem in water quality.

- Water samples for water quality analysis of water sources were taken from SIWA spring point, borehole K-1 and K-2 and candidate sites for new water sources in Kombito Creek area. According to the result of analysis, water quality of water sources satisfied WHO guideline values except for total coliform and Chrome (VI). On the other hand, more coliforms were detected in tap water than in source water. It is considered that coliforms were put into water in distribution.

- Water samples for water quality analysis of water sources were taken from borehole No.1, No.2, No.3 and distributing tank in Panatina area. According to the result of analysis, water quality of water sources satisfied WHO guideline values. Tap water did not have any problem in water quality.

B1.5.4 Countermeasures against Contamination of Water Source and Tap Water

As shown in Table B1-11, coliform group was detected in the groundwater of the boreholes in wide area covering White River, Mataniko River and Kombito Creek. Additionally, coliform group was detected from drinking water supplied through water distribution system of Kombito Creek. Countermeasures against coliforms are as follows;

(1) Coliforms in Water Source

Since water from the boreholes can be disinfected by chlorine in water distribution system from water sources to consumers, regular monitoring of residual chlorine at the end of water distribution network will prevent existence of coliforms. However, protection of boreholes of water sources should be considered against imperfect chlorination due to technical problems in disinfection facilities.

It is presumed that coliforms in the groundwater from boreholes be caused by infiltration of wastewater into aquifer of borehole. The wastewater was from septic tanks of the residents around boreholes, which infiltrated into the aquifer because sealing between borehole and casing is not enough.

Following countermeasures are proposed;

1) Concrete slab around borehole should be reconstructed, which can prevent infiltration of waste water into the ground.

2) Type of septic tank should be changed from seepage type to storage type such as concrete pit. In this case, community septic tank is desirable in view point of maintenance by SIWA. Night soil will be regularly collected by vacuum vehicle of SIWA.

3) For the area near the boreholes, public sewage discharge system should be constructed.

(2) Coliforms in Tap Water

It is considered that coliforms in water distribution system are caused by technical problems in the chlorination facility or insufficient dosage of chlorine. Residual chlorine in water must be checked more strictly by SIWA although it is done regularly at present. In addition to it, daily maintenance of chlorination facilities and control of chlorine dosage should be done by SIWA.

B1.6 Sewerage System

B1.6.1 Issues for Sewage Drainage and Treatment Service

(1) Current Situation

As a result of the field surveys and analysis of collected data, current conditions of sewage drainage and treatment have been confirmed as follows:

- There are no sewage treatment facilities in Honiara except small scale treatment facility in a central hospital and a few private companies.
- Only about 11% of the residents connect with sewer pipelines and the sewage is discharged into Iron Bottom Sea and Mataniko River through outfall pipes without any treatment.
- Most of the sewage outfall pipes are damaged at the seashore, so that the sewage is now diffused not offshore but along the seashore.
- About 90% of the residents discharge sewage into septic tank. Sewage is flooding from some of the septic tanks and flowing into the river.
- Sludge generated from communal and household septic tanks is dumped at the final disposal site

without any treatment.

(2) Data for Sewerage System

Basic data for sewerage sewage for Honiara in 2005 have been confirmed as follows:

Table B1-12 Basic Data for Sewerage Service for Honiara in 2005

Code	Item	Unit	Data
A	Population inside city boundary	Person	60,365
B	Population connected to sewer network	Person	7,450
C	Population using septic tank	Person	52,915
D	Served ratio [B/A x 100]	%	11.2
E	Sewage discharge per person	LCD	334
F	Sewage volume discharged into sea and river	m^3/day	2,490

Source : JICA Study Team

B1.6.2 Sewage Volume and Water Quality of Related Public Waters

(1) Sewage Volume

Sewage volume in Honiara was estimated as 15,400m3/day from the current water distribution volume and leakage ratio. Among this volume, the sewage discharged into the public sewer system is estimated as 2,490m^3/day and it is discharged into sea or river without any treatment. Remaining amount of sewage is dealt with septic tanks of each household.

(2) Result of Field Water Quality Survey on Contamination by Sewage

Field water quality survey was done in rivers/estuaries and at outlets along the seashore to confirm the extent of contamination by sewage drained from the surrounding areas. The summary of the survey is as follows;

1) Results of the field water quality survey of White River

- Water quality does not show remarkable difference between the dry season (June and August) and the rainy season (November and December).
- Considering change in DO value along the river (7.9-6.4 mg/L in the up-stream area and 2.3-1.0 mg/L in the down-stream area), it seems that contamination is more serious in the down-stream area. On the other hand, contamination is not so serious in the seashore around estuaries according to survey result (COD is 1-2 mg/L).

2) Results of filed water quality survey of Rove Creek

- Water quality does not show remarkable difference between the dry season (June and August) and the rainy season (November and December).
- DO value along the river is 2.2-5.6 mg/L in the up-stream area and 3.1-6.7 mg/L in the-down stream area. Water quality does not show remarkable difference along the river. Contamination is not so serious in the seashore around estuaries according to survey result: COD is 0-2 mg/L.

3) Result of field water survey of Mataniko River

- Water quality does not show remarkable difference between dry season (June and August) and rainy season (November and December).
- Considering change in DO value along the river (5.3-8.0mg/L in the up-stream area and 3.3-4.3 mg/L in the down-stream area), it seems that contamination is more serious in the down-stream area.
- Contamination in the seashore near estuaries is more serious in the rainy season than in the dry season according to survey result: COD is 0-2 mg/L in dry season, 5-7mg/L in rainy season.

4) Result of field water survey of Kombito Creek

- Water quality does not show remarkable difference between dry season (June and August) and

rainy season (November and December).

- Considering change in DO value along the river (4.1-7.4mg/L in the up-stream area, in the middle-stream area 0.3-2.3 mg/L and 3.0-7.1 mg/L in the down-stream area), it seems that contamination is more serious in the middle-stream area. There are pig farms in the middle-stream area, which is causing water contamination.
- Kombito creek disappears on the way before reaching the seashore.

5) Result of field water survey of Lungga River

- Water quality does not show remarkable difference between dry season (June and August) and rainy season (November and December).
- DO value along the river is 7.1-8.2 mg/L in the up-stream area and 6.6-8.2 mg/L in the-down stream area, which implies littler contamination in the river and no contamination source along the river.

6) Waste water outfall at seashore and along the Mataniko River

Observed COD is 0-7mg/L at entire survey points. COD is usually low (1-2mg/L), though COD becomes temporally high (5-7 mg/L) at some points for the peak period of domestic wastewater discharge.

B1.6.3 Outline of Existing Sewerage System

Honiara sewerage system consists of the following facilities.

- Collection :
  - Sewer network exists in some areas.
  - In most of the areas, individual septic tank is generally applied.
- Drainage and discharge :
  - Booster pumping station (2 nos.)
  - Outfalls (14 nos.)
- Treatment :
  - Communal septic tank is applied in three (3) areas (Tuvaruhu, Vara Creek and Rove area).
  - There are three (3) small-scale wastewater treatment plants operated by hospital and private company.
  - There are no other treatment plants in Honiara.

B2 Mid-term Facility Improvement Plan

B2.1 Water Demand Projection

Design population for the target year 2010 has been set based on the national census in 1999 and the AusAID report titled as "Development of the Solomon Islands Urban Water & Sewerage Infrastructure – Project Design Study" prepared in 2000. Water demand in 2010 is determined by the design served population, per capita per day consumption and effective water ratio. Design data for the water supply facility improvement plan for 2010 are as follows:

Table B2-1 Design Data for Water Supply Facility Improvement Plan for 2010

Code	Item	Unit	Data (2010)	Data (2005)
A	Population inside town boundary	--	71,695	60,365
B	Population outside town boundary	--	7,170	6,037
C	Population in water supply service districts [A + B]	--	78,865	66,402
D	Served population	--	61,520	46,221
E	Served ratio [(D/C) x 100]	%	78	70
F	Revenue water ratio	%	57	57
G	Non-revenue water ratio	%	43	43
H	Leakage ratio	%	40	40
I	Effective water ratio [100－H]	%	60	60
J	Effective water consumption (distributed water－leakage)	m^3/day	18,352	15,431
	- Domestic	m^3/day	10,118	7,596
	- Commercial	m^3/day	4,614	4,390
	- Government	m^3/day	2,063	1,963
	- Major customers (hotel, school, hospitals, etc.)	m^3/day	1,558	1,482
K	Per capita water consumption for domestic customers	LCD	164	164
L	Per capita water demand for domestic customers	LCD	274	274
M	Maximum daily water demand	m^3/day	30,587	25,719

Source : JICA Study Team

B2.2 Potential Projection of Water Source Development

B2.2.1 Surface Water and Spring

(1) Criteria of Exploitable Surface Water

1) Evaluation in normal river flow

Exploitable discharge of surface flow is commonly defined as the surplus of "Low-water discharge" after deduction of "Current water intake by SIWA" and "Normal discharge". Normal discharge is composed of maintenance flow discharge and intake water volume at downstream area. In objective rivers, no facility for water intake is identified at the down-stream area. Therefore, normal discharge is considered as equivalent to the maintenance flow discharge.

In Japan, maintenance flow discharge is set up a standard of approximately $0.3m^3/s/100km^2$. This maintenance flow discharge shall be applied for calculating exploitable discharge of the river surface flow.

Newly exploitable flow discharge shall be defined as follows,

Newly Exploitable flow discharge
= ⟦(Low-water river discharge) – (Current water intake by SIWA)] – (Normal discharge)

Normal discharge = Maintenance flow discharge
= $0.3m^3/s/100km^2$ ×Area of river basin(km^2)/100

2) Evaluation in Environmental Aspect

Other than from aspect of normal river flow, exploitable discharge was evaluated from aspect of social environmental view points, such as water use by local people, condition of water quality such as turbidity and bad smell. Based on result of analysis in normal flow aspect, it was confirmed that every rivers have potential for new exploitation. However, new water exploitation should be evaluated impossible, if water use of local people is affected or water quality is deteriorated by new exploitation.

(2) Newly Exploitable Surface Water

The summary of exploitable surface water in Honiara area is shown in Table B2-2. White river, Rove creek and Kombito creek have a little capacity for new exploitation in aspect of normal river flow. However, river water is used by local people living in the water source area for tapping, bathing, washing. Domestic waste water flows into the rivers in the down-stream area, which deteriorate the river environment showing white turbid water with bad smell. This means the current discharge at down- stream area is not enough to purify water quality. Therefore, exploitation of above 3 rivers should be avoided considering both "Normal flow aspect" and "Environmental aspect".

On the other hand, as Mataniko and Lungga River have large discharge due to large basins area. Those rivers have enough potential to satisfy water demand for Honiara area.

Table B2-2 Summary of Newly Exploitable Surface Water in Honiara Area

Water resource	Potential of exploitable surface water *1		
	Normal flow aspect	Environmental aspect	Total evaluation
White river	0.022m^3/s (1,900m^3/day)	New exploitation is difficult	0
Rove creek	0.040m^3/s (3,456m^3/day)		0
Mataniko river	1.099m^3/s (94,954m^3/day)	No problem in new exploitation	1.099m^3/s (94,954m^3/day)
Kombito Creek	0.016m^3/s (1,382m^3/day)	New exploitation is difficult	0
Lungga river	14.87m^3/s (1,284,768m^3/day)	No problem in new exploitation	14.87m^3/s (1,284,768m^3/day)

Note: 1. Exploitable discharge is in the down-stream of the current water-intake of SIWA
Source : SIWA

B2.2.2 Groundwater

(1) Water Balance and Groundwater Potential of Honiara Groundwater Basin

Groundwater potential of Honiara Groundwater Basin was evaluated from water balance analysis following relationship below.

① Precipitation = Evapo-transpiration + River Discharge (Direct runoff + Base flow) + Groundwater flow to the sea

② Groundwater Potential = Base flow + Groundwater flow to the sea

＜Water balance and groundwater potential in Honiara Groundwater Basin＞

Water balance and groundwater potential in Honiara Groundwater Basin was analyzed based on data for Lunga river. Result is shown below.

① Precipitation	=	Evapo-transpiration	+	Direct run-off	+	Base flow	+	Groundwater flow to the sea
2,500mm/year (100%)		1,400mm/year (56%)		324mm/year (13%)		355mm/year (14%)		421mm/year (17%)

②Groundwater Potential	=	Base flow	+	Groundwater flow to the sea	=	776mm/year	÷	700mm/year
		355mm/year		421mm/year				

(2) Groundwater Development Potential

Groundwater development potential of Honiara Groundwater Basin should be less than the

groundwater potential that was evaluated by water balance analysis as shown Table B2-3.

Table B2-3 Groundwater Development Potential

Basin Area of Honiara groundwater basin	Groundwater Potential	
59.4 km^2	700 mm/year	113,900 m^3/day

Source : SIWA

The groundwater development potential from Honiara Groundwater Basin was evaluated as shown in Table B2-4.

Table B2-4 Groundwater to be Developed

Groundwater potential		Current extraction of groundwater		Groundwater development potential
113,900 m^3/day	−	14,663m^3/day • 10,283 m^3/day from boreholes • 4,380 m^3/day from Love and Kombito spring	=	99,237 m^3/day

Source : JICA Study Team

B2.2.3 Optimum Water Resources

(1) Selection of Water Resources

Potential of water resources is summarized in Table B2-5.

Table B2-5 Water Demand in 2010 and Water Resources Development Potential

Area	Water demand in year of 2010 (m^3/day)	Water to be developed newly*1 (m^3/day)	Water development potential			
			Type of water source	Remaining potential*2 (m^3/day)	Water quality	Land ownership
Honiara	30,587	12,717	Surface-water	• Mataniko River: 29,980 • The other rivers: 0	Purification plant is necessary	Customary land
			Ground-water	99,237	Chlorination only	Town area

Note 1. Water to be developed newly = Water demand in 2010 – Current water extraction from existing sources (25,719m^3/day)
2. Remaining potential＝Development Potential－Current water extraction

Source : SIWA

In this Study, groundwater is proposed for source of water supply to meet water demand of year 2010. Groundwater is more favorable than surface water in terms of items below.

- Construction cost for water intake facilities
- Water quality
- Stability of water sources in connection to land-owner ship

(2) Important Notice in Groundwater Development

In formulation of groundwater development plan, items below should be taken into consideration.

- Boreholes that are located too near to the sea will cause sea water intrusion. Therefore, new boreholes should be located more than 500m far from the shoreline.
- New boreholes should be located within Honiara town area to prevent problem of water right in costmary land, though there was no similar case in the past.
- New wells should be located near the current water supply system to reduce construction cost for connection pipe between new boreholes and the current water supply system.

(3) Amount of Groundwater to be Developed and Number of Boreholes Necessary

Amount of groundwater to be developed in 2010 shall be determined taking into account the current available water sources and the water demand. Yield from one borehole is expected 800 (m3/day). Therefore, number of boreholes required in 2010 is calculated by the following formula.

$$\text{Number of boreholes required in 2010} = \frac{\text{Amount of groundwater to be developed}}{800\ (m^3/day)}$$

B2.2.4 Groundwater Development Plan

(1) Drilling Points and Landownership

Drilling points are shown in Table B2-6. Every drilling point is located within Honiara town boundary. Land within Honiara belongs to the Government. Therefore, payment for water right is not necessary for the groundwater from boreholes within Honiara. **(Refer to Annex-6)**

Table B2-6 Drilling points and land-ownership

Area	Borehole No.	Current land-ownership
Tasahe new borefield (Ngossi Area)	N-1	Public
	N-2	
	N-3	
	N-4	
Titinge new borefield (Mbokona Area)	M-1	Public
	M-2	
	M-3	
	M-4	
Skyline new borefield (Mbokonavera Area)	MB-1	Public
	MB-2	
	MB-3	
	MB-4	
Borderline new borefield (Kombuvatu Area)	Ko-1	Public
	Ko-2	Church
	Ko-3	Public
	Ko-4	

Source : SIWA

(2) Drillng Plan

Hydrogeology and borehole specifications are shown in Table B2-7.

Table B2-7 Hydrogeology and Borehole Specification

Area	Well No.	G.E.*[1]	Assumed G.W.L.*[2]	Planned Depth	Planned Φ*[3]	Aquifer	Depth of Aquifer (m) *[4]	Geological structure
Tasahe new borefield (Ngossi Area)	N-1	67m	64m	100m	8 inch	Honiara Bed	20-100	Fractured zone
	N-2	62m	59m					
	N-3	56m	53m					
	N-4	67m	64m					
Titinge new borefield (Mbokona Area)	M-1	63m	60m			Honiara Bed	40-100	Fractured zone
	M-2	51m	48m					
	M-3	54m	51m					
	M-4	54m	51m					
Skyline new borefield (Mbokonavera Area)	MB-1	58m	55m			Honiara Bed	30-100	Fault
	MB-2	52m	49m					
	MB-3	44m	41m					
	MB-4	40m	37m					
Borderline new borefield (Kombuvatu Area)	Ko-1	62m	59m			Honiara Bed	30-100	Fault
	Ko-2	54m	51m					
	Ko-3	56m	53m					
	Ko-4	56m	53m					

Note 1 Ground Elevation
2. Groundwater level is assumed from relation below: Groundwater level of proposed borehole = Ground elevation – 10(m)
3. Diameter of borehole
4. Result of electric resistivity survey

Source: SIWA

B2.3 Plan for Water Supply Facility Improvement

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. In the present Study, unit prices for materials and equipment of the AusAID report have been applied in the cost estimation in the Study.

The unit prices of AusAID report are considered reasonable because it is found that the equipment price such as pumps calculated with the inflation ratio of 4% applied under the ongoing Asian Development Bank (ADB) project is reasonable when compared with the present price.

(1) Basic Policy

In the Study, in consideration of SIWA's policy for shifting water sources from the sources in the customary land to those in the land inside the town boundary and based on the results of field surveys including socio-economic survey, mid-term facility plan for improving the existing water supply system (hereinafter referred to as "the Plan") has been formulated.

Problems facing SIWA and countermeasures to be taken in the Plan are mentioned in Table B2-8.

Table B2-8 Problems in Existing Water Supply Facilities and Countermeasures in the Plan

No.	Item	Problems	Countermeasures in the Plan
1	Main Water Sources	About 50% of water distribution volume in Honiara depends on Konglai Spring. Water intake volume from the spring is not stable due to the frequent blockage. The blockage occurred in October 2005 has not been recovered at present (as of May 2006) and it will not be recovered in the future. It is estimated that daily per capita water supply (excluding leakage) is reduced to 115LCD. Moreover, Konglai Spring is located in customary land in which SIWA faces problems in the maintenance work. Therefore, SIWA is desirous of shifting main source to groundwater inside the town boundary.	Three (3) options are examined in terms of water intake volume from Konglai Spring. Option J-1 White River high lift pumping system is cancelled. This system is now distributing 65% of water from the spring to water distribution districts. Option J-2 Current pumping system is maintained in this option. Option J-3 Capacity of the current pumping system is much reduced. Reduced amount of water and additional water by population increase will be secured by developing new groundwater sources inside the town boundary.
2	Water Pressure	About 25% of the residents in the water distribution districts in Honiara are suffering from low water pressure. Some of the residents can not get any water during the peak demand hours in daytime.	Water distribution system with pipe diameters sufficient for meeting water demand up to the year 2010 is planned to eliminate low water pressure areas.
3	Water Distribution System	Water transmission pipeline and distribution pipeline are not separated so that water distribution reservoir can not work with its original functions.	Independent water distribution system is established allocating one water source and one water reservoir in each water district.
4	Pipe Diameter	Pipe diameters are too small to secure the required water with enough water pressure to customers.	Pipe diameters for serving water demand up to 2010 are planned.
5	Capacity of Water Distribution Reservoir	Existing reservoirs have only 5 hour-volume of daily maximum water demand so that they can not serve enough water during the peak demand hours and in an emergency case.	Each distribution reservoir is planned so as to have a capacity of 12 hour-volume of daily maximum water demand.
6	Turbidity of Spring Water	Tap water often shows high turbidity after heavy rain and becomes unsuitable for domestic water use.	Water treatment facility for removing turbidity is installed in each spring water source.
7	Water Supply to the unserved areas	Unserved water supply area accounts for 30% of water distribution districts of SIWA.	Water distribution mains are expanded to the unserved areas.

Source : JICA Study Team

(2) Components of the Plan

The Plan consists of the following components;

- Development of new boreholes
- Construction of water transmission pump stations
- Expansion of water distribution reservoirs
- Replacement of main water distribution pipelines with larger diameter pipes
- Expansion of main water distribution pipelines for the unserved areas
- Construction of water treatment facility for reducing turbidity of spring water
- Construction of disinfection facility

Three (3) options for the plan have been proposed in consideration of the utilization of the existing Konglai Spring as follows; **(Refer to Annex-7, 8 and 9)**

Table B2-9 Outline of 3 Options in Water Supply Facility Improvement Plan

Option	Contents of Facility		Concept of the Plan
J-1	● New borehole ● Transmission pump station ● Water reservoir ● Distribution main ● Water treatment facility for reducing turbidity of spring water ● Disinfection facility	● 16 nos. ● 4 nos./each borefield ● 6 nos. with capacity of 7,005m^3 in total ● Diameter 50 to 300mm x 25.5km ● 3 nos./each spring ● 7 nos.	◆ 35% of water intake volume from Konglai Spring (accounting for 14% of the total water distribution volume for 2010 in Honiara) ◆ In order to shift the water source from unstable Konglai Spring to stable groundwater inside the city boundary, the high lift pumping station which consumes much electric power is cancelled.
J-2	● New borehole ● Transmission pump station ● Water reservoir ● Distribution main ● Water treatment facility for reducing turbidity of spring water ● Disinfection facility	● 6 nos. ● 2 nos./each borefield ● 6 nos. with capacity of 7,005m^3 in total ● Diameter 50 to 400mm x 25.8km ● 3 nos./each spring ● 5 nos.	◆ 100% of water intake volume from Konglai Spring (accounting for 40 percent of the total water distribution volume for 2010 in Honiara). ◆ Increment of water demand for 2010 is for the population increase.
J-3	● New borehole ● Transmission pump station ● Water reservoir ● Distribution main ● Water treatment facility for reducing turbidity of spring water ● Disinfection facility	● 12 nos. ● 3nos./each borefield ● 6 nos. with capacity of 7,405m^3 in total ● Diameter 50 to 300mm x 23.0km ● 3 nos./each spring ● 6 nos.	◆ This option is similar in principle to Option J-1. ◆ 43% of water intake volume from Konglai Spring (accounting for 17% of the total water distribution volume for 2010 in Honiara). ◆ White River Boreholes shall be utilized to cover the water demand in 2010. ◆ The distributed water amount from White River high lift pumping system is reduced to 1/8.

Source : JICA Study Team

(3) Water Production Volume to be Developed

Water production volume to be newly developed for the demand of 2010 in each option is determined from the water intake rate to the total intake volume from Konglai Spring. As shown in Table B2-10 the rate becomes the biggest in Option J-1.

Table B2-10 Newly Developed Water Production Volume (2010)

(Unit : m^3/day)

Option	Ratio to the total intake volume from Konglai Spring (2010)	Water Demand (2005)	Water Demand (2010)	Available Water Source (2010)	Water Production to be Newly Developed (2010)
J-1	35%	25,719	30,587	17,870	12,717
J-2	100%	25,719	30,587	25,719	4,868
J-3	43%	25,719	30,587	21,357	9,230

Source : JICA Study Team

(4) Effects by Implementation of Mid-term Water Supply Facility Improvement Plan

The following are the effects to be expected from the implementation of mid-term water supply facility improvement plan for the target year of 2010. **(Refer to Annex-10)**

- Stable water supply is secured even if blockage of Konglai Spring is not recovered. While it is estimated as 115LCD (excluding water leakage) for the daily per capita water supply during the blockage, 164LCD of the water supply will be secured after the implementation of the Plan.
- Stable water pressure and water supply are secured and low pressure area will be eliminated.
- High turbidity of the drinking water after heavy rain will be eliminated.
- Served ratio of 70% (served population of 46,221 in 2005) will be increased to 78% (served population of 61,520 in 2010) and the unserved area of 30% will be reduced to 22%.

B2.4 Plan for Sewerage Facility Improvement

(1) Basic Policy

It is difficult for SIWA to expand its business in sewerage system for the time being because SIWA has small investment budget of SIWA and many problems in water supply business. In consideration of this situation, facility improvement plan for sewerage system in Honiara has been formulated for rehabilitating the existing sewerage facilities.

(2) Components of the Plan

Based on the results of the field surveys, mid-term facility plan for improving the existing sewerage system (hereinafter referred to as "the Plan") has been formulated.

Table B2-11 Outline of Sewerage Facility Improvement Plan

Component	Contents of Facility or Equipment		Outline of Plan
Upgrading sewage outfall facility	● Outfall facility	● 3 nos.	There are 14 sewage outfalls and most of them are damaged, so that sewage is discharged along the seashore. In order to reduce maintenance difficulty and decrease sewage diffusion area, the existing outfalls are rearranged to new outfalls.
Construction of sludge treatment facility	● Sludge drying bed ● Sewage settling tank	● 1 no. ● 1 no.	Sludge from domestic septic tanks is treated to reduce the environmental pollutants into the public water bodies.
Improvement of operation and maintenance system of household septic tanks	● Vacuum truck ● Sewage cleaning vehicle ● Wheel loader	● 4 nos. ● 1 no. ● 1 no.	SIWA will take responsibility for maintenance and operation of household septic tanks so that the sewage drainage service will be able to be provided regularly and effectively. Another advantage is that SIWA can obtain additional revenue from carrying out this service. In order to do the above work, operation equipment is required.

Source : JICA Study Team

(3) Effects by Implementation of Mid-term Sewerage Facility Improvement Plan

The following are the effects to be expected from the implementation of mid-term sewerage facility improvement plan for the target year of 2010.

- Sewage is discharged offshore so that sewage diffusion at the seashore can be eliminated. Consequently, fear for environmental pollution by sewage at the seashore will be dissolved.

- Sludge is discharged from domestic septic tanks regularly so that effluent of sewage into public water bodies from the septic tanks can be eliminated. Consequently, environmental pollutants into the public water bodies will be reduced.
- Sludge is treated properly so that environmental pollutants can be reduced.

B2.5 Cost Estimation

Cost estimation was done using the unit costs of the AusAID report with an inflation rate of 4%. The results of the cost estimation are as follows:

(1) Water Supply System Improvement Plan

The capital cost and operation cost for the 3 options in the water supply system improvement plan in 2010 are as shown below:

Table B2-12 Capital Cost and Operation Cost for Each Option

(Unit : x1,000US$)

Option	Capital Cost (US$)	Operation Cost (US$/year)
J-1	7,236	1,570
J-2	6,098	1,491
J-3	6,514	1,628

Source : JICA Study Team

(2) Sewerage Facility Improvement Plan

The capital cost of sewerage facility improvement for 2010 is US$2,808,000.

B2.6 Technical Evaluation and Risk Analysis for the Project

Three (3) options were proposed for mid-term facility improvement plan for Honiara water supply system in this report as shown in Table B2-8. Technical evaluation was done and social risk was examined for each option as follows;

B2.6.1 Technical Evaluation

(1) Water Intake Volume from Konglai Spring

Technical evaluation related to the water intake volume from Konglai Spring is done because it is unstable as a major water source as mentioned below.

As mentioned in previous section (B1.5.2), Konglai Spring is located in the customary land, on which 40% of the total water production of Honiara is depended upon in this option at present (2006), has experienced frequent blockages of the inflow points in the catchment area (that is called "sinkhole"). There are 4 large sinkholes in the catchment area of Konglai Spring. Main sinkholes are located about 2km from the spring and in a large catchment area of the customary land. It is very difficult for SIWA to do maintenance of the sinkholes because SIWA staff cannot reach to the sinkholes without permission of the landowners. It is a big obstacle for SIWA's management and therefore SIWA is desirous of shifting water sources from the spring in the customary land to new boreholes inside the town boundary.

Blockage has been occurred six (6) times for the past ten (10) years from 1995 to 2005 by heavy rain or vandalism. The latest blockage happened after the heavy rain at the beginning of October 2005 and the water intake volume from the spring decreases to about 40% of the normal condition. Water shortages have occurred in many places of the city. At the moment (the end of April 2006), it is uncertain when the blockage will be removed and Konglai Spring will be restored. Rationing of

water supply is now executed in the western half of the city and therefore the residents suffer from insufficient water supply.

In consideration of the above-mentioned circumstances, technical evaluation related to the water intake volume from Konglai Spring was done for each option. The evaluation results are shown in Table B2-13 below:

Table B2-13 Technical Evaluation

Option	Ratio to Total Water Distribution in Honiara (2010)	Ratio to Total Intake Volume from Konglai Spring (2010)	Comment	Technical Evaluation
J-1	14%	35%	Even if blockage occurs in Konglai Spring and the recover is not possible, required water volume can be taken from the spring because the base flow from the spring is about 40% of the normal situation. Therefore, there is no technical problem in terms of securing required water intake volume in this option.	A
J-2	40%	100%	40% of water demand in Honiara depends on Konglai Spring. When Konglai Spring is blocked, the influence on the water supply system is large. Therefore, this option has much disadvantage.	C
J-3	17%	43%	The risk is similar to Option J-1. Even if blockage occurs in Konglai Spring and the recover is not possible, required water volume can be taken from the spring. Therefore, there is no technical problem in terms of securing required water intake volume in this option.	A

Rank. A : Low B : Medium C : High
Source : JICA Study Team

(2) Groundwater Development

In formulation of groundwater development plan for the above three options, not only groundwater development potential but also technical issues below shall be evaluated.

- Impact to groundwater use other than SIWA
- Land subsidence by over pumping
- Sea water intrusion

After the evaluation of the items above, there are no technical disadvantages related to the groundwater development in all options.

B2.6.2 Social Risks

(1) Relationship with Customary Land Owners

One of the social risks is the relation with the customary land owners. It has been examined in each option as follows;

Table B2-14 Risk for Relation with Customary Land Owners

Option	Risk	Evaluation
J-1	1. By shifting substantial amount of water from Konglai Spring to the new groundwater within the town boundary, SIWA will face some problems with the landowners of the Konglai Spring area. Raising unit price of current water right fee is considered as one of the risks. 2. For the new boreholes development, there will be risks as follows; - Land lease will not be permitted by the land owners - It will be permitted but at an exorbitant lease price.	C
J-2	1. No change of relation with the land owners of Konglai Spring area. So there is no risk for Konglai Spring. 2. Risk for development of new boreholes is almost the same as other options.	B
J-3	Similar to Option J-1.	C

Rank. A : Low B : Medium C : High
Source : JICA Study Team

(2) Security of Infrastructure

In the light of the social unrest on Guadalcanal occurred from 2000 to 2003, further acts of sabotage and interference with sources and storage tanks that are located in customary lands cannot be ruled out. Continued reliance on Konglai Spring as the main source of water is assessed as a major and unacceptable risk. The security of the project is assessed as follows;

Table B2-15 Risk for Security of Infrastructure

Option	Risk	Evaluation
J-1	Major sources are located within the town boundary so that the security risk is assessed as low.	A
J-2	In this option, Konglai Spring is still the major source. Therefore, the security risk is assessed as high.	C
J-3	Major sources are located within the town boundary so that the security risk is assessed as low.	A

Rank. A : Low B : Medium C : High
Source : JICA Study Team

B2.7 Project Evaluation

The project evaluation is aiming at selection of the water supply system in Honiara to be the most practical one for SIWA from viewpoints of viability.

The project evaluation is also made by risk analysis in addition to financial analysis. Financial analysis is made for these 3 alternatives (Option J-1, J-2 and J-3) of water supply system in Honiara.

Evaluation indicators are normally demonstrated by the Internal Rate of Return (IRR), Net Present Value (NPV), and Benefit-Cost Ratio (B/C).

B2.7.1 Preconditions

Financial analysis is made on the basis of the following preconditions.

(1) Scope of Analysis

A Comparison between newly incremental benefit and cost generated from the project to be implemented is made at the year 2005 price. Financial analysis is carried out for 3 alternatives (Option J-1, J-2 and J-3).

The scope of financial analysis is financial comparison between newly incremental revenue and expenditure with project. A benefit and cost generated from existing facilities are excluded for the

comparison of project profitability as deemed as a sunk cost, because of this project is not new one, rehabilitation project.

(2) Project Benefit

It is assumed that the project benefit is to be i) newly generated water sales by increasing number of users and water consumption unit, ii) saving of water production cost for water leakage, and iii) reduction of land lease fee for customary land.

1) Incremental water sales

Incremental water sales after implementation of the Project (With Project).is assumed by water demand (revenue water) and average water unit price (assumed price).

a) Revenue water

Revenue water is estimated by incremental water demand and revenue water ratio by year as shown in Table B2-16.

Table B2-16 Revenue Water in Honiara

Indicators	FY 2005	FY 2010	FY2016
A) Daily Maximum Water Demand (m^3/day) *1	25,719	30,587	31,510
B) Revenue Water Ratio (%) *2	57%	57%	70%

Notes: 1. Refer to Table G4-1.
2. Refer to Table G1-2.
Source : JICA Study Team

b) Average water unit price

Average water unit price is assumed by water demand proportion for domestic and commercial customers and government facilities in accordance with the preset tariff rate.

Table B2-17 Average Water Unit Price for Financial Analysis

Category	Average water unit price at the 2005 *1	Water demand proportion at the 2016 *2	Assumed unit price
Domestic	SI$1.57/$m^3$	62%	SI$0.97/$m^3$
Commercial/Government	SI$7.39/$m^3$	38%	SI$2.81/$m^3$
Weighed average unit price		100%	SI$3.78/$m^3$

Notes: 1. Average water unit price at the 2005 is that water billed .amount is divided by water sales unit per category.
2. Water demand proportion at the 2016 is based on water demand per category.
Source : JICA Study Team

2) Saving of water production cost by leakage reduction

It is expected that water leakage will be reduced after implementation of the project (from the 2011 onward). Saving of water production cost is assumed as project benefit of which reduction of operation cost i.e., electricity, chemical materials for chlorination

Reduction of leakage; 11,569 m^3/day (the 2011) – 12,131m^3/day (the 2010) = - 562m^3/day

3) Reduction of land lease fee

It should be considered that reduction or increment of land lease fee dealing with a benefit or cost, if this fee is to be changed by option.

At the Skyline tank, the water from Mataniko source and that from Konglai source is merged and mixed. Total water from Mataniko and Konglai source is 125,600m^3 per month. The total amount of water from Konglai has been calculated by SIWA based on the water consumption amounting to 60,800m^3 per month equivalent to SI$114,000. 25% of consumption due to tribe amounts to SI$28,500 per month are being paid by the Department of Land and Survey on behalf of SIWA.

Intake ratio from Konglai source and contribution ratio for the Project is shown in Table B2-18.

Table B2-18 Intake Ratio from Konglai Source by Option

Option	Ratio to Intake water volume from Konglai Spring in 2010	Contribution ratio for the Project (Benefit ratio)
J-1	35%	65%
J-2	100%	0%
J-3	43%	57%

Source : JICA Study Team

(3) Project Costs

Project costs is consisting of initial cost as capital cost in order to upgrade existing water supply system in Honiara and operation and maintenance (O & M) cost for upgraded facilities, not including sewerage and water supply system in provincial centers.

1) Capital cost

Capital cost of 3 Option is estimated as shown in Table B2-19. Option J-1 is the most expensive one and Option J-2 is the lowest one. The cost difference is approximately 18% between Option J-1 and J-2.

Investment schedule of the Project is planned as per implementation schedule from 2007 to 2010. It should be considered replacement cost of submergible bore pumps at water source and pumping stations after 15 years. Initial and replacement costs by option are shown as follows.

Table B2-19 Capital Cost by Option

Option		Capital Cost (US$)	Equivalent to SI$
J-1	Initial Cost	7,236,306	50,654,142
	Replacement Cost	786,324	5,504,268
J-2	Initial Cost	6,097,485	42,682,395
	Replacement Cost	331,112	2,317,784
J-3	Initial Cost	6,514,158	45,599,106
	Replacement Cost	630,243	4,411,701

Note: 1US dollar is equivalent to SI$7.0
Source : JICA Study Team

2) Operation and Maintenance (O & M) cost

O & M cost of each option is comparing with newly incremental cost with Project and Without Project. O & M cost is shown in Table B2-20 as per section B2.5.

Table B2-20 Annual O & M Cost by Option

Option	a) Electricity Cost (US$)	b) System Maintenance Cost (US$)	c) Total Cost (a+b) (US$)	d) Newly Incremental Cost (Total Cost -With Project)	
				(US$)	(SI$)
Without Project	611,495	406,700	1,018,195	0	0
J-1	998,012	572,278	1,570,290	552,095	3,864,665
J-2	846,733	643,991	1,490,724	472,529	3,307,703
J-3	1,009,082	618,963	1,628,045	609,850	4,254,950

Note: 1US dollar is equivalent to SI$7.0
Source : JICA Study Team

(4) Discount Rate

According to "CBSI Annual Report", the weighted average indicative interest rates for deposits of commercial banks widened from 13.48% in 2003 to 13.74% in 2004. Commercial bank's lending rate is some 16% p.a.

In this Study, it is adopted the following discount rates for the case study of financial analysis;

Table B2-21 Case Study of Discounted Rate

Discount Rate	Remarks
10.0%	The discount rate is normally adopted 10%-12% p.a. for the Project evaluation, in this case, it is adopted discount rate 10% p.a. for the case study.
3.5%	The weighted average rate is assumed to be 3.5% p.a. discount rate based on assumption of foreign soft loan with 1.6% p.a. for 80% of total project cost from international organization, etc. and domestic commercial loan with 16% p.a. for 20% of total project cost
1.0%	The weighted average rate is assumed to be 1.0% p.a. discount rate based on assumption of foreign grant aids for 95% of total project cost from international organization , etc. and domestic commercial loan with 16% p.a. for 5% of total project cost

Source : JICA Study Team

B2.7.2 Project Evaluation Results

(1) Evaluation by Financial Analysis

Option J-2 is the most viable project based on financial analysis (evaluation indices of IRR, B/C-Ratio and NPV).

Financial analysis results of three options mentioned above are shown as follows;

Table B2-22 Evaluation by Financial Analysis

Option	Discount Rates	NPV (SI$'000)	B/C	IRR	Evaluation
J-1	10.0%	-9,322	0.72	7.2%	B
	3.5%	24,167	1.59		
	1.0%	54,165	2.23		
J-2	10.0%	-958	0.97	9.7%	A
	3.5%	37,369	2.09		
	1.0%	70,778	2.90		
J-3	10.0%	-7,894	0.74	7.5%	B
	3.5%	23,974	1.65		
	1.0%	52,451	2.32		

Rank. A : Much profitable B : Less profitable than A C : Not profitable
Source : JICA Study Team

(2) Evaluation by Risk Analysis

As mentioned above, Option J-2 has been selected as the most profitable project by the financial analysis. However, evaluation by risk analysis should also be considered as explained in B2.6.

(3) Overall Evaluation

The overall evaluation through financial analysis and risk analysis is as shown in Table B2-23. Although Option J-1 and J-3 have the same mark, Option J-1 is considered more favorable because it is less ratio to the total intake volume from Konglai Spring and less O & M cost than J-3. Therefore, it was concluded that Option J-1 is the most viable project among 3 options.

Table B2-23 Result of Overall Evaluation

Option	Financial Evaluation	Technical Evaluation	Evaluation by Social Risk		Overall Evaluation (Mark)
			Relation with Landowner	Security of Infrastructure	
Weight	1.0	1.0	0.5	0.5	
J-1	B (2)	A (3)	C (0.5)	A (1.5)	1 (7.0)
J-2	A (3)	C (1)	B (1.0)	C (0.5)	3 (5.5)
J-3	B (2)	A (3)	C (0.5)	A (1.5)	2 (7.0)

Note : Figure in ( ) shows a mark for each rank, 3 for A, 2 for B and 1 for C.
Source : JICA Study Team

B2.8 Project Implementation Program

Mid term facility improvement plan shall include following projects with priority.

Priority-1 : Improvement of water supply system in Honiara

Priority-2 : Improvement of water supply system in Auki
(The improvement plan for Auki is described in PART C.)

Priority-3 : Improvement of sewerage system in Honiara

Based on the priority, project implementation program is formulated as shown in Table B2-24.

Table B2-24 Project Implementation Program

(unit : x 1000US$)

No.	Project	Investment Amount	2006	2007	2008	2009	2010	2011
1	Improvement of water supply system in Honiara (Option J-1)	7,240						
				1,020	2,600	2,600	1,020	
2	Improvement of water supply system in Auki	330						
						330		
3	Improvement of sewerage system in Honiara	2,810						
						670	2,140	
	Investment Amount - Total Accumulated	10,380		1,020	2,600	3,600	3,160	

Source : JICA Study Team

PART C PROVINCIAL CENTERS WATER SUPPLY AND SEWERAGE

C1 NORO

C1.1 Existing Conditions

C1.1.1 Natural Conditions

(1) Topography and Geology

Noro is located in marine terrace. Limestone of coral reef in the Tertiary forms the narrow terrace extending along the coast. Residential area of Noro is distributed in the top and the slope of the terrace. Inland area of Noro shows hilly terrain with gentle slope comprising limestone and the other sedimentary rocks of the Tertiary.

(2) Climate

Monthly temperature is the highest of 30.7 ℃, showing almost the same temperature throughout year with seasonal difference within 3℃. Annual precipitation is 3,607mm. Precipitation is the highest in March with 459mm, and it is the lowest in October with 218mm, showing enough precipitation throughout a year.

C1.1.2 Socio-economic Conditions

Noro is located in the western part of New Georgia Island, Western Province. Population in Noro is 4,109 in 2005. Major industry in Noro is fishing and private canned food company, Soltai Fishing & Processing Limited (Soltai). After the ethnic tension, public order is improved and private companies resume the business in Noro.

C1.1.3 Field Surveys

(1) Surface Water Survey

The results of the Surface water discharge measurement are shown in Table C1-1. **(Refer to Annex-10)**

- Discharge of the rainy season was slightly less than dry season.
- At each survey date, difference between the discharge No.1 and No.2 show quantity of water intake of the Zinta intake.

Table C1-1 Results of Surface Water Discharge Measurement in Noro

No	Name	Water flow (m^3/s)	Survey Date
No.1	Upstream of SIWA intake point	0.127	9 Jun. '05
		0.107	30 Nov '05
No.2	Downstream of SIWA intake point	0.105	9 Jun. '05
		0.088	30 Nov '05

Source : JICA Study Team

(2) Groundwater Survey

Noro is located in coral reef limestone that extends along the narrow shoreline. This limestone is porous and highly permeable. It is possible to get groundwater from boreholes in the limestone area. However, limestone is distributed only in the narrow coastal area. Therefore, groundwater development in large scale is impossible.

(3) Water Quality Survey

1) Result of water quality survey

The results of the field water quality survey are shown in Table C1-2. **(Refer to Annex-11)**

Table C1-2 Results of Field Water Quality Survey in Noro

Survey Month \ Survey Items		Water Temperature (℃)	Electric Conductivity (mS/m)	Turbidity (NTU)	pH	DO (mg/L)	COD (mg/L)
June 2005	No.1	25.4	10	8	7.6	1.81	-
	No.2	25.5	8	10	7.6	1.29	-
August 2005	No.1	25.1	8	10	7.4	1.18	6
	No.2	25.2	7	10	7.2	1.08	7
	Coast1	30.9	-	8	8.2	1.17	3
	Coast2	28.8	-	12	7.4	1.50	3
	Factory outfall	28.7	-	18	7.8	0.93	5
November 2005	No.1	25.9	11	1	6.1	4.43	9
	No.2	25.9	10	2	6.3	4.74	9
	Coast1	31.5	-	1	8.0	6.91	2
	Coast2	31.0	-	6	7.8	6.09	2
	Factory outfall	30.6	-	7	7.9	5.78	2

Source : JICA Study Team

The result of field water quality is summarized as below:

- At survey point No.1 and No.2, each survey result does not show remarkable difference.
- According to the DO and COD value, river water and sea water in the dry season was more contaminated than in the rainy season.
- COD value of survey points Coast-1, Coast-2 and Factory outfall (Soltai) ranges from 3 to 5 (mg/L) in August and is 2mg/L in November.

2) Results of water quality analysis in laboratory

Water analysis samples were collected from upstream area of the Ziata intake point, tap of Noro and Soltai borehole.

Water Source:

The analysis results do not exceeds WHO guideline value. Total Coliform Bacteria is 0(MPN/mL) at each sampling points.

Tap water:

The analysis results of these boreholes do not exceed WHO guideline value. Total Coliform Bacteria has been detected from the tap water.

3) Evaluation of water quality

- According to the results of water quality analysis, tap water of Noro system has no problem.

(4) Socio-economic Survey

The average household size is smallest in the target area of the Study (5.0 persons). Major type of toilet is flush same as in Honiara and the other provincial centers. The number of paid workers per household is largest in the provincial centers (1.9 persons). The average monthly income is 2,170 Solomon Islands Dollars (SI$).

Regarding water supply, combination of piped water and rain tanks is major source of water supply. The ratio dependent on rainwater for drinking use is very high (80% of drinking water). Major sewer

system is septic tank. There is no sewer connection. Almost half of the households have the experiences of disease caused by drinking water. All the respondents think that water source should be conserved in order to avoid contamination of water.

Monthly water bill averages SI$68.89, 3.2% in Noro. Marginal willingness to pay for better water supply service (MWTP) is SI$42.07. Total WTP is SI$110.96, 5.1% of average monthly income.

C1.1.4 Water Supply Facility

The served ratio is 61%. Soltai and other commercial customers are using about 60% (1,238m^3/day) of the total water supply (2,063m^3/day). This means that 825m^3/day is delivered to the domestic customer. So the average water supply per capita per day for domestic customer is 330LCD (including 40% leakage).

Existing surface water source (Ziata Creek) has much enough capacity for the whole water demand in Noro. The current water demand accounts for only 17% of the potential volume of the water source. Therefore, new water source development will not be needed.

For the existing water supply system in Noro, there are no outstanding problems. Basic data for water supply service for Noro in 2005 have been confirmed as follows;

Table C1-3 Basic Data for Water Supply Service for Noro in 2005

Code	Item	Unit	Data
A	Population in water distribution districts	--	4,109
B	Served population	--	2,498
C	Served ratio [(B/A) x 100]	%	61
D	Revenue water ratio	%	53
E	Non-revenue water ratio	%	47
F	Leakage ratio[estimated]	%	40
G	Effective water ratio [100－F]	%	60
H	Effective water ratio (distribution－leakage)	m^3/day	1,238
	- Domestic	m^3/day	495
	- Commercial	m^3/day	743
I	Per capita consumption for domestic customers	LCD	198
J	Per capita water demand for domestic customers	LCD	330
K	Maximum daily water demand	m^3/day	2,063

Source : JICA Study Team

C1.1.5 Sewerage Facility

In Noro, residential and commercial properties are served by septic tanks. Soltai Fishing & Processing Limited has its own wastewater treatment system for both industrial wastewater and sewage. However, the wastewater treatment system is now closed down and needed to be rehabilitated.

C1.2 Mid-term Facility Improvement Plan

C1.2.1 Water Demand Projection

Water demand in 2010 for Noro is as shown below:

Table C1-4 Water Demand in 2010 for Noro

Code	Item	Unit	Data
A	Population in water distribution districts	--	4,718
B	Served population	--	3,170
C	Served ratio [(B/A) x 100]	%	67
D	Revenue water ratio	%	53
E	Non-revenue water ratio	%	47
F	Leakage ratio[estimated]	%	40
G	Effective water ratio [100－F]	%	60
H	Effective water ratio (distribution－leakage)	m^3/day	1,408
	- Domestic	m^3/day	523
	- Commercial	m^3/day	885
I	Per capita consumption for domestic customers	LCD	198
J	Per capita water demand for domestic customers	LCD	330
K	Maximum daily water demand	m^3/day	2,347

Source : JICA Study Team

C1.2.2 Potential Projection of Water Sources Development and Optimum Water Source

Based on the results of analysis on development potential of the surface water and groundwater, it was concluded that both surface water and groundwater have enough potential for water demand in year of 2010. Development potential of water resources in Noro is summarized in Table C1-5.

Table C1-5 Water Demand in 2010 and Water Resources Development Potential for Noro

Water demand in year of 2010 (m^3/day)	Water to be developed Newly*1 (m^3/day)	Water development potential			
		Type of water source	Remaining potential*2 (m^3/day)	Water quality	Land ownership
2,347	284	Surface -water	3,629	Purification plant is necessary	Customary land
		Ground-water	More than 2,350	Chlorination only	Town area

Note: 1. Water to be developed Newly = Water demand in 2010 – Current water extraction from existing sources (2,063)
2. Remaining potential＝Development Potential－Current water extraction

Source : JICA Study Team

The current water source for water supply for Noro is Ziata River. To meet water demand in year of 2010, it is recommended that additional water should be taken form the current water intake-point of Ziata River.

C1.2.3 Policy for Improvement of Water Supply Facility Improvement

In Noro, it was confirmed that the existing water source and water distribution facilities will be able to serve for the water demand in the target year 2010. Therefore, the facility improvement plan for the year 2010 in Noro is not prepared. However, served ratio is still 61% in 2005. Therefore, SIWA is required to expand water distribution network to meet the demand of the unserved population.

C1.2.4 Plan for Sewerage Facility Improvement

In the provincial centers-Noro, Auki and Tulagi, there is no sewerage system in operation. Most of the people have a household septic tank. Since the sewage discharge volume is small, the environmental pollution from the sewage has not been found. Therefore, a plan for sewerage system improvement is not formulated in this study.

C2 AUKI

C2.1 Existing Conditions

C2.1.1 Natural Conditions

(1) Topography and Geology

Auki is located in hill-side of Tertiary limestone. This limestone is classified as Suaba chalk deposit of Maraita Group. Rock is compact and poor in porosity except where fractures are densely developed. There are many sinkholes in hills behind Auki town area. Groundwater comes out at the bottom of sinkholes. Group of sinkholes has formed special topography that can be called as cockpit karst.

(2) Climate

Annual average temperature of Auki is 26.6℃. Monthly average temperature is 27.1℃ in January and 25.8℃ in July, showing almost constant temperature throughout year. Annual precipitation of Auki is 3,271mm. Precipitation is 406mm in January and 212mm in July, showing much precipitation throughout a year.

C2.1.2 Socio-economic Conditions

Auki is located in the north-west of Malaita Island, Malaita Province. Population in Auki is 4,747 in 2005. Major industry in Auki is fishing and agriculture. There is no such a large factory as Soltai in Noro.

C2.1.3 Field Surveys

(1) Surface Water Survey

The results of the Surface water discharge measurement are shown in Table C2-1. **(Refer to Annex-12)**

- Discharge along the Kawaibala River except Kawaibala water resource of rainy season is larger than discharge of dry season.
- At survey point No.6, Kawaibala water resource, discharge of rainy season was less than dry season. This means that groundwater recharge by rain fall is not enough so as to raise the groundwater level and to increase base flow at beginning of the rainy season.

Table C2-1 Results of Surface Water Discharge Measurement in Auki

No	Survey Month	Name	Water flow (m^3/s)	Comment
No.1	June 2005	Lebagnali spring water	0.004	Spring water
No.2		Tributary of Lebagnali	0.039	Few spring points at tributary.
No.3		Main river of upstream of confluence	0.151	Discharge of the Kawaibala River before confluence
No.4		Middle reach	0.101	
No.5		Downstream	0.247	
No.6		Kawaibala water resources	0.180	No effluent from spillway
No.1	November 2005	Lebagnali spring water	0.009	Spring water
No.2		Tributary of Lebagnali	0.054	Few spring points at tributary.
No.3		Main river of upstream of Confluence	0.313	Discharge of the Kawaibala River before confluence
No.4		Middle reach	0.439	
No.5		Downstream	0.509	
No.6		Kawaibala water resources	0.006	No effluent from spillway
No.7		Bitakaula spring water	0.065	

Source : JICA Study Team

(2) Groundwater Survey

Promising water sources for water supply is groundwater from sinkholes and boreholes. Characteristics of sinkholes and boreholes for water sources in Auki are summarized in Table C2-2.

Table C2-2 Sinkholes and Boreholes in Auki

Type	Merit / Demerit for water sources	
Sinkhole	Merit	• Water can be easily taken from simple facility such as small weir. • Water from sinkholes can be distributed by gravity.
	Demerit	• Yield of spring in bottom of each sinkhole is usually small. • Long pipeline is necessary to deliver water from the sinkholes to Auki. • Water will be turbid by strong rainfall. • Sinkholes are located in customary land, and it will cause problems in water right.
Groundwater	Merit	• Limestone is distributed in Auki, and it is promising to drill boreholes within town area. Therefore, payment for water right is not necessary. • Drilling boreholes seems highly successful with expected yield of 800m^3/day per one borehole. • There may be no environmental problem by new groundwater development for SIWA Water supply.
	Demerit	• Auki is located in seaside, and over-pimping from boreholes will cause sea water intrusion into boreholes.

Source : JICA Study Team

(3) Water Quality Survey

1) Result of field water quality survey

Results of field water quality survey in Auki are shown in Table C2-3. **(Refer to Annex-13)**

Table C2-3 Results of Field Quality Survey in Auki

Survey Point	Survey Month	Water Temperature (℃)	EC (mS/m)	Turbidity (NTU)	pH	DO (mg/L)	COD (mg/L)
No.1	June 2005	24.6	40	14	7.6	6.6	-
No.2		25.3	20	14	7.8	6.6	-
No.3		24.6	40	14	7.6	7.8	-
No.4		27.1	38	14	7.9	3.8	-
No.5		24.7	60	10	7.7	4.6	-
No.6		26.2	-	11	8.0	1.7	-
No.7		28.6	-	14	8.0	2.3	-
No.8		-	-	-	-	-	-
No.1	August 2005	24.8	36	4	7.6	2.9	4
No.2		24.8	41	4	7.7	2.7	7
No.3		24.5	35	1	7.9	2.9	7
No.4		24.7	35	3	7.9	2.9	7
No.5		26.3	36	2	7.8	3.5	6
No.6		26.3	100	3	7.8	5.5	7
No.7		30.5	-	33	7.9	7.3	7
No.8		-	-	-	-	-	-
No.1	November 2005	24.8	34	6	7.8	5.7	6
No.2		25.0	37	6	7.3	7.4	7
No.3		25.6	37	3	8.3	5.4	7
No.4		25.7	32	7	8.0	7.4	7
No.5		25.8	32	7	8.0	5.6	6
No.6		27.0	-	5	7.9	5.3	7
No.7		30.7	-	1	7.5	6.4	3
No.8		26.6	35	7	7.1	6.3	7
No.9		26.6	42	5	7.3	6.7	6

Source : JICA Study Team

- According to DO values, Kawaibala River is contaminated in downstream area of the river.
- COD value at sea is not less than 2mg/L at each survey time. It shows that sea water is slightly contaminated.

2) Results of water quality analysis in Laboratory

Results of water quality analysis conducted by SIWA are as follows; **(Refer to Annex-14)**

Water Source:
The analysis results did not exceed WHO guideline value. Total Coliform Bacteria was detected at all spring and content of Total Coliform Bacteria ranged from 43 to more than 200MPN/mL.

Tap Water:
The analysis results did not exceed WHO guideline value. Total Coliform Bacteria was 0 MPN/mL.

3) Evaluation of Water Quality

- Total Coliform Bacteria was detected at all spring points. However, it was not detected from the tap water of SIWA office.
- Phenol was detected at Kawaibala spring and Bitakulala spring. Phenol dose not exist naturally and therefore it is considered that the contamination is caused by human activity.

(4) Socio-economic Survey

Major dwelling style in Auki is "rented" (77%) and the percentage of owner-occupied dwellings is very low (20%). The average household size is larger than the other provincial centers (6.7 persons). Major type of toilet is flush type which is the same as in Honiara and the other provincial centers. The number of paid workers per household is 1.3 persons. The average monthly income is SI$1,184.

Regarding water supply, combination of piped water and rain tanks is a major source of water supply. The ratio dependent on piped water for drinking use is very high (77% of drinking water). Major sewer system is septic tank. There is no sewer connection. Over 80% of the households have the experiences of disease caused by drinking water. All the respondents answered that water source should be conserved in order to avoid contamination of water.

Monthly water bill averages SI$20.61, 1.7% in Auki. Marginal willingness to pay for better water supply service (MWTP) is SI$13.70. Total WTP is SI$34.31, 2.9% of the average monthly income.

C2.1.4 Water Supply System

The served ratio is 58% in Auki. The per capita demand for domestic customers is 104LCD (including 40% leakage) and actual available water per person is only 63LCD. Rationing of water supply is being executed because the yield of water source is much short of the actual demand.

Therefore, development of new groundwater source will be required in the facility improvement plan for the year 2010. Basic data for water supply service for Auki in 2005 have been confirmed as follows;

Table C2-4 Basic Data for Water Supply Service for Auki in 2005

Code	Item	Unit	Data
A	Population in water distribution districts	--	4,747
B	Served population	--	2,700
C	Served ratio [(B/A) x 100]	%	58
D	Revenue water ratio	%	50
E	Non-revenue water ratio	%	50
F	Leakage ratio[estimated]	%	40
G	Effective water ratio [100－F]	%	60
H	Effective water ratio (distribution－leakage)	m^3/day	287
	- Domestic	m^3/day	172
	- Commercial	m^3/day	115
I	Per capita consumption for domestic customers	LCD	63
J	Per capita water demand for domestic customers	LCD	104
K	Maximum daily water demand	m^3/day	478

Source : JICA Study Team

C2.1.5 Sewerage Facility

Auki has a small reticulated sewer system, which is not in operation because the outlet pipe runs through customary land and no agreement has yet been reached with the owners of the land to operate the outlet pipeline. Each household uses a septic tank for treatment of its domestic wastewater.

C2.2 Mid-term Facility Improvement Plan

C2.2.1 Water Demand Projection

Water demand in 2010 for Auki is as shown below:

Table C2-5 Water Demand in 2010 for Auki

Code	Item	Unit	Data
A	Population in water distribution districts	--	5,450
B	Served population	--	3,663
C	Served ratio [(B/A) x 100]	%	67
D	Revenue water ratio	%	50
E	Non-revenue water ratio	%	50
F	Leakage ratio[estimated]	%	40
G	Effective water ratio [100－F]	%	60
H	Effective water ratio (distribution－leakage)	m^3/day	977
	- Domestic	m^3/day	586
	- Commercial	m^3/day	391
I	Per capita consumption for domestic customers	LCD	160
J	Per capita water demand for domestic customers	LCD	267
K	Maximum daily water demand	m^3/day	1,628

Source : JICA Study Team

C2.2.2 Optimum Water Source

(1) Selection of Water Sources

Both surface water and groundwater have enough potential for water demand in year of 2010. Development potential of water resources is summarized in Table C2-6.

Table C2-6 Water Demand in 2010 and Water Resources Development Potential for Auki

Water demand in year of 2010 (m^3/day)	Water to be newly developed*[1] (m^3/day)	Water development potential			
		Type of water source	Remaining potential*[2] (m^3/day)	Water quality	Land ownership
1,628	1,150	Surface-Water	3,369	Chlorination only	Customary land
		Ground-water	More than 1,200	Chlorination only	Town area

Note 1. Water to be newly developed = Water demand in 2010 – Current water extraction from existing sources(478)
2. Remaining potential＝Development potential－Current water extraction from existing sources

Source : JICA Study Team

Groundwater development is proposed for water supply to meet the water demand of year 2010 of Auki for the reasons below.

- Surface water potential is high but water source is far from Auki. Development of surface water

will cause problem in payment for water right and trouble in water intake.
- Groundwater can be developed within Auki town area, which will prevent problem above.
- Water sources development of 1,150m^3/day is necessary to meet water demand of year of 2010. This is small amount that can be obtained from just two boreholes.

(2) Groundwater Development Plan

Drilling Point

Drilling point is located in site of Low level tank of SIWA. Two boreholes are proposed near the tank. This site belongs to SIA, and behind the site there is small valley that is public area.

Specification of borehole

Specification of proposed borehole is as shown Table C2-7. Amount of new groundwater development is proposed 1,200m^3/day. Distance between the proposed boreholes and the shoreline is 600m. Yield of 1,200m^3/day will not cause sea water intrusion into aquifer.

Table C2-7 Specification of Proposed Bores in Auki

Depth	Diameter	Planned yield	Number of wells	Total yield	Distance between wells	Aquifer
100m	8 inch	600m^3/day	2	1,200m^3/day	100	Limestone

Source : JICA Study Team

C2.2.3 Plan for Water Supply System

In Auki, it was confirmed that the existing water source from Kwaibala spring will not be enough to serve for the water demand in the target year 2010. For water distribution facilities, they will have enough capacity in 2006 to serve for the water demand in 2010 owing to ongoing ADB project for upgrading water distribution facility such as water transmission mains, water reservoir, etc., and rehabilitation of water intake facility. As a facility improvement plan in the Study, it is proposed that two (2) new boreholes will be developed. Meanwhile, served ratio is still 58% in 2005. Therefore, SIWA is required to expand water distribution network to meet the demand of the unserved population.

C2.2.4 Cost Estimation

Water supply system improvement plan for Auki includes following components.

Water source development (two boreholes)

The cost for the water source development in Auki is estimated as follows.

Table C2-8 Cost Estimate for Water Supply Facility Improvement in Auki

Component	Quantity	Amount (US$)
Water source development in Auki		166,000/borehole
- Borehole drilling work	2 nos.	
- Procurement of submersible bore pump	3 units	
- Water conveyance pipeline (150mm PVC)	150m	
Total		332,000

Source : JICA Study Team

C2.2.5 Risk Analysis for the Project

Two (2) boreholes will be developed in Auki for the water demand of 2010. The borefield will be located inside the Power Station of SIEA Auki.

There will be two risks for implementing this project, that is, political risk and technical risk.

Political risk

The political risk is either that the land lease will not be permitted by SIEA or that it will be permitted but at an exorbitant lease price. However, since there is SIWA's water reservoirs and pump station located in the proposed site and size of the new borefield sites is small, the risk is assessed as low.

Technical risk

Impact on groundwater environment by new groundwater development will be negligible because of reason below.

- Amount of groundwater to be developed is only 1,200m^3/day. This is small amount compared with the total development potential of groundwater basin covering Auki.
- There is no groundwater use within Auki except for small pumping-up by SIWA. Therefore, there is no impact on groundwater use other than SIWA by new groundwater development.
- Site for borehole drilling is located at 600m from the shoreline. Pumping rate of about 1,200m^3/day will not cause sea-water intrusion into aquifer.

Sea-water intrusion is only risk in terms of groundwater environment. Regular monitoring of water quality (electric conductivity) of groundwater from boreholes should be conducted to evaluate effect of sea-water intrusion. If salinity of the groundwater increases, pumping-rate from the boreholes should be decreased.

C3 TULAGI

C3.1 Existing Conditions

C3.1.1 Natural Conditions

Tulagi Island extends NW-SW direction with 3.3km-length and 0.7km-width with area of 2.3 km^2. Drainage system is not developed because of too small drainage area. Most of the lands show hilly topography, which has gentle slopes with the top altitude of 31m. Tulagi is located in Tulagi Island, of which geology comprises Kombuana sandstone of Oligocene to Pliocene of the Tertiary.

C3.1.2 Socio-economic Conditions

Tulagi is located in Tulagi Island, Central Province. Population in Tulagi is 1,573 in 2005. Before World War II, Tulagi was capital of Solomon Islands. Soltai had a base for fishery before ethnic tension. Now it is moved to Noro. Major industry in Tulagi is fishing. There is no factory but a shipyard which is only one in Solomon Islands.

C3.1.3 Field Surveys

(1) Surface Water Survey

The results of the surface water flow discharge measurement are shown in Table C3-1. **(Refer to Annex-15)**

The results of water flow discharge measurement are summarized as below.

- In dry season, water discharge of resource is about 0.020m^3/s, which is said to originate in spring existed in upstream area.
- Water flow of the downstream river is only 0.005m^3/s, river width is about 1.8m, and maximum depth is 2cm. In rainy season, water discharge of resource is about 0.107m^3/s and 0.062m^3/s at downstream area.
- Each season, most of water flow is presumed to infiltrate into the ground between upstream

to downstream. Discharge of the dry season is less than that of the rainy season.

Table C3-1 Results of Surface Water Discharge Measurement in Tulagi

Measurement Point	Name	Water flow (m^3/s)	Survey Date	Comment
No.1	SIWA water resources	0.020	8 Jun. '05	Intake from river
No.2	Downstream of river	0.005		
No.1	SIWA water resources	0.107	6 Dec '05	Intake from river
No.2	Downstream of river	0.062		

Source : JICA Study Team

(2) Groundwater Survey

Tulaghi Island is small island surrounded by sea. Groundwater development will easily cause sea water intrusion. Aquifer of Tulaghi Island is being intruded by sea water all around the island because the island is very small. Groundwater development is impossible except for small development for domestic water supply. Groundwater development should be planned not in Tulaghi but in Nggela Sule Island.

(3) Water Quality Survey

1) Result of water quality survey

The results of the field water survey are shown in Table C3-2. **(Refer to Annex-16)**

Table C3-2 Results of Field Water Quality Survey in Tulagi

Survey Point	Survey Month	Water Temperature (℃)	EC (mS/m)	Turbidity (NTU)	pH	DO (mg/L)	COD (mg/L)
No.1	June 2005	25.4	18.	12	8.4	1.2	-
No.2		25.4	34	0	8.0	1.0	-
No.1	August 2005	25.5	21	11	8.1	-	-
No.2		25.7	28	11	7.3	-	-
No.1	December 2005	25.6	11	5	8.2	6.4	7
No.2		26.1	11	4	8.7	6.3	7

Source : JICA Study Team

The results of field water quality survey are summarized as below:

- The results do not have remarkable difference between at survey point No.1 and No.2, and the rainy season and dry season.
- According to DO value, the water quality in the dry season is more contaminated than the water quality in the rainy season.

2) Results of water quality analysis in Laboratory

Water Source:

Water analysis samples were collected from existing water source and existing borehole.

- Although, the Chromium analysis result of the existing water source sample exceeds the WHO guideline value, the results of the other items do not exceed the WHO guideline value.
- Total Coliform Bacteria is more than 200(MPN/mL) at Existing borehole (back ground of school).But this bore has not been used now.

Tap Water:

According to the water quality analysis that was done by SIWA from 1996 to 1999, Chromium content was detected. However, it does not exceed the WHO guideline value.

3) Evaluation of Water Quality

- Chromium analysis result of the existing water source sample exceeds the WHO guideline value. It is considered that this is caused by geological distribution of the upstream of the river.

(4) Socio-economic Survey

The average household size is 5.3 persons. Major type of toilet is flush same as in Honiara and the other provincial centers. The number of paid workers per household is 1.3 persons. The average monthly income is the lowest in the provincial centers (SI$1,025).

Regarding water supply, combination of piped water and rain tanks is major source of water supply. The ratio dependent on rainwater for drinking use is 50%. Major sewer system is septic tank. There is no sewer connection. 30% of the households have the experiences of disease caused by drinking water. All the respondents think that water source should be conserved in order to avoid contamination of water.

Monthly water bill averages SI$56.38, 5.5% in Tulagi. Marginal willingness to pay for better water supply service (MWTP) is SI$23.33. Total WTP is SI$79.71, 7.8% of average monthly income.

C3.1.4 Water Supply Facility

The served ratio is 68% in Tulagi. NRW is relatively high as 61%. The leakage ratio is expected as more than 50%. The yield of water source is enough for the actual demand in 2005. The problem other than the NRW problem in Tulagi water supply system is that there is no disinfection facility. Installation of the chlorination injection facility is urgently needed.

Basic data for water supply service for Tulagi in 2005 have been confirmed as follows:

Table C3-3 Basic Data for Water Supply Service for Tulagi in 2005

Code	Item	Unit	Data
A	Population in water distribution districts	--	1,573
B	Served population	--	1,064
C	Served ratio [(B/A) x 100]	%	68
D	Revenue water ratio	%	39
E	Non-revenue water ratio	%	61
F	Leakage ratio[estimated]	%	50
G	Effective water ratio [100－F]	%	50
H	Effective water ratio (distribution－leakage)	m^3/day	278
	- Domestic	m^3/day	167
	- Commercial	m^3/day	111
I	Per capita consumption for domestic customers	LCD	157
J	Per capita water demand for domestic customers	LCD	314
K	Maximum daily water demand	m^3/day	556

Source : JICA Study Team

C3.1.5 Sewerage Facility

Tulagi is served by septic tanks and no reticulated sewer system exists. There are no outstanding problems related to the sewage in Tulagi.

C3.2 Mid-term Facility Improvement Plan

C3.2.1 Water Demand Projection

Water demand in 2010 for Tulagi is as shown below:

Table C3-4 Water Demand in 2010 for Tulagi

Code	Item	Unit	Data
A	Population in water distribution districts	--	1,806
B	Served population	--	1,345
C	Served ratio [(B/A) x 100]	%	74
D	Revenue water ratio	%	39
E	Non-revenue water ratio	%	61
F	Leakage ratio[estimated]	%	50
G	Effective water ratio [100－F]	%	50
H	Effective water ratio (distribution－leakage)	m^3/day	352
	- Domestic	m^3/day	211
	- Commercial	m^3/day	141
I	Per capita consumption for domestic customers	LCD	157
J	Per capita water demand for domestic customers	LCD	314
K	Maximum daily water demand	m^3/day	704

Source : JICA Study Team

C3.2.2 Potential Projection of Water Sources Development and Optimum Water Source

The current water source of a river is enough for water demand of year of 2010. Therefore, new water source is not necessary so far. Water demand and water development potential is summarized in Table C3-5.

Table C3-5 Water Demand in 2010 and Water Resources Development Potential for Tulagi

Water demand in year of 2010 (m^3/day)	Water to be newly developed *1 (m^3/day)	Water development potential			
		Type of water source	Remaining potential*2 (m^3/day)	Water quality	Land ownership
704	148	Surface water	1,728	Chlorination only	Customary land
		Ground-water	Negligibly small	Chlorination only	-

Note 1. Water to be newly developed = Water demand in 2010 – Current extraction from water sources(556)
2. Remaining water development potential＝Development Potential－Current extraction from water sources

Source : JICA Study Team

C3.2.3 Policy for Water Supply Facility Improvement

In Tulagi, it was confirmed that the existing water source and water distribution facilities will be able to serve for the water demand in the target year 2010. Therefore, the facility improvement plan for the year 2010 in Tulagi is not prepared. However, leakage detection and the repair work will be required and since there is no chlorination disinfection facility in the water distribution system, installation plan for chlorination injection facility has been proposed as an urgent rehabilitation plan. Meanwhile, served ratio is still 68% in 2005. Therefore, SIWA is required to expand water distribution network to meet the demand of the unserved population.

C3.2.4 Plan for Sewerage Facility Improvement

There is no sewerage system in Tulagi. Most of the people have a household septic tank. Since the sewage discharge volume is small, the environmental pollution from the sewage has not been found.

Therefore, a plan for sewerage system improvement is not formulated in this study.

PART D CURRENT MANAGEMENT CONDITIONS OF SIWA

D1 Tariff Structure and Water Sales

D1.1 Current Tariff Structure

Based on the recommendation of the study financed by the European Commission in 2003, SIWA introduced a tariff adjustment which brought its water tariffs to less inadequate levels, by raising the commercial/government tariff from SI$3.00 to SI$5.60 and SI$6.16 per m^3 respectively and the tariff for domestic consumers to a uniform tariff of SI$1.00 per m^3 from SI$1.30 per m^3 for the first 30m^3 and SI$2.42 per m^3 for consumption thereafter. SIWA also charges half the water consumption charges for the sewerage service cost, as in Honiara. Some 1,000 households and commercial/institutional set-up are connected to the sewer network.

Table D1-1 Fees and Charges for Water Supply

(Unit: SI$)

Classification		Effective from 1995	Effective from July 2001	Present Rate (Effective from Oct. 2003)
Domestic (per 1m^3)	<=30 m^3 (life line)	0.65	1.30	1.00
	>30 m^3	1.30	1.30	2.42
Commercial	Per 1 m^3		3.00	5.60
Government	Per 1 m^3			6.16
Standing (or Fixed) Charge	Per Month	6.20		
Connection Fee (Service pipe length should be less than 10m, more than 10m to be assessed)	Domestic	350.00	400.00	
	Commercial		700.00	
Deposit (Refundable, Trust Account)	Domestic		60.00	500.00
	Commercial		300.00	1,000.00

Source: Sales and Customer Service Dept., SIWA

D1.2 Number of Customers and Collection Efficiency

The number of customers/users is around 6,800 on the basis of issued bills as of April 2005.

The amount of the average monthly revenue water was recorded at about 410,000m^3 for FY2005. Domestic and commercial sales accounted for 58% and 42% respectively.

Table D1-2 Operation Income for FY2003-FY2005

(Unit: SI$1000)

		FY2003		FY2004		FY2005	
	Income-Honiara (A+B)	14,853.7	93.5%	15,471.0	89.9%	19,367.4	91.7%
A	**Water Supply-Honiara**	14,062.7	88.5%	13,755.5	79.9%	17,406.4	82.4%
	Domestic Water	2,715.2	17.1%	2,167.5	12.6%	4,182.0	19.8%
	Commercial Water	10,694.5	67.3%	10,571.2	61.4%	11,206.0	53.1%
	Standing Charge	502.0	3.2%	514.7	3.0%	1,551.4	7.3%
	Other Income	151.0	1.0%	502.1	2.9%	467.0	2.2%
B	**Sewerage-Honiara**	791.0	5.0%	1,715.5	10.0%	1,961.0	9.3%
C	**Provinces**	1,034.5	6.5%	1,746.9	10.1%	1,753.0	8.3%
	Auki	8.6	0.1%	6.2	0.0%	145.0	0.7%
	Noro	820.0	5.2%	1,380.3	8.0%	1,137.0	5.4%
	Tulagi	205.9	1.3%	360.4	2.1%	471.0	2.2%
D	**Total Income(A+B+C)**	**15,888.2**	**100%**	**17,217.9**	**100%**	**21,120.4**	**100%**

Source : SIWA

D1.3 Special Circumstances

D1.3.1 Lease Agreements with Landowner

Currently about 50% of SIWA's water sources depend on Konglai Spring, where a lease agreement is concluded between the Department of Lands and the landowners. The Department is paying a few landowners 25% of the water sales revenue from Konglai Spring source, corresponding to the distributed amount per month at the Skyline tank, as calculated by SIWA.

For example, water distribution from Konglai Spring for April 2005 is estimated at 60,773 m^3 per month (the amount deducted 64,800m^3 distributed by Mataniko borefield from 125,573m^3). Consequently, total water sale from Konglai is estimated at SI$114,062 of which SI$26,515 (25%) is due to landowners.

D1.3.2 Small Revenue from Auki

Revenue from Auki is negligible, due to insufficient water distribution volume. Although a water supply facility rehabilitation project by the Asian Development Bank (ADB) in Auki is under construction to upgrade existing water distribution facilities, groundwater development to find a new water source is indispensable.

D1.4 Technical Assistance by Foreign Donors

D1.4.1 The World Bank

The World Bank carried out the technical assistances for power and water utilities restructuring, management and regulation at the request of the Solomon Islands Government (SIG).

The following paragraphs are extracted from "The Final Report: Implementation of Management Contract - the Solomon Islands Electricity Authority (SIEA) and the Solomon Islands Water Authority (SIWA)" prepared by the consultants in September 2005.

In February, 2005 the World Bank (WB) and the Solomon Islands Government (SIG) initiated a project to prepare a financial restructuring plan for SIEA and to formulate various private sector participation (PSP) options for the 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 the Solomon Islands Water Authority (SIWA), recommend a PSP option and develop an implementation plan for that option. the Consultant (PricewaterhouseCoopers in association with Allens Arthur Robinson) were engaged by the World Bank to carry out this project.

The Consultants recommended that a five year management contract be implemented for both SIEA and SIWA where the management contractor would be expected to initially run the two authorities separately during a transition period before they were legally merged into one authority. A management contract, if properly implemented, can prepare SIEA and SIWA for the future application of a fuller form of PSP (e.g. a concession in 5 years time).

The objectives of the management contract will be to establish an efficient and reliable operation and management of the electricity and water sectors in current service locations and to achieve full localisation of both authorities.

D1.4.2 Asian Development Bank

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).

The assistance 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.

D1.4.3 Coordination with Technical Assistances by Foreign Donors

Mutually integrated technical assistance has been implemented by the World Bank, ADB and JICA Study to improve the public sectors in the Solomon Islands.

Once this technical assistance ends, the management of SIWA is expected to be smoothly implemented by SIWA staff, from top management to employees, as an autonomous organization, focusing on securing its financial autonomy.

D2 Financial Situation

SIWA's Annual Budget is drafted by the end of the previous year. The draft budget is prepared by each department and provincial departments firstly, then internal adjustment is made by the top management staff (general manager, 3 division managers). Finally SIWA's board approves the budget. Daily expenses are also accounted for and controlled by the division level. The main reason is to facilitate control of every expense.

SIWA's financial performance from the FY2003 to FY2005 (estimated) is shown in Table D2-1.

Total income in FY2005 is expected to be some SI$21 million, which is an increase of 16% on the FY2004 figure of SI$17.2 million.

Total expenditure is expected to be SI$24.7 million, including capital costs (SI$7.9 million), in FY2005. Total income is more than recurrent expenses (SI$16.7 million). However, electricity arrears to be settled with SIEA are not included.

Recurrent expenses amount to some SI$10 million (excluding depreciation) in FY2004 and were estimated at some SI$16.7 million for the FY2005.

Operation cost is the cost of operating water supply and sewerage systems and accounts for some 46% of total expenses. The largest portion of operation cost is electricity charges, amounting to SI$3.1 million in FY2004 and SI$5.6 million in FY2005.

SIWA owed SIEA SI$17.885 million in arrears for electricity charge as of December 2004.

SIWA has reviewed the electricity bills issued by SIEA for the period FY1999 to FY2004 and prepared "Financial Proposals for the Electricity Arrears" on 29 April 2005. According to this proposal, SIWA concluded that it actually owes SIEA about SI$10.2 million, as of the end of December 2004, in arrears for electricity charges.

This gap between SIWA and SIEA will be arbitrated by their supervisory organization.

The Department of Lands has the responsibility to pay land rent for the sites of water sources, pipelines and water reservoirs, etc. However, SIWA also has responsibility to pay land rent for the lease of the Skyline tank, the borehole for the White River, and the pipeline for Tasahe and the provinces.

Table D2-1 SIWA Financial Data

(Unit: SI$1000)

		FY2003		FY2004		FY2005	
I	**Total Income**	**15,888.2**	**100%**	**17,217.9**	**100%**	**21,120.4**	**100%**
II	**Recurrent Expenses (1+2+3)**	**6,068.2**	100.0%	**10,014.0**	100.0%	**16,771.7**	100.0%
1	**Employee Costs**	2,544.6	41.9%	2,911.3	48.0%	3,024.1	49.8%
	Salaries & Wages	1,862.1	30.7%	2,039.2	20.4%	2,170.0	12.9%
	Allowances	547.9		684.2		624.0	
	NPF Contributions	113.2		157.9		197.2	
	Others	21.4		30.1		33.0	
2	**Administration Costs**	2,009.6	33.1%	2,590.8	25.9%	5,966.1	35.6%
	Board Members Allowances	139.4		133.6		140.0	
	Audit & Accounting Fees	64.3		10.7		265.0	
	Awareness & Public Relations	59.0		140.2		10.0	
	Education/Training	30.0		18.0		286.0	
	Accommodations & Housing	841.1	13.9%	1,039.4	10.4%	1,194.0	7.1%
	Computer & Office Equipment	164.4		640.5		1,229.0	
	Printing, Stationery & Postage	96.8		309.1		473.5	
	Telephone	88.3		133.6		152.8	
	Transport & Travel	115.7		128.7		474.2	
	Others	410.6		37.1		1,741.6	
3	**Operation Costs**	1,514.0	25.0%	4,511.8	45.1%	7,781.5	46.4%
	Electricity	671.6	11.1%	3,150.3	31.5%	5,649.5	33.7%
	Motor Vehicles & Machine Repairs	263.9		963.0		1,009.0	
	Fuel & Lubricants	295.6		276.5		572.0	
	Chemicals	34.2		42.1		225.0	
	Land Rental/Compensation	58.6		40.6		208.5	
	Others	190.1		39.4		117.5	
III	**Balance (I-II)**	**9,820.0**	**61.8%**	**7,203.9**	**41.8%**	**4,348.7**	**20.6%**
IV	**Capital Costs**	718.5	_	2,062.5	_	7,922.3	_
	System Maintenance	591.3		1,379.2		3,081.5	
	Project Works	0.1		492.9		4,670.0	
	Tools & Equipments	127.1		190.3		170.8	
V	**Balance before Grants Aid (III-IV)**	**9,101.5**	**57.3%**	**5,141.4**	**29.9%**	**-3,573.6**	**-16.9%**
VI	**Government/Grants Aid**			**1,795.4**		**8,852.9**	
VII	**Total Balance (V+VI)**	**9,101.5**	**57.3%**	**6,936.8**	**40.3%**	**5,279.4**	**25.0%**

Note 1. Values in FY2003 and Fy2004 are recalculated based on the data by the SIWA department and values in FY2005 are estimated by the Study Team based on the 2006 Annual Budget.

2. Percentages of balance mean percentage of total income and other percentages are based on recurrent expenses.

Source : SIWA

D3 Financial Forecast

D3.1 Preconditions

The assumption of income and expenses statement should take account of annual inflation. The domestic inflation rates considered for the financial projections are provided in the table below in this financial plan. All values (SI$) are indicated in the form of nominal values, rather than fixed prices.

Table D3-1 Domestic Annual Inflation Rates

Year	Annual % Change	Notes
1998	12.4%	(*1)
1999	8.0%	
2000	6.9%	
2001	7.6%	
2002	9.4%	
2003	10.1%	
2004	6.9%	
2005	6.6%	
2006	9%	(*2)
2007	8%	
2008	6%	
2009	6%	
2010	6%	

Source: 1. Annual Report 2004, Central Bank of Solomon Islands
2. "SIEA Financial Restructuring Plan" prepared by the World Bank.

D3.2 Income Forecast

Annual income will be estimated based on the projection of FY 2006, as estimated by SIWA. Monthly average revenue water is 410,000m^3, including provinces, and 375.000m^3 for Honiara, which accounts for 90% of the total revenue water of SIWA.

D3.3 Expenses Forecast

SIWA's expenses consist of recurrent expenses in the form of a routine budget and capital cost in the form of an infrastructure development budget.

i) Annual expenditure is estimated based on the FY2006 Approval Annual Budget of SIWA.

ii) Annual estimation shows a nominal price, including annual inflation.

D3.3.1 Costs

Costs consist of direct and indirect costs, including electricity debt payment to SIEA and depreciation cost.

(1) Employee Costs

Employee costs consist of salaries and wages, allowances, NPF contributions and others.

(2) Direct Costs

Direct costs for services of water supply and sewerage systems consist of employee costs, electricity costs, including debt payment to SIEA, depreciation costs and other recurrent costs for providing service. The direct costs are estimated based on the 2006 Annual Budget for the Office of Divisional Manager Engineering Services, Department of Planning & Design, Department of Water Supply, Department of Waste Water, Department of Environment, Department of Provincial Operations – Auki, Department of Provincial Operations – Tulagi, Department of Provincial Operations – Noro and Technical Services.

1) Electricity

Electricity cost is budgeted based on annual consumption plus debt repayment (SI$10.2 million) to SIEA for the period FY 2006 to FY2010.

Table D3-2 Estimated Electricity Cost (SI$1,000)

	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010
Electricity Bills *1	5,649.5	6,214.5	6,711.6	7,114.3	7,541.2	7,993.6
(Debt payment) *2		2,400.0	2,400.0	2,400.0	2,400.0	600.0
Annual SIWA Paid SIEA	5,649.5	8,614.5	9,111.6	9,514.3	9,941.2	8,593.6

Note 1:Electricity bills in FY2005-2006 are based on SIWA estimate and for FY2007-2010 are estimated by the Study Team.
Note 2: Debt payment schedule is based on the arrear installment proposal for SIEA prepared by SIWA.
Source: JICA Study Team

2) Depreciation

The SIWA accounting system does not take the depreciation cost into account. However, depreciation cost is essential for the survival of SIWA in terms of renovation or replacement of invested capital in future. Therefore, the following annual depreciation cost must take account of recurrent costs, according to the capital investment plan and based on Non-Current Assets of some SI$42.4 million at the end of 2003.

The depreciation period is divided into two categories, considering the lifespan as follows:

Table D3-3 Depreciation Period

Category	Capital Goods	Service Life	Average Life
System	Building, System, Plants, Equipments, Meters, etc.	15 – 30 years	25 years
Other	Computer, Motor Vehicles, Motors, etc.	5 – 10years	6 years

Note: Estimated by the Study Team.
Source: JICA Study Team

Table D3-4 Depreciation Cost

(Unit : SI$ 1,000)

	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010
Non-Current Assets	44,929.8	50,381.3	54,725.6	70,789.7	85,877.6	100,886.7
Depreciation	2,353.7	2,541.3	3,143.0	3,346.9	4,277.0	5,105.9

Note: Values in Non-Current Assets are estimated based on SIWA data of SI$42,397,123 in FY2003
Source: JICA Study Team

3) Other

Other costs consist of operation costs, such as fuels & lubricants, motor vehicle repair & service, and maintenance costs based on the FY2006 Annual Budget.

(3) Indirect Costs

Indirect costs are estimated on the basis of the FY2006 Annual Budget, with annual inflation taken into account.

Indirect costs consist of recurrent costs for a) sales division such as the Office of the Divisional Manager Finance & Sales, Department of Sales and Customer Services, Department of Financial Management, Department of Internal Audit, and b) administration division such as the Board of Directors, Office of General Manager, Office of Divisional Manager Support Services, Department of Human Resources Development, Department of Administration and Department of Management Information Systems.

D3.3.2 Capital Costs

Capital costs mainly consist of system maintenance, project work and tools & equipment cost. It also includes vehicles and computers as other items. Annual capital costs are estimated in Table D3-5.

Table D3-5 Capital Costs

(Unit : SI$ 1,000)

		FY2005	FY2006	FY2007	FY2008	FY2009	FY2010
Capital Costs	System	1,056.7	4,480.0	4,581.4	16,338.8	16,572.0	16,423.6
	Other	1,077.7	1,159.0	704.0	854.0	384.0	344.0
	Total	2,134.4	5,639.0	5,285.4	17,192.8	16,956.0	16,767.6

Note: Estimated by the Study Team.
Source : JICA Study Team

D3.4 Financial Forecasts and Counter Measures

D3.4.1 Financial Forecasts

According to the above assumptions, a trial calculation for profit and loss statement is made. The Estimated Profit & Loss Statement -A (refer to Table D3-6, Revenue assumption based on the FY2006 Annual Budget) shows deficits (negative profits) arising from FY2007. With this in mind, SIWA must either increase the revenue or reduce costs. If SIWA is unable to reduce costs, revenue should be increased from FY2007.

When it is assumed that revenue for FY2007 will be increased by 20% over the FY2006 level, SIWA will be sustainable up to FY2008. In FY2009, costs will be nearly equal to income, as shown in the Estimated Profit & Loss Statement - B (refer to Table D3-7, Revenue assumption, where FY2007 increased by 20% over FY2006). However, in FY2010, it will be difficult for SIWA to cover all costs, including depreciation.

Therefore, an applicable water tariff is needed for the period FY2007 to FY2009 for full cost recovery. If SIWA boosted revenue by 20% for the period FY2007 to FY2009, it would be financially viable according to the Estimated Profit & Loss Statement -C (refer to Table D3-8, Revenue assumption in the FY2007 and FY2010 increased by 20% over levels for FY2006 and FY2009 respectively). Accordingly, the water tariff must change by FY 2010.

Table D3-6 Estimated Profit & Loss Statement -A

(Unit : SI$ 1,000)

		FY2005	FY2006	FY2007	FY2008	FY2009	FY2010
A	Income						
	Water fees & Charges	18,635.7	21,950.0	21,950.0	21,950.0	21,950.0	21,950.0
	Wastewater fees & Charges	1,802.2	2,020.0	2,020.0	2,020.0	2,020.0	2,020.0
	Other Income	682.5	685.0	685.0	685.0	685.0	685.0
	Total	21,120.4	24,655.0	24,655.0	24,655.0	24,655.0	24,655.0
B	Direct Costs						
	Employee Costs	1,694.7	1,872.2	2,022.0	2,143.3	2,271.9	2,408.2
	Electricity (Billed)	5,649.5	6,214.5	6,711.6	7,114.3	7,541.2	7,993.6
	Electricity Debts	0.0	2,400.0	2,400.0	2,400.0	2,400.0	600.0
	Depreciation	2,353.7	2,541.3	3,143.0	3,346.9	4,277.0	5,105.9
	Other	2,896.1	3,368.7	3,638.2	3,856.5	4,087.9	4,333.1
	Total Direct Costs	12,594.0	16,396.6	17,914.7	18,860.9	20,577.9	20,440.8
C	Balance (A-B)	8,526.4	8,258.4	6,740.3	5,794.1	4,077.1	4,214.2
D	Indirect Costs						
	Employee Costs	695.4	916.4	989.8	1,049.1	1,112.1	1,178.8
	Other	764.2	1,490.1	1,609.3	1,705.9	1,808.2	1,916.7
	Sub Total (Sales)	1,459.6	2,406.5	2,599.1	2,755.0	2,920.3	3,095.5
	Employee Costs	634.0	1,241.8	1,341.2	1,421.6	1,506.9	1,597.3
	Other	2,084.1	4,536.2	4,899.1	5,193.0	5,504.6	5,834.9
	Sub Total (Administration)	2,718.1	5,778.0	6,240.2	6,614.7	7,011.5	7,432.2
	Total Indirect Costs	4,177.7	8,184.6	8,839.3	9,369.7	9,931.9	10,527.8
E	Total Costs (B+D)	16,771.7	24,581.1	26,754.0	28,230.6	30,509.7	30,968.6
F	Net Profits/Deficits (A-E)	4,348.7	73.9	-2,099.0	-3,575.6	-5,854.7	-6,313.6

Note: 1. It is assumed that revenues and cost based on the 2006 Annual Budget.
2. Values in FY2006 are based on the 2006 Annual Budget and Values in FY2007-2010 are estimated by the Study Team.
Source : JICA Study Team

Table D3-7 Estimated Profit & Loss Statement -B

(Unit : SI$ 1,000)

	Item	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010
A	Income						
	Water fees & Charges	18,635.7	21,950.0	26,340.0	26,340.0	26,340.0	26,340.0
	Wastewater fees & Charges	1,802.2	2,020.0	2,424.0	2,424.0	2,424.0	2,424.0
	Other Income	682.5	685.0	822.0	822.0	822.0	822.0
	Total	21,120.4	24,655.0	29,586.0	29,586.0	29,586.0	29,586.0
B	Costs (Direct and Indirect)						
	Employee Costs	3,024.1	4,030.4	4,352.9	4,614.0	4,890.9	5,184.3
	Electricity	5,649.5	8,614.5	9,111.6	9,514.3	9,941.2	8,593.6
	Depreciation	2,353.7	2,541.3	3,143.0	3,346.9	4,277.0	5,105.9
	Other	5,744.4	9,395.0	10,146.6	10,755.4	11,400.7	12,084.8
	Total	16,771.7	24,581.1	26,754.0	28,230.6	30,509.7	30,968.6
C	Net Profits/Deficits (A-B)	4,348.7	73.9	2,832.0	1,355.4	-923.7	-1,382.6

Note: 1. It is assumed that revenues from FY2007 to 2010 are increased by 20% of 2006 revenus.
2. Values in FY2006 are based on the 2006 Annual Budget and Values in FY2007-2010 are estimated by the Study Team..

Source : JICA Study Team

Table D3-8 Estimated Profit & Loss Statement -C

(Unit : SI$ 1,000)

	Item	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010
A	Income						
	Water fees & Charges	18,635.7	21,950.0	26,340.0	26,340.0	26,340.0	31,608.0
	Wastewater fees & Charges	1,802.2	2,020.0	2,424.0	2,424.0	2,424.0	2,908.8
	Other Income	682.5	685.0	822.0	822.0	822.0	986.4
	Total	21,120.4	24,655.0	29,586.0	29,586.0	29,586.0	35,503.2
B	Costs (Direct and Indirect)						
	Employee Costs	3,024.1	4,030.4	4,352.9	4,614.0	4,890.9	5,184.3
	Electricity	5,649.5	8,614.5	9,111.6	9,514.3	9,941.2	8,593.6
	Depreciation	2,353.7	2,541.3	3,143.0	3,346.9	4,277.0	5,105.9
	Other	5,744.4	9,395.0	10,146.6	10,755.4	11,400.7	12,084.8
	Total	16,771.7	24,581.1	26,754.0	28,230.6	30,509.7	30,968.6
C	Net Profits/Deficits (A-B)	4,348.7	73.9	2,832.0	1,355.4	-923.7	4,534.6

Note: 1. It is assumed that revenues from FY2007 to 2009 are increased by 20% of FY2006 revenue and revenue of FY2009 is increased by 20% of 2009 revenue.
2.Values in FY2006 are based on the 2006 Annual Budget and Values in FY2007-2010 are estimated by the Study Team.

Source : JICA Study Team

D3.4.2 Consideration for Water Rate Revision

Based on the above forecasts, SIWA must revise its water rates to increase income. Before the introduction of a new tariff structure, the following items should be carefully reviewed by SIWA:

1) To review the possibility of a reduction in recurrent expenses from FY2007 in particular and to avoid a financial burden on users.
2) To consider the ability to pay of low-income groups for tariff revision, based on socio-economic survey results such as Ability to Pay and Willingness to Pay by low-income groups.
3) It is preferable to introduce a block-based commodity charge method for water consumption restraint type. To study countermeasures for different metering devices to come up with a new tariff calculation.
4) To study a change of tariff structure at 2 year intervals when significant changes take place at 3 year intervals.
5) To study special water rates to be applicable for foreign or high income residents, if they can be identified.
6) To consider water rates for large demand users in addition to socio-economic survey results, because they are important customers for SIWA. Relatively high rates are already adopted for commercial and government institutions from the viewpoint of an income ratio of some 70%, even though their water distribution ratio received only amounts to some 40% of total water supply.

7) To review options as case studies for new rates to cover the expenditure forecast in FY2009. These options are made for Honiara, which accounted for 90% of total income based on the FY2005 performance record (refer to Part G2.2 for the Action plan).

D4 SIWA Organizational Structure and Business Strategy

SIWA Mandate, Departmental Purpose & Description and Strategic Directions are drafted as follows:

SIWA is mandated to deliver and levy charges for urban water industry services & products within its declared area of operations in a sustainable and environmentally responsible manner, consistent with government policies on good governance, transparency and accountability, while observing the cultural and social values of the Solomon Islands.

The board of directors consists of the 7 members mentioned below and board meetings are held regularly on a quarterly basis.

SIWA is mainly divided into 4 departments, namely i) Executive Management, ii) Engineering Services, iii) Support Services and iv) Financial and Sales under the Board of Directors.

SIWA is planning to increase the number of staff to 88 from the current workforce of 76.

The business strategy of SIWA is as follows:

- Develop a competitive advantage by attracting, developing and maintaining a competent workforce.
- Achieve customer satisfaction by developing and managing urban water industry infrastructure to international best practices standard throughout the Solomon Islands.
- A move to a highly efficient and effective regulated national urban water industry.
- Adherence to strong corporate governance and sound commercial principles & practices

D5 Current Problems Facing SIWA

The following problems are identified through the Study and necessary activities to be taken by SIWA for management improvement are mentioned in the Action Plan of "PART G".

D5.1 Tariff Collection

(1) Collection Efficiency

SIWA identified a lack of full tariff collection as a problem because some people do not pay for water bills. SIWA will act to disconnect their meters and take legal action. SIWA will ensure they collect a deposit when applications are received to ensure that all arrears are paid.

(2) Bill Posting to Customers

It is noted that approximately 2,000 water bills had not been delivered to customers, since customers had no postal boxes and their water bills were always delayed. Further arrangement to address this problem will be dealt with by SIWA and the Post Office management, respectively. SIWA decided to increase the delivery of water bills by hand as far as possible.

(3) Change of Names/Addresses of Customers

SIWA found that customers sometimes move to new location from their usual place without settling their water bills. When doing so, they also either change their name/s or address/es so that it is difficult for SIWA to deliver their water bills to their new locations. To solve this problem, SIWA decided that landowners will be responsible for the payment of water bills of their occupants or tenants.

(4) Mix of Gallon Meters and Metric Meters

There are two types of meters used by SIWA. One is the imperial (Gallon unit) and the other is the metric type. Sometimes bill amounts are calculated inappropriately due to miscalculation during conversion. On a monthly basis, the number of claims from customers amounted to about 500, including those made to the telephone enquiry number on bills. SIWA will change all the old meters (imperial) to metric ones and considers that all meter readers should periodically receive proper training.

(5) Tariff Collection from Shared Standing Pipe User's

Some communities use one water tap as shared standing pipes and payment for the bill can not be coordinated by the users of the group. In many cases, their bill payments are not made properly. SIWA will give some incentives to community leaders who will act as SIWA agents to collect tariff from their community's members.

D5.2 Income Sources

(1) Water Sales Arrears

The customers owed SIWA around SI$ 12.4 million (active debtors) as of the end of 2005. Although the arrears of the government are gradually being recovered and are declining, the problem of college's arrears remains unsolved. SIWA will take legal means to ensure that creditors, including the government, make payments in full.

(2) Water Tariff

All expenses such as salary, electricity, fuel, etc. in SIWA's account have been increased day by day due to inflation, while the present water tariff rate has been fixed since December 2003. The current tariff rate does not reflect the cost in tariff to services and recovering costs. Currently, Honiara subsidizes the water production cost in the provinces. SIWA is considering how to justify a reasonable tariff rate, for which there would be 3 categories.

(3) Low Pressure and Unserved Area

As described in B1.4 "Water Supply System", the Study has confirmed that about 25% of the served population in Honiara suffer from low pressure there. In order to overcome the above mentioned problems, SIWA is planning to improve the existing system to consumers demand, based on the results of this Study. SIWA will supply water to meet consumers' demands and needs in the low pressure areas. SIWA is also planning to provide a water tanker to deliver water to consumers in unserved or low pressure areas.

(4) Sludge Disposal Services

There are 3 commercial vacuum trucks owned by the Honiara City Council and a commercial company. However, these services are not considered free from pollution. Sludge collected from the septic tanks is drained into SIWA's sewer manholes along the seashore or dumped untreated at the final disposal site.

Since sewage treatment service is one of the SIWA mandates for environmental protection, SIWA intends to take the responsibility for the maintenance service of septic tanks.

D5.3 Operation and Maintenance (O/M) Cost

(1) Electricity

The remarkable item of operation costs is electricity. How to reduce electricity cost is a big issue for SIWA. SIWA owed SIEA some SI$17million in arrears on electricity bills since 1999 to the end of FY2004. SIWA submitted SIEA a reconciliation proposal for the electricity arrears of SI$10.2 million

in April 2005. However, negotiation for reconciliation between two parties had yet been held as of the end of 2005.

(2) Housing Allowance

SIWA is spending lots of money on renting accommodation for its employees according to a housing free policy. In addition, SIWA needs to repair the rented houses. SIWA is considering alternative possibilities to solve this issue and has already acquired land for housing estates in Honiara and the provinces.

(3) Non Revenue Water (NRW)

According to the leakage survey under this Study, NRW (real loss plus administration loss) was revealed to be 43%. Water losses are mostly considered to be due to leakage on water distribution facilities used beyond their service lifespan and due to poor workmanship of construction. SIWA usually executes repairs on the damaged parts only when leakage has occurred.

(4) Land Lease

Land lease fees for the sites of boreholes, pipelines, water tanks, etc. should be borne by SIWA. In the case of Mataniko, SIWA and owners have mutually agreed upon an annual fee since 1988. However, land lease fees in Noro and Tulagi remain under negotiation.

D5.4 Organization and Human Resources

(1) Staffing

SIWA currently has 76 staff and is planning to employ more than 10 persons to strengthen the organizational functions by securing workers to repair the aged infrastructure. SIWA is planning to renovate the existing headquarters to a two-story building in order to cater for space to accommodate the new development within the organization. SIWA is also concerned about insufficient staff in the provinces, e.g. only two staff members in Auki.

(2) Assets Management and Inventory Control

SIWA has lots of materials and parts in its store to make repairs to the water supply system. However, the inventory control system from purchasing materials and parts to their delivery for repair at customer request is not well established. SIWA is planning for a store expert to be developed and countermeasures to be introduced.

(3) Accounting System

SIWA's accounting system does not accord with the international accounting system. The present accounting staff are incapable of preparing Balance Sheets (B/S) and Profit and Loss Statements (P/L). B/S and P/L for 1996 were drafted by the accounting office in Solomon and authorized by SIG in 2005. B/S and P/L for the period 1997 to 2005 have not yet been authorized. However, SIWA is planning to recruit a highly educated accountant who is able to produce B/S and P/L.

(4) Geographical Information System (GIS)

The existing data and information concerning the water supply system has not been updated properly in the GIS system introduced in SIWA, due to a lack of manpower of GIS engineers. This sometimes causes trouble in terms of repair and maintenance work at site because the existing conditions at the site differ from the existing data and information. SIWA is planning to use GIS more effectively by the engineers.

(5) Efficient Operation System for Water Supply Facilities

The electricity cost is a burden on overall SIWA operation costs. In order to reduce the cost of electricity through an efficient operation system for water supply facilities. SIWA is planning to introduce a SCADA system for intensively controlling the whole of SIWA's facilities at the SIWA headquarters.

(6) Water Quality Analysis

SIWA is only capable of performing water analysis for typical items defined in WHO guidelines because of a lack of testing equipment and staff. SIWA needs to acquire laboratory equipment to enhance capacity building for water quality analysis and also laboratory staff to enhance its quality services.

(7) Information Technology (IT)

An IT system (Linux) is installed in the Honiara headquarters but not yet in the provinces. Therefore, SIWA needs to install the latest software for the headquarters and IT hardware for the provincial offices to achieve efficient service.

(8) Workshop for Maintenance

There is no workshop building for the maintenance of vehicles and machinery in and around the premises of SIWA headquarters. Mechanical technicians are forced to perform repair works outside, where they are affected by the severe natural circumstances. The Study Team prepared a plan of workshop building for repair work.

PART E PLAN FOR NEW BUILDINGS FOR INSTITUTIONAL STRENGTHENING OF SIWA

E1 Current Situation and Problems for Office Environment of SIWA

Head office of SIWA is located in Honiara and the premises of SIWA's head office comprise of main office building, customer service building, meeting house, store house and security post.

Current problems facing SIWA are described as follows.

- Existing main office building is full up to capacity and it is difficult to make a proper room allocation to the staff.
- SIWA is planning to recruit around 10 new staff in the near future. However, insufficient capacity of main office building is now an obstacle to the recruiting plan of SIWA.
- Staff rooms for accountant department and the related departments are allocated separately so that their work can not be done efficiently.
- Since water quality laboratory is located in the main office building, it should be relocated in a separate building because the dangerous chemicals are handled there.
- Main store house is located across the road along SIWA's head office premises. Therefore, it is difficult for SIWA to do its maintenance properly. SIWA has a small store house made of container within the head office premises. However, it does not have enough space to contain important items with frequent use. Repair of vehicles and equipment is executed outside, which is easily affected by the weather.
- The elevation of the premises is lower than that of the road nearby and therefore the main office building is likely to be flooded by a heavy rain.
- There are 36 technicians and field workers mainly working outside who have no indoor space to take a rest.

E2 Overall Plan for New Buildings

In order to solve the above-mentioned problems, SIWA is desirous of making a construction plan for new buildings. It is considered that the construction of new buildings is important for organization and staff reinforcement. Therefore, in this Study, the construction plan for new buildings has been proposed in consideration of the following points. **(Refer to Annex-17)**

Table E2-1 Points to be Considered in Construction Plan of New Buildings

Building	Points to be Considered
Main Office Building	・ Functions of existing customer service building and conference building shall be included in new main office building so that services to the customers can be improved. ・ Space for all the permanent staff shall be secured and each room shall be arranged in the new main office building so that the staff can work efficiently.
Workshop Building	・ Water quality laboratory shall be relocated from the current main office building to this building. ・ Space for a store of important items with frequent use and maintenance area of vehicles and equipment shall be secured. ・ Space for all the field workers shall be secured so that they can use it for their doing desk work and taking a rest.
Security Post	・ Security Post shall be located at the west end and at the new entrance of SIWA's premises.
Landscaping	・ Fences shall be installed along the boundary of the premises. ・ The elevation of the land of the current premises shall be raised by 40cm in average so that the rain water does not flow into the buildings. ・ Space for vehicles for SIWA staff, customers and maintenance work shall be secured.

Source: JICA Study Team

E3 Cost Estimation

The construction cost for new buildings was estimated as shown in Table E3-1.

Table E3-1 Cost Estimation for New Buildings of SIWA

Building Name	Floor Area (m^2)	Unit Price (SI$/$m^2$)	Cost (SI$)	Remarks
Main Office Building	1,224	5,000	6,120,000	Structural Steel
Workshop Building	648	4,000	2,592,000	Structural Steel
Security Post	35	2,000	875,000	Wooden Frame
Related Works	--	--	3,155,000	
Total			12,742,000	

Note : Related works include site reclamation work, fencing/gate installation work, and demolishing of the existing buildings of SIWA.

Source: JICA Study Team

PART F PILOT PROJECTS OF THE STUDY

F1 Contents of Pilot Projects

F1.1 Policy for Selecting Pilot Projects

Pilot projects shall be selected in accordance with the following policy;

- Pilot project will lead to capacity building of management and financial aspect of SIWA.
- Pilot project will lead to strengthening the relation between SIWA and residents.
- Outcomes of the pilot project will be utilized for the action plan.

F1.2 Analysis of Current Issues for SIWA and Selection of Pilot Projects

The current problems which SIWA is faced with have been sorted out by the internal workshops by SIWA and results of several discussions with SIWA about the current issues to be solved.

Pilot projects have been selected using four (4) criteria as follows;

- Criterion-1 : Impact on SIWA's capacity building
- Criterion-2 : Period for implementation
- Criterion-3 : Effect after implementation
- Criterion-4 : Utilization of outputs in action plan

Finally, after consultation with the stakeholders in the workshop held in 8th of August 2005, following four (4) pilot projects were selected;

PP-1 : Formulation of Tariff Collection Improvement Method
PP-2 : Establishment of Leakage Reduction Indicator
PP-3 : Water Conservation Campaign
PP-4 : Installation of Shared Standing Pipe

F1.3 Outline of Pilot Projects

Outline of pilot projects is shown in Table F1-1.

Table F1-1 Outline of Pilot Projects

No.	Pilot Project	Goal	Purpose	Target Group	Outputs	Inputs (Activities)
PP-1	**Formulation of tariff collection improvement method**	Financial situation of SIWA is improved.	Improvement plan for tariff collection ratio by SIWA is formulated.	SIWA Staff	• Practical method for collection efficiency is formulated. • Tariff collection improvement method is acquired by SIWA staff.	• Hold workshops for tariff collection improvement. • Analyze current problems including SIWA collection system • Find out countermeasures for tariff collection efficiency including staff training, billing and collection system, etc.
PP-2	**Establishment of leakage reduction indicator**	Effective leakage reduction plan can be formulated by SIWA	Leakage reduction indicator through the replacement of pipelines with large leakage is established.	SIWA Staff	• Leakage volume for each material type and diameter per km is obtained. • Leakage survey technique is transferred to SIWA staff.	• Execute leakage survey before replacement of pipelines. • Conduct replacement of pipes for the section with much leakage. • Execute leakage survey after replacement of pipelines. • Calculate the parameters related to leakage reduction for each pipe diameter and piping material.
PP-3	**Water conservation campaign**	Water supply volume to be developed by SIWA can be reduced.	Water conservation is enhanced in the sample users.	SIWA Customers	• Public awareness of water conservation is raised. • Leakage in the sampled customers' houses is decreased.	• Carry out awareness survey. • Prepare and issue PR materials • Hold community workshops on water conservation • Carry out awareness survey on water conservation at the end of pilot project. • Check leakage from sample users' taps, toilets and showers before replacement of equipment. • Procure materials for leakage repair. • Read meters of sample users before replacement of equipment • Replace equipment • Measure sampled customers' meters after replacement of equipment
PP-4	**Installation of shared standing pipe**	Living condition of model communities is improved.	Water supply of model areas is improved.	Low Income Households	• Shared standing pipe is installed in the area. • Operation and management of shared standing pipe is done by the community members. • Cost sharing system for construction of shared standing pipe is proposed.	• Select installation sites (3 sites) • Procure materials for shared standing pipes • Install the equipment. • Appoint the leader of standing pipe management in the area. • Establish management system of shared standing pipe. • Conduct questionnaire survey on living condition and household expenses before and after the project.

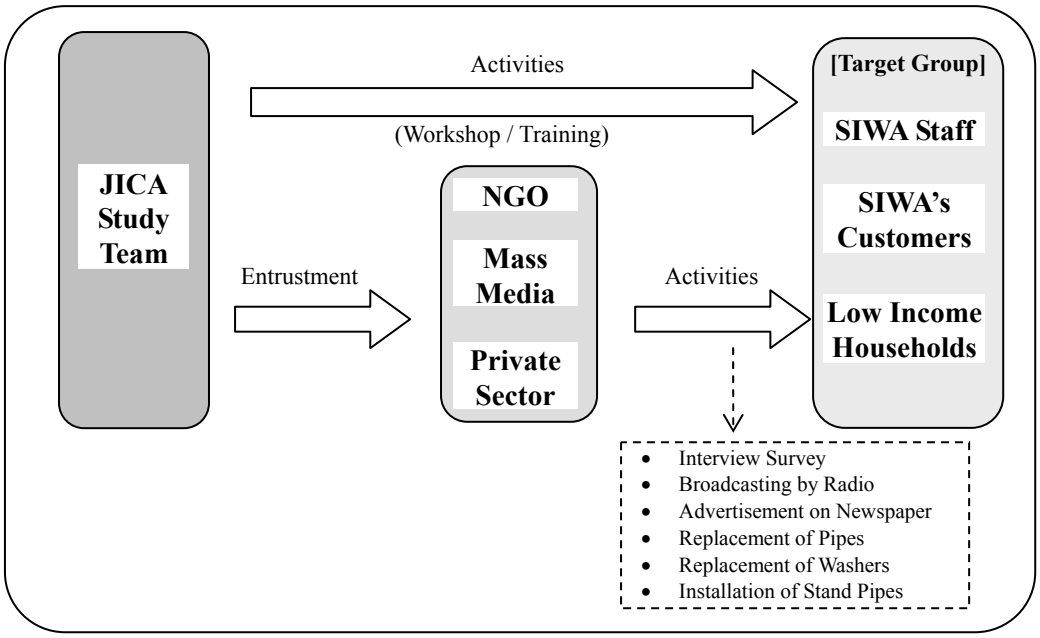
Source: JICA Study Team

F1.4 Implementation Framework of Pilot Project

Pilot projects have been implemented for getting data for formulation of the action plan on capacity development of SIWA by means of;

- Training SIWA staff for the improvement method for water tariff collection
- Training SIWA staff for leakage detection and reduction technique
- Training SIWA staff for enhancing awareness of water conservation to the residents and,
- Training SIWA staff for developing a method for expansion of water supply to the unserved population mainly in the low income area

The pilot projects were implemented by JICA Study Team in cooperation with SIWA counterpart staff and by the assistance of NGOs, mass media and private sectors. Implementation frame of the pilot projects are as shown in Figure F1-1.



Source: JICA Study Team

Figure F1-1 Implementation Framework of Pilot Projects

F2 Results of Pilot Projects (PP)

F2.1 PP-1 : Formulation of Tariff Collection Improvement Method

In order to strengthen SIWA management system, two (2) workshops with SIWA staff were held on 16th and 23rd of November 2005 for examining a method for revenue improvement of SIWA by means of project cycle management (PCM) method.

The targets of the workshop were as follows;
1. Increasing water sales income (tariff collection ratio)
2. Improving financial situation of SIWA

The workshops were held to discuss current problems (direct causes) on tariff collection system by means of problem analysis and find out solution of each problem through objective analysis taking into account their realization in terms of expectation.

Attendants were 13 staff of SIWA from Support Services Division, Finance & Sales Division and

Engineering Services Division including general manager.

After the discussions in the workshops, following problems were identified and their solutions were reflected in the action plan;

(1) Low water rates for domestic customers
(2) Affordability of low-income group
(3) Water sales arrears
(4) Change of names/addresses of customers
(5) Bill posting method
(6) Customers' negligence
(7) Customers' satisfaction
(8) Mix of metric meters and gallon meters
(9) Lack of logistic support

In order to discuss how to improve revenue SIWA, the workshops were held twice in November 2005. Through these workshops, top management and senior staff of SIWA had discussions on the current problems on tariff collection system and solution of the problems. Lesson learnt from the workshop is described as follows;

Purpose of workshop is to find out the current problem on tariff collection system and how to increase collection efficiency from the present tariff collection achievement. However, it is very difficult for them to fix future collection ratio because they are familiar with water sales value (Billed Amount) on a monthly basis. There would be two major reasons mentioned below.

1) One of the absolute measures is to disconnect meters of the customers that do not pay water charge. On the other hand, this countermeasure is against SIWA's slogan of "Water is life" and it will reduce number of customers. Therefore, SIWA is in a dilemma whether to implement disconnection of meters or to allow payment arrear which causes huge amount of debts for SIWA.
2) Although they understand collection efficiency is the most important matter in view of SIWA management, it is difficult for them to assume future collection ratio because there is no achievement records due to the ethnic tension.

F2.2 PP-2 : Establishment of Leakage Reduction Indicator

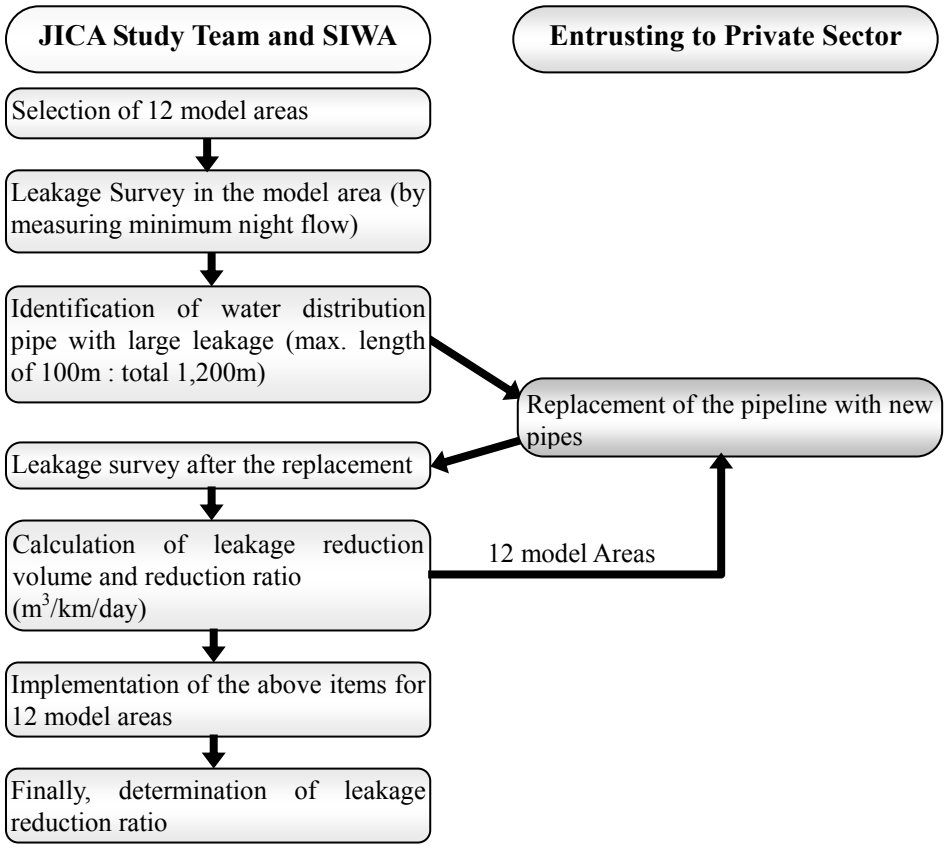
According to the leakage survey conducted in Phase-1 of the Study, the leakage (or real loss) ratio of Honiara was found as 40% and non revenue water consisting of leakage, apparent loss and unbilled authorized consumption was 43%. This means that SIWA is distributing much water without revenue so that revenue water ratio is as low as 57% in 2005. Therefore, reduction of leakage is considered as one of the biggest issues for the management of SIWA.

Purpose of this pilot project is to establish leakage reduction indicator which will be utilized for implementation of the efficient leakage reduction program by SIWA. The pilot project is mainly divided into two activities as follows;

- Minimum night flow (or leakage) survey by JICA Study Team and SIWA counterpart.
- Pipe replacement work done by the private sector entrusted by the Study Team.

The pilot project (PP-2) was implemented from the end of November 2005 to the middle of March 2006. Process and activities of PP-2 is as explained in Figure F2-1.

Locations of 12 model areas have been selected in such a manner that the selected areas represent the whole Honiara.



Source: JICA Study Team

Figure F2-1 Process of the Activities for PP-2

In order to grasp the leakage reduction volume, the minimum night flow before pipe replacement was measured. Then, the pipeline with large leakage was replaced with new pipes. After that, the minimum night flow was measured again.

From the survey in this pilot project, 300m^3/km/day was obtained as the leakage reduction indicator.

The Solomon Islands has a dry season and rainy season. Implementation period of this pilot project fell in the rainy season. Therefore, the progress of pipe replacement work and minimum flow measurement were much affected by the weather.

During the detection work of the existing pipelines with large leakage to be replaced, it was found that the existing GIS drawings of SIWA do not show the pipe location exactly and some of the pipelines are buried just under the ordinary houses or opposite side of the indicated route. This means that the maintenance of the pipelines is difficult for SIWA.

In this pilot project, the existing pipelines with the diameters of 50, 75, 100 and 150mm and service life of more than 30 years were selected. Among these diameters, leakage amount of 50 and 75mm pipeline, the length of which accounts for one-third of the existing pipelines, was judged relatively bigger than 100 and 150mm.

By the implementation of this pilot project, following lessons have been learnt;

- Pipe replacement for leakage reduction should be executed intensively during dry season.
- SIWA has to update the GIS data for the location of water supply facilities such as pipelines, valves, etc. so that the pipe replacement work can be executed smoothly and effectively.
- Leakage reduction work has to be concentrated on the pipelines of 50mm and 75mm at the early stage to gain much leakage reduction.

F2.3 PP-3 : Water Conservation Campaign

In order to raise awareness of water conservation, replacement of washers and cisterns was carried out at the selected households, KG VI school and Honiara Hospital. Prior to implementation, SIWA carried out questionnaire survey to select the candidate households for the PP-3. As a result, 50 domestic users and two large water users (KG VI School and Honiara Hospital) were selected as the targets. After repair of water service equipment, water consumption of the large water users tends to decrease after repair of leaking taps, showers and toilets. On the other hand, water consumption of the domestic users is decreasing for some households, while others are increasing or no change. Monitoring period is only one month after repair, so that there is not enough data to evaluate effects of repair of water service equipment on water conservation. It is necessary to continue to monitor water consumption of the large water users and domestic users.

Newspaper advertisement and radio programme were carried out for eight weeks in order to raise public awareness of water conservation. Leaflets explaining tips for water conservation were prepared and distributed in order to raise public awareness of water conservation.

Community workshops were carried out at Kaibia, Fulisango and Burns Creek. Participants of the workshops had no knowledge of water conservation. They did not understand the importance as to why water has to be conserved. Some people knew the radio programme of water conservation. Therefore, the necessity of water conservation was explained by facilitator.

<Necessity of water conservation>

- Residents in Kaibia have been facing water problems due to the fact that the flow of water at the source has changed its direction. This has resulted with water shortage. Therefore, it is important that the residents save water as it is getting more difficult to obtain water from their source.
- Fulisango residents have been facing same water problems as Kaibia. If they did not save water by monitoring and saving their daily usage they are at risk of drying up their water source faster.
- Residents have to use their water sustainable as SIWA has to practice sustainable pumping or the water in the borehole will mix up with sea water.

<Benefit of water conservation>

- If they monitor the amount of water, they will be able to save a lot of money.
- In addition to saving money, the environment will improve as there is less water that is used. It means that the supply does not deplete at a fast rate.

Participants did not know how to calculate daily water consumption and bills, so that they split into two groups to calculate water consumption and bills based on the amount of water used in a typical household. In case of calculation for only one person, they feel the water bill is not so high. However, when they calculate water consumption and bills for their family, those become very high because of the extended family and their behavior. Thus some participants raised comments that it is hard to save water because of the extended family.

The followings are identified as low perception of current water tariff and behavior through the community workshops and questionnaire survey.

- Most of community members did not know the current water tariff and water consumption per day before the workshop.
- In Kaibia and Fulisango, they use the piped water as they do in their home village, i.e. washing clothes under running tap, etc. In Burns Creek, they use different water sources by purpose because they do not have private water taps and the number of standing pipe is very limited.
- Most of community members did not understand the term "water conservation" before the workshop.
- In addition to their behavior on water consumption, the extended family also makes the water bills

high. Therefore, it is thought that water conservation is difficult.
- Some people do not care about washing dishes/clothes under running tap and unattended running taps.
- Landlords are responsible for repair of leaking taps in the rented dwelling, so that tenants' awareness of leaking taps is relatively lower than dwelling owners.

SIWA had activities for raising public awareness of water such as talks at schools, issuing newsletters, etc. before changing job description of community education and consultation officer in 1999. After that, nobody is in charge of public relations and a few activities have been carried out in the national event or the anniversary of establishment of SIWA. It is difficult to disseminate basic information on water supply, i.e. water tariff and enhance practice of proper water use or water conservation because the activities are not carried out continuously. Meter readers are most visible and have opportunities for public relations, but reliability from the customers on meter reading is very low.

F2.4 PP-4 : Installation of Shared Standing Pipe

Matariu and two communities of Burns Creek were selected as model communities for the PP-4. Matariu was hit in the Socio-economic Survey as a community, which had wanted a shared standing pipe. Several communities of Burns Creek have already had shared standing pipes and SIWA recognizes that communities of Burns Creek have potentials to manage shared standing pipes since there are good example in the area. The number of households is forty (40) for Burns Creek 1, eight (8) for Burns Creek 2, and three (3) for Matariu.

For each community, one representative was appointed to control usage of the shared standing pipe and collect charge from the households. The representative consulted with the community members on usage of the shared standing pipe and charge collection. As a result, the representative and the community of each target area decided that the standing pipe should be used for drinking and cooking only because it is very difficult to control water consumption if it can be used for all proposes.

In principle, scope of SIWA is to lay 10m of water service pipe branched from water distribution pipe. Most of required water service pipe laying work should be borne by customer. Bearing the water service cost is supposed to be one of the reasons that low income households can not conduct the water connection individually. Therefore cost per household should be affordable for the households of the target community if the standing pipe water supply were extended by SIWA.

After the facility construction, the representative person of each target community applied water supply service to SIWA and SIWA put meters and started managing the standing pipes as customer. Since one standing pipe is counted as one customer under the current SIWA's customer registration system, the number of registered customer increased only three. However there are 51 households behind the three registered customers. As a result, SIWA got 51 real customers and 51 households became to be capable to obtain the piped water.

Each target community plans to pay the water tariff through the representative person, who signed on water supply service application form to SIWA. The representative person is required to collect certain amount of money from member households and finish the monthly payment to SIWA.

(1) Advantage and Disadvantage of Shared Standing Pipe

Through PP-4, the followings are found as advantage of shared standing pipe.

- Shared standing pipe increases real customers at low investment cost when the length of water service pipe can be kept shorter and consisting household number can be secured enough.
- Shared standing pipe decreases unserved population of the piped water at low investment cost.
- Shared standing pipe is effective for low income households, who can not afford to connect the piped water individually.

Meanwhile, the followings are found as disadvantage of shared standing pipe.

- Shared standing pipe requires investment to be charged to customers for construction. The construction cost is high, especially for communities far from the existing water distribution pipe.
- Shared standing pipe requires stable revenue form member households. In case that some households did not pay their share, all remaining households should be influenced for water supply maintenance.

(2) Recommended Ways to Overcome Disadvantages

1) Investment sharing and payment

In order to keep fairness between shared standing pipe customers and other individual customers, the construction cost should be borne by customers. Therefore candidate communities, which need shared standing pipe, are responsible for construction in principle.

However many of communities are supposed to be unable to finish full payment at construction time. In this case, it is recommended that SIWA constructs the facility and claim the payment in installments. Reasonable payment period is as same as life of construction i.e. 25 years for water service pipe and 15 years for tap facility. When the payment in installments is introduced, SIWA claim the construction cost monthly as an additional claim to water tariff.

2) Securing stable revenue

The following two cases are forecasted as obstacles for stable revenue;

- Some households are put in serious situation for paying water tariff or refuse the payment. Consequently enough amounts can not be collected to complete the payment to SIWA.
- Representative person, who collect the tariff in the community, does not complete the payment to SIWA.

In order to solve the above problem, SIWA should conduct a series of workshops in the community before the construction and obtain residents' consent on rule of shared standing pipe management. It is recommended to have a written consent of member households as an attachment of water supply application.

3) Residents' consensus

The written consent, as described above, is recommended to cover the followings:

- Ways to select/dismiss the representative person and his service term
- Rights and obligations of the representative person
- Name of the selected first representative person
- Ways to share the construction cost and payment period
- Ways to share the maintenance cost, reserve fund for repair and manage the fund
- Ways to determine the sharing water tariff such as fixed rate per household or number of family
- Location of tap facility
- Rules for usage of the tap facility
- Ways to withdraw from community of shared standing pipe
- Countermeasures in case that non payable household is found

(3) Role of SIWA

SIWA should play roles of not only water supplier but also facilitator to conduct the residents' consensus. The recommended activities of SIWA are as follows for the shared standing pipe;

- Survey for candidate community on number of households, topography, households' spreading condition, distance from the existing distribution pipeline, capable water quantity to be supplied from the existing distribution network
- Cost estimation for construction of shared standing pipe and make a example price to be shared

- Holding workshop to confirm the residents' intension to have a shared standing pipe and presenting the example price to be shared
- Facilitating the residents' consensus through several workshops until completion of written consent
- Inspection and maintenance with charge of the facility on behalf of the community if the community desires

(4) Finding Candidate Community

Principally, SIWA starts facilitating activities based on community's application. However SIWA can utilize the shared standing pipe as one way to increase the number of customer and develop the income. It is therefore recommended positive customer development through shared standing pipe.

SIWA can list up candidate communities utilizing the existing list of customer and contact the listed community for needs and market survey through hearing from sampled households. After confirmation of potential to have a shared standing pipe, SIWA should organize the first workshop to confirm the intention of the community.

(5) Standard Number of Household of Candidate Community

Water consumption rate of shared standing pipe is supposed to be approx. 50 LCD. According to the Socio-economic Survey, average family number is about 8 per household in Honiara. Therefore the water consumption per household is supposed to be 12 m^3 per month. This is converted into SI$12.00 using the current water tariff rate.

The other hand, from the result of "Survey on Water Supply after the Project" done in PP-4, resident s are willing to pay SI$20.00 - 30.00/household/month. In this case, SI$8.00 - 18.00/household/month can be affordable for construction and maintenance cost of the shared standing pipe because the standing pipe is used only for drinking and cooking, so that the water charge will not become so high.

Assuming that standard length of water service pipe is 100m, the construction cost is calculated at SI$10,725.00.

Considering depreciation years and maintenance cost (1% of construction cost per year), total cost per year is supposed to be SI$668.25/year and to be covered by 40 households. Therefore, standard number of household to share one stand pipe is set as 40.

(6) Attention to be Paid in the Extending Shared Standing Pipe

Although the extending shared standing pipe will conduct the customer development, it has a risk of unstable revenue. Therefore SIWA should pay attentions on the residents' consensus and confirm through the written consent. The followings are conditions to be examined.

- Residents' consensus is confirmed.
- Residents understand the tariff and ways for payment.
- SIWA has enough capacity of water supply for the area.

F3 Evaluation of Pilot Projects

Based on the results and achievements of the pilot projects executed in Phase-2 of the Study, a final evaluation was conducted for the activities of the pilot projects from the view point of five criteria, i.e., relevance, effectiveness, efficiency, impact and sustainability. The results of evaluation are summarized in Table F3-1 on each pilot project.

Table F3-1 Summarized Evaluation of Pilot Projects

Pilot Project	Relevance	Effectiveness	Efficiency	Impact	Sustainability
PP-1 : **Formulation of Tariff Collection Improvement Method**	Since the improvement of tariff collection ratio is one of the vital issues for SIWA's management, it can be said that the pilot project has met the keen needs of the Solomon side on management strengthening.	The project purpose of the pilot project has been successfully achieved because solutions have been obtained from the pilot project and incorporated in the action plan.	The inputs from both sides were appropriate for achievement of outputs. Three workshops were held and 13 staff including general manager participated in the workshops, which were more than planned.	Almost all the staff for administration and financial departments participated in the workshop. They discussed and found solutions for tariff collection system. Almost all the staff of SIWA is now aware of the problems and solutions. Therefore, it can be said that this pilot project had positive impact.	Sorting out problems and finding out solutions through workshops is now familiarized among SIWA staff.
PP-2 : **Establishment of Leakage Reduction Indicator**	Since the leakage reduction is one of the key issues for improving management capacity of SIWA. Therefore, it can be said that the pilot project has met the keen needs of the Solomon side on technical knowledge.	The project purpose of the pilot project has been successfully achieved because the leakage reduction indicator was obtained and technical transfer was made effectively.	Most of the necessary inputs have been made as planned from the Japanese side and Solomon side.	By the implementation of this pilot project, about 380m^3 of leaked water was reduced. It accounts for 1.6% of total leakage in Honiara. Therefore, it can be said that this pilot project had positive impact.	During this pilot projects, three (3) staff of SIWA mastered the leakage detection and reduction method. Therefore, SIWA will be able to establish a leakage reduction team or section.
PP-3 : **Water Conservation Campaign**	In order to make the bills low, it is necessary for the customers to save water. Repair of leakage and saving water help SIWA reduce volume and cost of water supply.	For the participants of PP-3, awareness of water conservation was raised. However, it takes time to practice water conservation, so that it is necessary to monitor change of water consumption.	The inputs from both sides were appropriate for achievement of outputs. However, implementation period should be longer and life style of Solomon Islanders should be taken into consideration.	Based on the monitoring data, water consumption of large water users such as school and hospital is decreasing after repair of leaking taps. However, it is necessary to continue to monitor water consumption.	It is necessary to assign the officer in charge of public relations. Current conditions and public perception of water supply also should be improved to obtain cooperation of the customers.
PP-4 : **Installation of Shared Standing Pipe**	It is necessary for the low income households to improve access to the piped water. SIWA should provide the options which enable the low income households to connect the piped water.	improved water supply in the target area. On the other hand, there is no change of water consumption volume at Burns Creek due to the limited uses for drinking and cooking.	The inputs from both sides were appropriate for achievement of outputs. It is necessary to examine share of the expenditure for installation between communities and SIWA.	Although water use was not so changed drastically due to the limited uses, access to the piped water was improved after installation of the shared standing pipe.	It is necessary for the candidate communities to understand the tariff and ways for payment and consent installation of shared standing pipe. SIWA should also have enough capacity of water supply for the areas.

Source: JICA Study Team

PART G ACTION PLAN

G1 Future Frame for Action Plan

G1.1 Socio-economic Frame (Population Projection)

In Solomon, the official document which can be an aid to forecast future socio-economic conditions at a national level is the National Economic Recovery, Reform and Development Plan (NERRDP) 2003 - 2006. NERRDP is a medium-term development strategy policy document of the Solomon Islands Government. Its purpose is to set out government strategies, polices and actions to be taken for economic recovery, social restoration, reform and development during the Plan period.

The overall national development goal of NERRDP is to enhance and improve the quality of life and the living standards of all the people in the Solomon Islands.

In NERRDP, it states, based on the 1999 census, that the population of the whole Solomon Islands is 409,042 people and the average population growth rate between 1986 and 1999 is 2.8%.

In the Study, population projections for 2005 and 2010 were executed, based on the national census conducted by the Department of Statistics in 1986 and 1999, which is referred to in NERRDP. As mentioned above, the annual population growth rate for the whole nation is 2.8% in average. For the population projection of Honiara, the growth rate was examined, taking into consideration migration into the capital city, and determined as 3.5%, based on the study result in the AusAID report. For the provincial centers of Noro, Auki and Tulagi, an average national growth rate of 2.8% was applied.

The action plan has been formulated for the following three (3) stages:

- Short term plan : Period from 2006 to 2007
- Mid term plan : Period from 2008 to 2010
- Long term plan : Period from 2011 to 2016

Thus, the population projection for the action plan (2007, 2010 and 2016) for the study areas was determined as shown in Table G1-1.

The population of Honiara shows the population of the service area in Honiara, including that of the urban developed areas adjacent to and still outside the city boundary, which is estimated to be 10% of the population inside the city boundary.

Table G1-1 Population Projection for Study Areas in 2007, 2010 and 2016

Study Area	1999 Census Population Inside City Boundary	Annual Population Growth (%) (2006～2016)	Population Projection		
			2007 (Short-term)	2010 (Mid-term)	2016 (Long-term)
Honiara City	49,107	3.5	64,664 (71,131)	71,695 (78,865)	88,131 (96,945)
Noro	3,482	2.8	4,342	4,718	5,568
Auki	4,022	2.8	5,017	5,450	6,432
Tulagi	1,333	2.8	1,662	1,806	2,131

Note : Figures in ( ) shows the population of service area by SIWA.
Source : Calculated by the Study Team using data from SIWA data from Department of Statistics

G1.2 Indicators and Targets for Managerial and Institutional Strengthening of SIWA

In general, it is recognized that important indicators for the management of water supply utility include the revenue water ratio, water tariff collection ratio, leakage (or Real loss) ratio, effective water ratio and served ratio.

Future targets for the above indicators are as shown in Table G1-2. The targets have been determined

based on the actual figures in 2005, which were obtained in the field survey and analysis of the collected data, and Water Supply Capital Works Plan of SIWA.

Table G1-2 Performance Indicators and Targets for SIWA's Management

(Unit : %)

No.	Indicator	Area	Targets		
			2007 (Short-term)	2010 (Mid-term)	2016 (Long-term)
1	Revenue water ratio	Honiara	57	57	70
		Noro	53	53	60
		Auki	50	50	60
		Tulagi	39	39	55
2	Water charge collection ratio	Honiara	90	95	98
		Noro	-	-	-
		Auki	-	-	-
		Tulagi	-	-	-
3	Leakage ratio	Honiara	40	40	27
		Noro	40	40	35
		Auki	40	40	35
		Tulagi	50	50	40
4	Effective water ratio	Honiara	60	60	73
		Noro	60	60	65
		Auki	60	60	65
		Tulagi	50	50	60
5	Served ratio	Honiara	70	78	90
		Noro	63	67	75
		Auki	60	67	75
		Tulagi	70	74	80

Source : SIWA and field survey by JICA Study Team

G1.3 Evaluation of Management Improvement for SIWA

SIWA is currently facing management problems, which are caused by issues such as a lack of human resources, financial constraints and obsolete infrastructure. Thus, the management problems have been initially classified by objective analysis for management improvement. Secondly, the necessary activities to be taken by SIWA are evaluated by several requirements for management improvement, which are divided into two categories as mentioned below.

- Primary evaluation for activities is made by the first category that consists of a) urgency and b) the scale of influence for management.
- Secondary evaluation for activities is made by the second category that consists of c) the necessity for support from donors, d) the necessity for facility improvement and e) the contribution to the improvement of services.

The evaluation results mentioned above are summarized as follows.

Table G1-3 Evaluation of Management Improvement for SIWA

Subject	Related Section for Action Plan	Activities	Primary Evaluation		Secondary Evaluation		
			Urgency	Scale of Improvement Effect	Necessity of Support from Donors	Necessity of Facility Improvement	Contribution to Improvement of Services
Tariff Collection Improvement	G2.1	1) Improving collection efficiency	A	A			
		2) Increasing delivery of water bills	A	B			
		3) Improving collection of water sales arrears	A	B			
		4) Integrating into metric system meter for reducing billing mistakes	B	B		Y	Y
		5) Establishing water tariff collection system for shared standing pipe	C	C		Y	Y
Introduction of New Tariff Structure	G2.2	Setting reasonable water tariff for improving revenue	A	A			
New Staff Reinforcement for Service Improvement	G2.3	1) Constructing new office building for recruiting additional staff	A	A		Y	Y
		2) Constructing workshop building for maintenance of equipment for improving services	C	C		Y	
		3) Reinforcing staff in provincial centers for improving services and management	B	C		Y	Y
Establishment of Assets Management	G2.4	Rationalizing management by establishing inventory control system	A	A	Y	Y	
Establishment of Effective Water Distribution	G2.5	Establishing efficient operation system for water supply facilities	B	B	Y	Y	
Human Resources Development for Existing Staff	G2.6	1) Reducing meter reading mistakes	A	A			Y
		2) Introducing international accounting system	A	A	Y		
		3) Rationalizing inventory control and assets management	A	A	Y	Y	
		4) Improving capability for planning and maintenance of water supply system	B	B	Y		
		5) Utilizing geographical information system (GIS)	B	B	Y		
		6) Conducting water quality analysis in accordance with the international standards	B	B		Y	
		7) Introducing Information Technology for encouraging rationalization of management	B	A		Y	
Water Supply and Sewerage Facility Improvement	G3	1) Shifting water source from spring to groundwater	A	A	Y	Y	Y
		2) Upgrading water supply facilities which are inefficient and deteriorated by over-service life	A	A	Y	Y	Y
		3) Improving water quality	A	A	Y	Y	Y
Leakage Reduction	G4	Conducting regular leakage reduction activity	A	A		Y	Y

Notes: A - high (large), B - normal, C - low (small), Y – Yes (Necessary)
Source: JICA Study Team

G2 Action Plan for Capacity Development of SIWA

The action plan for the SIWA capacity development is formulated as follows. The implementation schedule of the Action Plan is shown in Table G2-2.

G2.1 Tariff Collection Improvement

One of the most important issues for SIWA management is tariff collection improvement. Several problems represent obstacles to tariff collection for SIWA activities. Of these, major problems are false meter readings caused by meter readers and the huge number of undelivered bills. For improvement from meter readings to tariff collection, SIWA should consider the following activities with management improvement;

1) It is recommended to establish a monitoring committee for the tariff collection rate and the committee should monitor the collection efficiency regularly.

2) Undelivered bills should be delivered by meter readers to customers when they visit households for monthly inspection.

3) To improve the collection efficiency of water sales arrears.

4) To reduce meter reading errors caused by meter readers, remedial education of meter readers is necessary.

5) SIWA is planning to replace old gallon meters, some of which are out of order, with metric meters. The above monitoring committee must prepare a meter replacement plan as mentioned below and observe the practice sequentially.

- To prepare an annual implementation plan to replace all gallon meters within 5 years. In order to reduce the level of incorrect meter reading, meter replacement will be completed by a circle unit (water supply district).
- To draft the plan in parallel with annual budget preparation for the procurement of meters in the next fiscal year, so that meter replacement will be conducted according to the plan.
- To procure approved number of metric meters, according to the plan.
- To transfer the latest information on meter type to meter readers after a renewable system directory whenever meter exchange is completed.

6) It is proposed to increase tariff collection efficiency on shared stand pipes.

G2.2 Introduction of New Tariff Structure

It is recommended that the current water tariff be revised. There are proposals to revise the following procedures. As income from Honiara accounts for 90% of total SIWA income, thus it is suggested that the new tariff structure in Honiara be established firstly.

(1) Setting Reasonable Water Tariff for Improving Revenue

(a) Establishment of New Tariff Committee

It is preferable to establish a tariff revision committee, headed by the General Manager, to examine a new tariff structure. According to the findings of the socio-economic survey being carried out under this Study, a reasonable water rate should be established for both sides of SIWA management and customers as users.

(b) Study of New Tariff

The examination should proceed based on the following preconditions.

- It is required that the rate should be set at a reasonable level compared with the cost of water under efficient management because of the monopoly by SIWA as the public authority.
- Full cost recovery cannot be achieved within the current tariff structure because depreciation and amortization are not considered as current expense items.
- 70% of people (of those who responded to the questionnaire) are complaining about the billed amount for water relative to SIWA's service level.
- It is estimated that the "Willingness to Pay" of a household in the high-income group is more than twice that of a household of low-income group.
- The average water consumption of 164 liters per person in Honiara is high in comparison with other developing countries, hence the use of the charging method for consumption restraint is preferable to reduce water consumption.
- Considering the current inflation rates in the Solomon, it seems that a revision is desirable at every 2 to 3 years intervals.

For reference, case studies for new tariff structure are made based on the following points. The results of study are shown in Table D2-1.

a) Taking into consideration the socio-economic survey result such as WTP (Willingness to Pay) and ATP (Ability to Pay)
b) Introduction of a new tariff structure of differentiated unit price for every $10m^3$ block up to $30m^3$ from the constant price of SI$1.00 for $30m^3$ should be considered for public utility charges of the water consumption restraint type.

A number of case studies for the new tariff structure have been prepared based on the means by which SIWA can secure its revenues to cover the estimated expenditure in FY2009. For the case studies, the following 3 preconditions are selected from the socio-economic survey results:

Case-1: Domestic water rates are set for an ATP of SI$80.28 as the upper limit for the low-income group.

Case-2: Domestic water rates are set for an ATP of SI$142.80 as the upper limit for an average in the low- and high-income groups.

Case-3: Domestic water rates are set for a WTP of SI$167.14 as the upper limit that is a precondition to improve the water supply service for the low-income group.

Table G2-1 Case Study for New Tariff Structure

Classification	Current Water Tariff		Case 1 ATP(SI$80.28) for Low Income Group		Case 2 Average ATP (SI$142.12)		Case 3 WTP(SI$167.14) for Low Income Group	
Domestic	Unit	a) Current Rates	b) Changed ratio	New Rates (=a x b)	c) Changed ratio	New Rate (=a x c)	d) Changed ratio	New Rate (=a x d)
Fees and Charges (0 to 10m^3)	SI$/m^3	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fees and Charges (10 to 20m^3)	SI$/m^3	1.00	1.20	1.20	1.80	1.80	2.00	2.00
Fees and Charges (20 to 30m^3)	SI$/m^3	1.00	1.40	1.40	2.40	2.40	3.10	3.10
Fees and Charges (over 30m^3)	SI$/m^3	2.42	1.50	3.63	3.00	7.26	3.50	8.47

Classification	Record of Water Supply Services for FY2005			Case 1 ATP(SI$80.28) for Low Income Group		Case 2 Average ATP (SI$142.12)		Case 3 WTP(SI$167.14) for Low Income Group	
Domestic	Unit	a) Current Rates	Record	b) Changed ratio	New Rates (=a x b)	c) Changed ratio	New Rate (=a x c)	d) Changed ratio	New Rate (=a x d)
Average Charges/household	SI$/Month		60.31		81.47		142.94		167.10
Average Water Value/m^3	SI$/m^3		1.58	1.35	2.13	2.37	3.74	2.77	4.37
No. of Households *1	Household		5,778						
Water Consumption (Honiara)	m^3/year		2,653,000						
Water Sales Value (Honiara)	SI$/year		4,182,000	1.35	5,648,976	2.37	9,911,232	2.77	11,586,216
Water Consumption/capita/day	LCD		180						
Commercial/Government									
Commercial Fees and Charges	SI$/m^3	5.60		1.75	9.80	1.50	8.40	1.30	7.28
No. of Commercial Customers *1	No.		639						
Government Fees and Charges	SI$/m^3	6.16		1.75	10.78	1.50	9.24	1.30	8.01
No. of Government Customers *1	No.		318						
Water Consumption (Commercial/Government)	m^3/year		1,845,000						
Water Sales Value (Commercial/Government)	SI$/year		13,167,000	1.75	23,042,250	1.50	19,750,500	1.30	17,117,100
Average Value	SI$/m^3		7.14		12.49		10.70		9.28
Other Income *2	SI$/year		2,018,400		685,000		685,000		685,000
1. Total Sales Value (Honiara)	SI$/year		19,367,400	1.52	29,376,226	1.57	30,346,732	1.52	29,588,206
2. Sales Value (Province) *2	SI$/year		1,753,000		1,280,000		1,280,000		1,280,000
A. Income Forecast (1 + 2)	SI$/year		21,120,400		30,656,226		31,626,732		30,668,316
B. Expenditure Forecast (FY2009)	SI$/year				30,509,700		30,509,700		30,509,700
C. Balance (A - B)	SI$/year				146,526		1,117,072		158,616
D. Expenditure Forecast (FY2008)	SI$/year				28,230,600		28,230,600		28,230,600
E.. Balance (A - D)	SI$/year				2,425,626		3,396,132		2,437,716

Note :1: Actual data as of April 2005 were given by SIWA.
2: Actual data in FY 2005 and value for case-1 to case-3 is based on SIWA 2006 Approved Annual Budget.
Source : JICA Study Team

(c) Getting Approvals from the Board and SIG

If a new rate revision plan is settled by the Committee, SIWA board members should study in particular whether the revision plan is acceptable for low income group households or not. A rate revision is enforced only after getting approval for the rate revision plan from the SIG parliament.

(d) Implementation of Awareness Campaign

The enforcement of the new rate should be introduced by an explanation and publicity campaign. SIWA should announce the revision rate, effectively using the media, such as radio and newspapers. Through acting to explain to residents, SIWA is required to get the consensus of residents, especially those from the low-income group.

(2) Rate Revision of Province

A new tariff structure for the provinces is to be introduced by a similar step while observing the domestic customer payment situation, after the introduction of a new tariff structure in Honiara City and

based on the socio-economic findings in the Provinces

G2.3 Staff Reinforcement for Service Improvement

It is physically impossible to reinforce the number of staff because the SIWA office building is not capable of housing additional staff. Therefore, it is necessary for SIWA to prepare an organizational reinforcement plan by examining both an office expansion plan and staff recruitment plan.

(1) Constructing a New Office and Workshop Building for Recruiting Additional Staff

A new plan of an office building is already planned by this study, and construction once funding can be secured. In addition, it is desirable that a workshop for machinery repair, including a laboratory, be constructed at the same time.

(2) Expanding the Water Supply and Sewerage Disposal Services for Improving Services

SIWA must examine the following for staff reinforcement in parallel with construction of the office buildings:

(a) Study of Cost and Service Comparision with Outsourcing

A "Corporate Plan 2005-2007" is drafted, based on the mandate given to SIWA. A staff reinforcement plan, including a positional description of each department, including the ability of the current staff, etc should be reviewed, based on the cost comparison analysis between direct management and outsourcing for the provision of the same service, according to the SIWA management strategy. It is assumed that the General Manager is the enforcement person in charge for this purpose.

(b) Review of Corporate Plan

In 2007, the "Corporate Plan 2008-2010" will be drafted after a review of "Corporate Plan 2005-2007" and on the basis of the results of performance records. In particular, it is advisable that the realization of new services, such as water supply service and sewage treatment service, should be studied as mentioned in the action plan. In addition, a new plan should be considered to meet the requests of several provincial centers for water supply services.

(c) Providing Services with Water Tankers and Vaccume Trucks

Staff reinforcement is required for the new duties of SIWA's service expansion. New services are expected as follows;

- Water supply service : Employment of the new staff for water supply service by water tanker to unserved areas will be necessary (a cost comparison study with outsourcing should be done).
- Sewage treatment service : There are plans to purchase vacuum trucks for sewage sludge disposal service. For realization of this service, it is necessary to hire new staff (a cost comparison study with outsourcing should be done).
- Water quality analysis : One of the SIWA mandates is to supply safe drinking water. For this purpose, water quality analysis is essential. However, current water analysis is carried out as part of an item set by WHO guidelines. It is necessary to carry it out for all items stipulated under WHO guidelines on a regular basis. It is necessary to reinforce the staff with this purpose and to supply the chemical reagent for water analysis appropriately.

(3) Reinforcing Staff in Provincial Centers for Improving Services and Management

SIWA is responsible for a water service business in provincial centers. Noro, Auki and Tulagi are already administered by SIWA, but SIWA is to administer other provincial centers. When these are realized, reinforcement of personnel is also required. The water supply business in several provincial centers is planned in SIWA Water Supply Capital Works Plan.

G2.4 Establishment of Assets Management

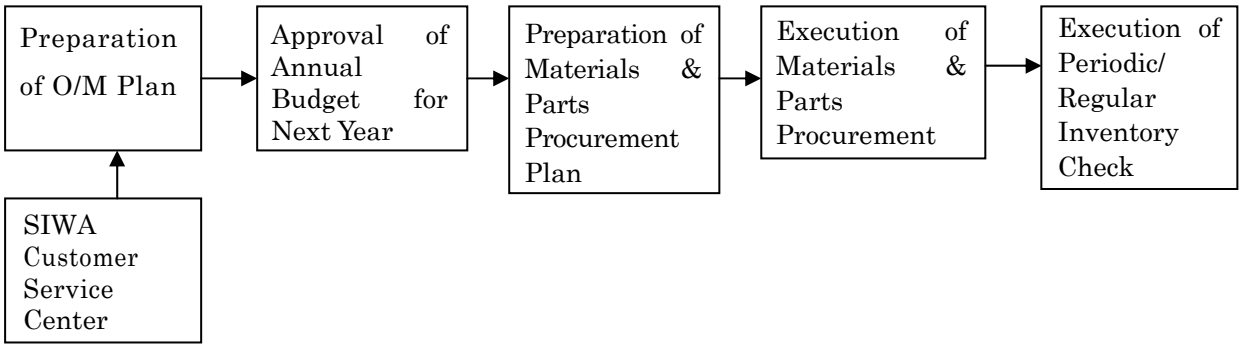
SIWA is expecting to establish a reasonable management system for materials and parts control. SIWA

must stock and deliver materials and parts to the site on a timely basis from their procurement through management of a series of duties. In the case of SIWA, most material and maintenance parts for water supply and sewerage systems are usually imported from overseas. This may lead to a problem of supplies being delayed for several months due to supplier conditions. On the other hand, it is necessary to maintain material stock to cope quickly when they are needed.

The following demerits are included for stock possession so that it is necessary to manage stock adequately:

1) Increase of inventory control expense
2) Increase of stock fund
3) Obsolescence of stock articles, and deterioration of quality
4) Increase of stock space

SIWA is required to establish the following inventory control flow from the preparation of an operation and maintenance (O/M) plan to periodic and regular inventory check.



Source : JICA Study Team

Figure G2-1 Inventory Control Flow

G2.5 Establishment of Effective Water Distribution System

SIWA is planning to take certain countermeasures to reduce operation and maintenance costs by effective pump operation and make effective use of the limited water sources in the water distribution districts.

Therefore, SIWA wishes to introduce a SCADA system (Supervisory Control and Data Acquisition) for controlling, a) water distribution from water sources to the distribution reservoir, b) water level change at water sources and distribution reservoir and c) pressure change at main pumping stations, which will enable SIWA to distribute the limited water effectively in the water distribution district and to control the total waterworks system comprehensively for effective water distribution over a wide district area.

The SCADA system has already been introduced in many countries and includes many advantages, in particular for complicated water supply systems in urban areas.

The SCADA system consists of measuring instruments to collect data at monitoring sites, a telemetry system to convey collected data to the central station, and data processing equipment at a monitoring center (SIWA Office) to process the collected data. Telemeter panels will be installed in each monitoring site and monitoring center to convey data.

However, since it seems difficult for SIWA to introduce such system as part of the short and mid-term plans, due to their financial and technical constraints, the introduction of the system shall be examined as part of the long term plan and implemented according to the following steps, under technical guidance from an overseas expert, if available:

1) Basic design of the SCADA system

2) Purchasing and installation of the SCADA system

3) Operation guidance for the SCADA system

G2.6 Human Resources Development for Existing Staff

(1) Review of Staff Training Plan

In order to reinforce the SIWA organization, human resources development is one of the essential issues. Even if SIWA has already drawn up a "Staff Development Plan 2004-2006" and is going to actively implement ability development of the staff, the following points should be considered for review of the personnel training plan.

(2) Necessary Training Fields

SIWA should conduct capability development of the existing staff in the following areas:

1) Meter readers
2) Accounting staff
3) Inventory control staff
4) Water supply and SCADA system engineer
5) GIS engineer
6) Laboratory staff
7) IT engineer

(3) Training Methods

There would be various kinds of methods for training, i.e. dispatching staff for participation in seminars for the short term or vocational school for the longer term. However, external resources in Solomon for acquired technical knowledge are considerably limited to capability development, meaning an effective method would either be technical guidance by a special instructor from overseas or dispatching staff to overseas specialized agencies for a certain period of time. It seems that practice by OJT (On-the-Job Training) is the most effective method.

Table G2-2 Action Plan for Capacity Development of SIWA (1/3)

Subject		Activities	Performance Measure	Short-term 2006	Short-term 2007	Mid-term 2008	Mid-term 2009	Mid-term 2010	Long-term 2011-2016	Responsible
Tariff Collection Improvement	1	Improving collection efficiency	Establishment of monitoring committee							GM
	2	Increasing delivery of water bills	Dispatching undelivered bills							DMFS
	3	Improving collection of water sales arrears	Implementation of awareness campaign & negotiation with debtors							DSCS
	4	Integrating into metric system meter for reducing billing mistakes	Preparation of meter replacement plan							DSCS
			Replacement of imperial meters to metric							DSCS
	5	Establishing water tariff collection system for shared standing pipes	Promotion of shared standing pipe installation							DSCS
			Negotiation with group users & Appointment of money collector							DSCS
Introduction of New Tariff Structure	1	Setting reasonable water tariff for improving revenue	Establishment of new tariff committee							GM
			Study of new tariff							DMFS
			Getting approvals from Board and SIG							GM
			Implementation of awareness campaign							DSCS

Notes:
- DMSS: Divisional Manager Support Services,
- DFM: Department of Financial Management,
- DA: Department of Administration ,
- DPD: Department of Planning & Design ,
- DMIS: Department of Management Information Systems,
- DMFS: Divisional Manager Finance & Sales ,
- DSCS: Department of Sales and Customer Services
- DIA: Department of Internal Audit
- DWS: Department of Water Supply
- DE: Department of Environment
- GM: General Manager
- DMES: Divisional Manager Engineering Services

Source : JICA Study Team

Table G2-2 Action Plan for Capacity Development of SIWA (2/3)

Subject		Activities	Performance Measure	Short-term		Mid-term			Long-term	Responsible
				2006	2007	2008	2009	2010	2011-2016	
New Staff Reinforcement for Service Improvement	1	Constructing new office & workshop building for recruiting additional staff	Finding out fund							GM
			Preparation of tender document and tendering							DMES
			Construction supervision							DMES
	2	Expanding water supply and sewerage disposal services for improving services	Study of cost & service comparison with outsourcing							DMSS/DMES
			Review of Corporate Plan							GM
			Providing services with water tankers & vacuum trucks							DMSS/DMES
	3	Reinforcing staff in provincial centers for improving services and management	Business expansion in provincial centers							DMSS
Establishment of Assets Management	1	Rationalizing management by establishing inventory control system	Preparation of O/M plan							DMES
			Preparation of materials and parts procurement plan							DMFS
			Materials and parts procurement							DMSS
			Periodic and regular inventory check							DA

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Source : JICA Study Team

Table G2-2 Action Plan for Capacity Development of SIWA (3/3)

Subject		Activities	Performance Measure	Short-term		Mid-term			Long-term	Responsible
				2006	2007	2008	2009	2010	2011-2016	
Establishment of Effective Water Distribution	1	Establishing efficient operation system for water supply facilities	Basic design of SCADA system						■	DPD
			Purchasing and installation of SCADA system						■	DMES
			Operation guidance for SCADA system						■	DPD
Human Resources Development for Existing Staff	0	(Common items)	Review of staff training plan	■	■	■	■	■		DMSS
	1	Reducing meter reading mistakes	On the Job Training	■	■	■	■			DSCS
	2	Introducing international accounting system	Training of accounting staff at schools	■	■	■	■			DFM
			Receiving technical guidance by foreign expert or overseas training		■	■				DIA
	3	Rationalizing inventory control and assets management	Receiving technical guidance by foreign expert or overseas training		■					DA
	4	Improving capability for planning and maintenance of water supply system	Receiving technical guidance by foreign expert or overseas training	■	■	■			■	DWS/DPD
	5	Utilizing geographical information system (GIS)	Receiving technical guidance by foreign expert or overseas training	■	■	■				DPD
	6	Conducting water quality analysis in accordance with the international	On the Job Training	■	■	■				DE
	7	Upgrading information technology for encouraging rationalization of management	Overseas training		■	■				DMIS

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- DWS: Department of Water Supply
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- GM: General Manager
- DMES: Divisional Manager Engineering Services

Source : JICA Study Team

G3 Action Plan for Water Supply and Sewerage Facility Improvement

In 2004, SIWA prepared the "Water Supply Capital Works Plan" for the period from 2006 to 2016. Therefore, the action plan for the water supply and sewerage facility improvement has been prepared, taking into account the Capital Works Plan by SIWA.

The outline of the action plan for the water supply and sewerage facility improvement is as shown in Table G3-1 and the detail of the plan is shown in Table G3-2.

Table G3-1 Outline of Action Plan for Water Supply and Sewerage Facility Improvement

Area	Item to be Implemented	Short-term	Mid-term	Long-term
		2006～2007	2008～2010	2011～2016
Honiara	［Water Supply］			
	Implementation of mid-term facility improvement plan		▨	
	Replacement of the existing equipment	▨		
	Expansion of water distribution network	▨	▨	▨
	Replacement of meters	▨	▨	▨
	［Sewerage］			
	Implementation of mid-term facility improvement plan		▨	
Noro	Expansion of water distribution network	▨	▨	▨
	Replacement of filters for water treatment facility	▨		
	Replacement of pumps	▨		
	Replacement of motors		▨	
	Replacement of meters	▨	▨	▨
Auki	Implementation of mid-term facility improvement plan		▨	
	Expansion of distribution reservoir	▨		
	Replacement of riser main	▨		
	Installation of booster pumps	▨		
	Expansion of water distribution network	▨	▨	▨
Tulagi	Installation of disinfection facility	▨		
	Replacement of pumps		▨	▨
	Expansion of distribution reservoir	▨		
	Expansion of water distribution network	▨	▨	▨
	Replacement of meters	▨	▨	▨
Expected Project Cost（x 1,000 SI$）		16,746	77,226	20,791

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (1/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
A. HONIARA Water Supply System in the Mid-term Facility Improvement (MFI) Plan by JICA Study (Option J-1)	**A-1. Source Development**												
	1. Tasahe New Borefield 800m^3/day x 4 bores				1,711,346	1,711,346	1,711,346						
	2. Titinge New Borefield, 800m^3/day x 4 bores				1,729,000	1,729,000	1,729,000						
	3. Skyline New Borefiels 800m^3/day x 4 bores				1,554,000	1,554,000	1,554,000						
	4. Borderline New Borefield 800m^3/day x 4 bores				1,869,000	1,869,000	1,869,000						
	A-2. Water Treatment												
	1. Disinfection Plant for New Borefields	Tasahe New Borefield Titinge New Borefield Skyline New Borefield Borderline New Borefield			634,737	634,737	634,737						
	2. Disinfection Plant for Existing Borefield	Mataniko Borefield Kombito EU Borefield Panatina Borefield			454,300	454,300	454,300						
	3. Intermediate Water Treatment Facility	While River Gravity System Rove Spring Kombito Spring			2,811,494	2,811,494	2,811,494						
	A-3. Pumping station												
	1. Tasahe New Borefield	Tasahe to Tasahe Preservoir			344,155	344,155	344,155						
	2. Titinge New Borefield	Titinge To Titinge Reservoir			326,200	326,200	326,200						
	3. Skyline New Borefield	Skyline To Skyline Reservoir			326,200	326,200	326,200						
	4. Borderline New Borefield	Borderline To Borderline Reservoir			326,200	326,200	326,200						
	A-4. Distribution Storage												
	1. Upper Tasahe Reservoir (1,600m^3)				461,447	461,447	461,447						
	2. Titinge Reservoir (1,400m^3)	From Titinge New Borefield			387,800	387,800	387,800						
	3. Skyline SIWA Reservoir (1,550m^3)	From Skyline New Borefield			424,200	424,200	424,200						
	4. Lower West Kolaa Reservoir (455m^3)	From Mataniko Borefield			147,700	147,700	147,700						
	5. Panatina Reservoir (2,000m^3)	From Panatina Borefield			701,400	701,400	701,400						
	A-5. Distribution Mains												
	1. Tasahe New Borefield to Tasahe Reservoi	PVC main, 250mm, 1.0km			169,806	169,806	169,806						
	2. Tasahe Distribution Main	PVC main, 50~100mm, 4.9km			331,151	331,151	331,151						
	3. Rove Spring Distribution Main	PVC main, 200mm, 1.5km			202,300	202,300	202,300						
	4. Titinge New Borefield to Titinge Reservoir Rising Main Skyline New Borefield to Skyline Reservoir Rising Main Titinge Distribution Main	PVC main, 100~250mm, 3.3km			388,500	388,500	388,500						
	5. Skyline Distribution Main	PVC main, 50~250mm, 4.8km			508,500	508,500	508,500						
	6. Borderline New Borefield to Borderline Reservoir Rising Main Borderline Distribution Main	PVC main, 50~300mm, 9.8km			811,900	811,900	811,900						
	7. Panatina Distribution Main	PVC main, 100~150mm, 3.2km			251,800	251,800	251,800						

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (2/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
B. HONIARA	**B-1. Source**												
General	1. Develop New Source	**Refer to "A. HONIARA Water Supply System" (A-1)**											
	2. Telemetry System									500,000			
	B-2. Treatment												
	1. Water Testing Equipment	Chemical testing equipment											
	B-3. Existing System												
	1. Expected Network Replacement		500,000	300,000				130,560	130,560	168,249	168,249	168,249	168,249
	2. Identified Network Replacement					**Refer to A-5**							
	B-4. New Areas												
	1. Projected New Network		950,000	500,000		**Refer to A-5**		1,282,728	1,282,728	1,603,873	1,603,873	1,603,873	1,603,873
	B-5. Meters	Bulk flow meters	100,000	50,000	20,000								
		Residential meters	700,000	700,000	595,440	613,702	631,845	650,107	668,250	742,254	764,944	787,572	810,319
	B-6. Residential Housing	Tuvaruhu renovations Renovate 3 blocks 12 rooms											
		6 residential houses	300,000	300,000									
		2 executive houses	500,000										
		General managers residence	100,000										
		Henderson development (49 houses)											
		Kombivalu development (5 houses)	200,000	700,000									
	B-7. Offices and Stores	Renovate Tuvaruhu workshop											
		Renovate existing offices to stores and build new office	200,000	2,000,000									
	B-8. Plant	Replacement vehicles	600,000	1,000,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
		Tip truck											
		Water tanker		500,000									
		Trailer mounted drilling rig							1,000,000				
	B-9. Other equipment	Replacement - computers	90,000	49,000	49,000	49,000	49,000	49,000	49,000	49,000	49,000	49,000	49,000
		Information Systems Upgrade	500,000										

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (3/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
C. HONIARA	**C-1. Source Development**												
White River Gravity	1. Catchment Management Plan	Develop draft											
		Obtain legal advice											
		Public education		5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
		Installation of signs											
	2. Investigation of White River Spring	2 week input by specialist											
	C-2. Treatment												
	1. Filtration	Install cartridge filtration system											
	2. Disinfection	Purchase back-up pump											
		Replacement of pump				10,000				10,000			
	C-3. Reservoirs Development												
	1. New Tanks	**Refer to "A. HONIARA Water Supply System" (A-4)**											
	C-4. Pumps												
	1. New White River Pump Station - Emergency supply to Tasahe Tank			200,000									
	2. Standby Generator												
	C-5. Pipeline Development												
	1. Realign Pipe Water Crossing (secure pipeline)												
	2. New Pipeline connecting White River Tank to Tasahe Tank			300,000									
	C-6. Houses												
	1. Caretaker houses			60,000									

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (4/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
D. HONIARA	**D-1. Source Development**												
White River	1. Restore JICA Bores-Kombito												
High Level	2. Develop New Boreholes at Mataniko to increase capacity												
	3. Develop Mataniko Gallary Source			200,000									
	4. Investigate Kovi Sinkhole to reduce chances of blockage												
	D-2. Treatment												
	1. Filtration	Install cartridge filtration system											
	2. Disinfection	Puchase back-up pump											
		Replacement of pump				10,000				10,000			
	3. Integrate treatment plant for water purification	**Refer to "A. HONIARA Water Supply System" (A-2)**											
	D-3. Reservoirs Development												
	1. New Tanks	**Refer to "A. HONIARA Water Supply System" (A-4)**											
	D-4. Pumps												
	1. White River Pump Station	Motor - major service	50,000				10,000						
		Motor - replacement									30,000		
		Motor - major service	50,000				10,000						
		Motor - replacement									30,000		
		Motor - major service				10,000				10,000			
		Motor - replacement								30,000			
	2. JICA Mataniko Bores	Replacement - 0.43m^3/min x 100mH x 11kW			50,000								
		Replacement - 0.43m^3/min x 100mH x 11kW			50,000								
		Replacement - 0.43m^3/min x 100mH x 11kW			50,000								
		Replacement - 0.43m^3/min x 100mH x 11kW			50,000								
		Replacement - 0.43m^3/min x 100mH x 11kW			50,000								
		Motor - major service			10,000								
		Motor - replacement	100,000							15,000			
	3. Exploring Alternatives Power Sources - Solar, Water and Oil									50,000			
	4. Telemetry System			100,000									
	D-5. Pipeline Development	Link Kombito JICA bores to East Kolaa Tank											
		Replace West Kolaa to East Koaa pipeline	200,000										
		Investigate and assess Mataniko under water Crossing											
		Link Skyline to Rove Gravity System		100,000									

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (5/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
E. HONIARA	**E-1. Source Development**												
Rove Spring	1. Catchment Management Plan												
	2. Rehabilitate Source	Revegetation											
		Construction of Dam Walls											
		Replace Fencing of perimeter of source											
	3. Develop New Boreholes												
	E-2. Treatment												
	1. Filtration	Install Cartridge Filtration System											
	2. Disinfection	Purchage back-up pump											
		Replacement of pump				10,000				10,000			
	3. New Treatment Plant	**Refer to "A. HONIARA Water Supply System" (A-2)**		200,000									
	E-3. Reservoirs Development												
	1. New Tanks	New 600m^3 Tank											
		Replacement - Lengakiki Tank roof	200,000										
	2. Pumps	Replacement - 0.6m^3/min x 80mH x 11kW			50,000								
		Replacement - 0.6m^3/min x 80mH x 11kW			50,000								
		Replacement - 0.6m^3/min x 80mH x 11kW			50,000								
		Replacement - 0.6m^3/min x 80mH x 11kW			50,000								
		Motor - major service			50,000								
		Motor - replacement								15,000			
	E-4. Standby Generator												
	E-5. Pipeline Development	Replace pipeline from Rove Source to											
		Lengakiki Tank		100,000									
		Realignment of Gravity line		100,000									

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (6/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
F. HONIARA	**F-1. Source Development**												
Panatina	1. Development of New Bores	**Refer to "A. HONIARA Water Supply System" (A-1)**											
	2. Catchment Management Plan	Installation of signs											
		Revegetation											
	3. Secure Kombito Source Dam		40,000										
	4. Investigate Lunga River as a new source												
	5. Investigate Mboko as an alternative source			10,000									
	F-2. Treatment												
	Panatina-Kombito Source												
	1. Filtration	Install cartridge filtration system											
	2. Disinfection	Purchase back-up pump											
		Replacement of pump				10,000	10,000				10,000	10,000	
	F-3. Reservoirs Development												
	1. New Tanks	Replacement 900m^3 tank											
		New 900m^3 tank											
		New 600m^3 tank				150,000							
		Replacement - SICHE Kukum campus tank			100,000								
	F-4. Pumps												
	1. Panatina Pumping Station	Replacement - Grundfos bores pump (BH3)	50,000									50,000	
		Replacement - Grundfos bores pump (BH2)	50,000										50,000
		Replacement - Grundfos bores pump (BH1)									150,000		
	2. Kombito Bores	Replacement - Southern Cross bore pump											
		Motor - major service				10,000							
		Motor - replacement									10,000		
		Replacement - JICA 0.53m^3 x 80mH x 11kW											
		Replacement - JICA 0.53m^3 x 80mH x 11kW											
	3. Standby Generator		300,000										
	4. Telemetry System												
	5. Pipeline Development	Amplication of pipeline behind Hot Bread Kitchen	100,000										

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (7/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
G. HONIARA	**G-1. Source Development**												
Mataniko	1. Development of New Bores	Hiring of drilling rig									150,000		
		Hiring of pump test equipment									10,000		
		100m x 6" bore casing									50,000		
		6" bore pump 30L/s at 100mH									100,000		
	2. Catchment Management Plan	Installation of signs											
		Protection of existing boreholes											
	3. Rehabilitation Infiltration Gallery												
	G-2. Treatment												
	1. New Water Treatment Plant												
	2. Disinfection	**Refer to "A. HONIARA Water Supply System" (A-2)**											
											10,000	10,000	
	G-3. Reservoirs Development												
	1. New Tanks	Lower West Kolaa Tank 1											
		Lower West Kolaa Tank 2	200,000										
		Replace fensing											
	G-4. Pumps												
	1. Mataniko Pumping Station and Bores	Replacement - BH1 bore pump	50,000									50,000	
		Replacement - BH2 bore pump	50,000										
		High lift pump (Kelly and Levis 65x40-200)		50,000									
		15kW motor - major service					10,000						
		15kW motor - replacement										15,000	
		High lift pump (Southern Cross 65x40-200)										100,000	
		15kW motor - major service					10,000						
		15kW motor - replacement										15,000	
		High lift pump (Southern Cross 100x65-200)											
		30kW motor - major service						10,000					
		30kW motor - replacement											15,000
	2. Standby Generator		750,000										
	3. Upgrade of Pump Station	Pipeworks											
		Switchboard											
		Fencing											
	G-5. Pipeline Development	Cross connection of Skyline to West Kolaa	200,000										

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (8/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
H. HONIARA Sewerage System in the Mid-term Facility Improvement (MFI) Plan by JICA Study	**H-1. Sewage Outfall System**	Cyclone proof ocean pipeline & outfalls				7,000,000	5,418,000						
		Pumping station											
	H-2. Sludge Treatment Facility	Sludge drying bed					938,000						
		Septic tank											
	H-3. Procurement of Operation	Vacuum truck					6,300,000						
	Equipment	Jet cleaning truck for sewer pipe											
		Wheel loader for sludge disposal											
I. NORO	**I-1. Source Development**												
	1. Catchment Management Plan	Repairing of signs											
	I-2. Treatment	Replacement of filler material ($20m^3$)	130,000	100,000									
		Disinfection - pump									10,000		
	I-3. Reservoirs	New $900m^3$ tank											
	I-4. Pumps	Standby - high lift pump							8,500				
		Replacement - motor											
		Major service - motor				10,000					10,000		
		Replacement - river pump											
		Replacement - river pump		60,000									
	I-5. Standby Generator			200,000									
	I-6. New Areas	Installation of new reticulation areas	50,000	50,000	96,255	95,969	96,255	95,969	96,255	114,535	114,535	114,535	114,535
	I-7 Miscellaneous	Domestic meters	45,000	50,000	64,937	66,560	68,302	69,925	71,667	77,329	79,334	81,339	83,344
		Bulk flow meters	35,000										
		New residential house											
		New stores/office	200,000										
		New vehicle	200,000										

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (9/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
J. TULAGI	**J-1. Source Development**	Preliminary design - earthfill dam											
		Earth fill dam (5m high, 30m long)		50,000									
		Installation of signs											
	J-2. Treatment	Total unit - chrolination equipment and shed	50,000										
	J-3. Reservoirs	Replacement 600m^3 tank	50,000										
		Replacement 10m^3 tank											
	J-4. Pumps	Replacement of pump station											
		Replacement - motor									15,000		
		Major service - motor				10,000							
		New standgy high lift pump											
		Replacement - motor									15,000		
		Major service - motor				10,000							
		New float control system											
	J-5. Rising Mains	Amplification of rising main											
	J-6. Existing System	Replacement of existing network	20,000										
	J-7. New Areas	Installation of new reticulation areas		7,230	6,784	6,962	7,230	7,319	7,498	7,765	7,944	8,122	8,390
	J-8. Miscellaneous	Domestic meters	15,000	20,000	19,323	19,827	20,404	20,871	21,405	22,011	22,571	23,140	23,781
		Bulk flow meters	10,000										
		New stores/office	50,000										
		Rehabilitate residential housing											
		Canoe and outboard		60,000	50,000								
K. AUKI	**K-1. Source Development**												
MFI Plan by JICA Study	1. New Borefield, 600m^3/day x 2 bores	To be located at the transmissio pump station site (Low Level Tank)				1,162,000	1,162,000						

Source : SIWA and JICA Study Team

Table G3-2 Action Plan for Water Supply and Sewerage Facility Improvement (10/10)

(Unit : SI$)

Urban Center	Item	Detail Description	Short Term		Mid-Term			Long Term					
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
L. AUKI	**L-1. Source Development**	**Refer to "K. AUKI MFI Plan by JICA Study"**											
	L-2. Reservoirs	New 900m^3 tank											
		New 450m^3 tank											
	L-3. Pumps	Renovate gallery source pump station											
		Renovate Kwaibala source pump station											
		Replacement - booster pump (Kwaibala)											
		Standby - booster pump (Kwaibala)											
		Replacement - booster pump (gallery)											
		Standby - booster pump (gallery)											
	L-4. Rising Mains	New transfer main (allow 3km of 150mm PVC)											
		New transfer main (allow 1km of 200mm PVC)											
	L-5. Existing System	Amplification of delivery main											
		Replacement of existing network		69,353	69,353	69,353							
	L-6. New Areas	Installation of new reticulation areas		20,000			57,660	57,491	57,491	72,075	72,075	72,245	72,075
	L-7. Miscellaneous	Domestic meters	80,000	50,000	54,496	56,191	57,949	59,586	61,281	68,321	70,446	72,633	74,701
		Bulk flow meters	20,000										
		New residential house											
		New stores/office	200,000										
		New vehicle	200,000										
Annual Projected Capital Works			8,485,000	8,260,583	18,753,724	26,497,700	31,974,781	2,678,556	3,699,635	3,820,412	3,797,971	3,475,708	3,318,267

Summary

Urban Centers	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HONIARA	7,130,000	7,524,000	18,392,576	24,990,838	30,504,981	2,367,395	3,375,538	3,458,376	3,381,066	3,103,694	2,941,441
NORO	660,000	460,000	161,192	172,529	164,557	165,894	176,422	191,864	213,869	195,874	197,879
AUKI	500,000	139,353	123,849	1,287,544	1,277,609	117,077	118,772	140,396	142,521	144,878	146,776
TULAGI	195,000	137,230	76,107	46,789	27,634	28,190	28,903	29,776	60,515	31,262	32,171
Total	8,485,000	8,260,583	18,753,724	26,497,700	31,974,781	2,678,556	3,699,635	3,820,412	3,797,971	3,475,708	3,318,267

To be implemented by SIWA's budget and or donor's assistance

To be implemented by ADB project

Source : SIWA and JICA Study Team

G4 Action Plan for Leakage Reduction

Leakage (or real loss) in the water supply system is one of the most important factors which affects the management of water supply utility. Reduction of the leakage will lead to the following improvement;

- Reduction of water distribution volume
- Reduction of the operating cost (electricity cost, disinfection cost, etc.)
- Elimination of the necessity of new water source development in the future

Through the pilot project for establishment of leakage reduction indicator, leakage reduction rate per unit length (m^3/km/day) has been obtained as explained in section F2.2 of PART F.

On condition that the mid-term facility implementation plan is implemented by 2010 and SIWA executes regularly the replacement of pipelines for leakage reduction, action plan for leakage reduction was formulated as shown in Table G4-1.

Table G4-1 Action Plan for Leakage Reduction by Pipe Replacement

Item	Unit		Short Term		Mid Term			Long Term					
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Water Demand (or Distributed)*1													
- Demand With Leakage Reduction	m^3/day	25,719	26,590	27,504	28,477	29,513	30,587	30,684	30,850	31,016	31,182	31,350	31,510
(Design production capacity)			25,719	25,719	25,719	25,719	30,957	30,957	30,957	30,957	30,957	30,957	30,957
- Demand Without Leakage Reduction	m^3/day	25,706	27,047	28,468	29,990	31,615	33,368	35,230	37,244	39,408	41,736	44,243	46,944
Leakage of the Year	m^3/day	10,288	10,545	10,517	10,489	10,468	12,416	12,169	11,632	11,091	10,471	9,800	9,085
Pipe Length to be Replaced	**km/year**		**0.95**	**0.95**	**0.95**	**0.95**	**0.95**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
Leakage Reduction Rate	m^3/km/day		300	300	300	300	300	300	300	300	300	300	300
Leakage Reduction Volume	m^3/day		285	285	285	285	285	600	600	600	600	600	600
Leakage With Replacement	m^3/day	10,288	10,259	10,232	10,204	10,183	12,131	11,569	11,032	10,491	9,871	9,200	8,485
Leakage Without Replacement	m^3/day		11,089	11,957	12,896	13,911	15,015	16,206	17,505	18,916	20,451	22,122	23,942
Leakage Ratio													
- With Replacement	**%**	**40**	**40**	**40**	**40**	**40**	**40**	**38**	**36**	**34**	**32**	**29**	**27**
- Without Replacement*2	%	40	41	42	43	44	45	46	47	48	49	50	51
Effective Ratio (with replacement)	**%**	**60**	**60**	**60**	**60**	**60**	**60**	**62**	**64**	**66**	**68**	**71**	**73**
Population in Service Area*3		66,402	68,726	71,131	73,621	76,198	78,865	81,625	84,482	87,439	90,499	93,667	96,945
Served Ratio	%	70	71	73	75	76	78	80	82	84	85	87	90
Served Population*4		46,221	48,948	51,836	54,894	58,117	61,520	65,150	68,994	73,064	77,375	81,940	86,775
Per Capita Consumption													
- Domestic	LCD	164	164	164	164	164	164	164	164	164	164	164	164
Water Consumption													
- Domestic	m^3/day	7,596	8,045	8,519	9,022	9,551	10,118	10,707	11,339	12,008	12,717	13,467	14,261
- Commercial and Others	m^3/day	7,835	7,913	7,992	8,072	8,153	8,235	8,317	8,400	8,484	8,569	8,655	8,741
Total	m^3/day	15,431	15,958	16,512	17,094	17,705	18,352	19,024	19,739	20,492	21,286	22,122	23,003
Per Capita Demand	LCD	334	326	319	311	305	298	292	286	280	275	270	265
Design Production Capacity*5	m^3/day	25,719	25,719	25,719	25,719	25,719	30,957	30,957	30,957	30,957	30,957	30,957	30,957

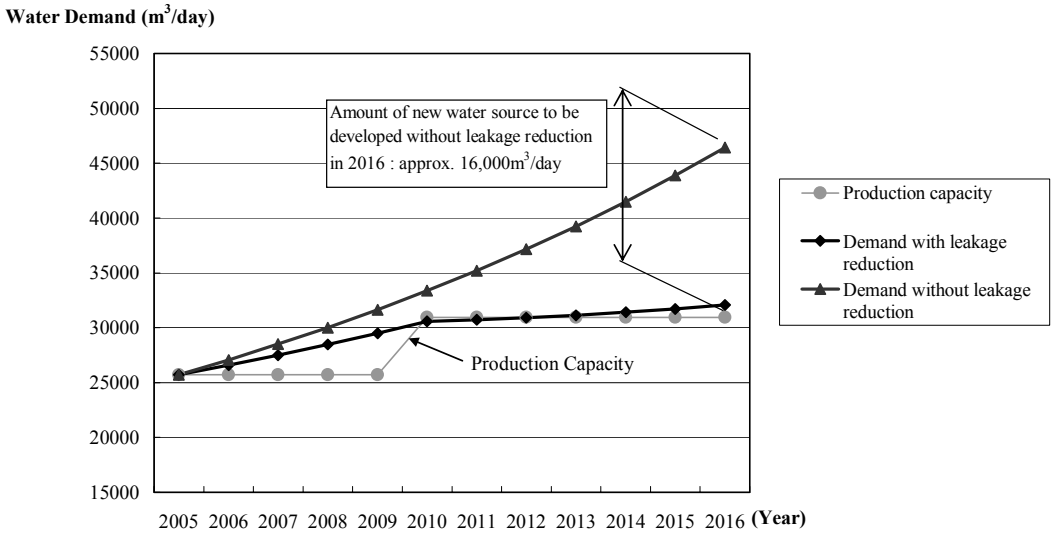
Notes : 1. Water Demand = Water Consumption/(1-Leakage Ratio/100)
2. Leakage ratio without taking leakage reduction measures is assumed to be increased annually by 1.0% .
3. Annual growth rate of population is 3.5% .
4. Served population is assumed to be increased annually by 5.9% based on the past records.
5. Design production capacity in and after 2010 is the capacity proposed in this study.

Source : JICA Study Team

A substantial length of transmission and distribution pipelines will be replaced in accordance with the mid-term facility improvement plan. Therefore, in order to avoid duplication of the pipe replacement, it is recommended that SIWA start large scale leakage reduction work by replacing pipes after the implementation of the mid-term facility plan. Based on the above action plan, SIWA is required to conduct the replacement of pipes with significant leakage of about 1.0 km per year to keep the current leakage ratio of 40% until the implementation of the mid-term facility improvement plan. In order to achieve the target leakage ratio of 27% in 2016, SIWA has to perform pipe replacement of 2.0km every year after the year 2011.

In case SIWA has sufficient budget and starts large scale reduction work, they should follow the mid-term facility plan prepared in this study.

Figure G4-1 shows the water demand, both with and without leakage reduction respectively. In case leakage reduction measures are not taken, new water source development of 16,000m^3/day will be required in 2016. On the other hand, assuming leakage reduction measures are properly implemented, no new water source development will be required.



Source : JICA Study Team

Figure G4-1 Water Demand Forecast up to 2016