

(1) Water Sources

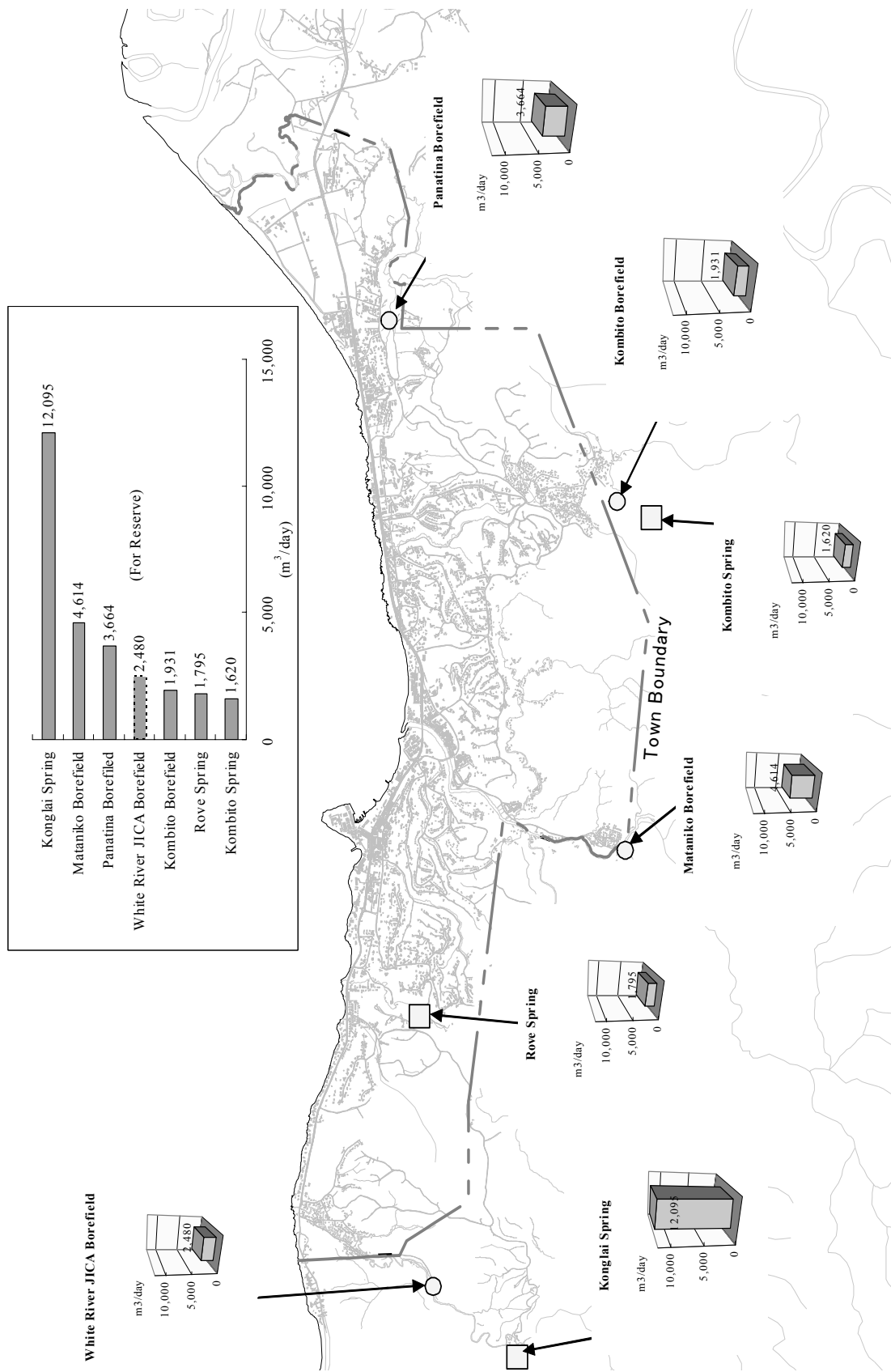
There are four (4) groundwater bore fields and three (3) spring sources for Honiara water supply system. Among the bore fields, White River Borefield which was developed under the Japan's grant aid project completed in 1998 are used only for emergency case.

Water production volume for each source is shown in Table B1.4-9. As shown in the table, groundwater source accounts for about 40% and spring source for about 60% of the whole production volume. For the spring source, Konglai spring source accounts for about 50% of the whole water sources.

Table B1.4-9 Current Water Production Volume for Each Water Source (2005)

| Water Source | 2005 | | | | | Average Monthly Production (m ³ /month) | Expected Yearly Production (m ³ /year) |
|--|---------|---------|---------|---------|---------|--|---|
| | Jan. | Feb. | Mar. | Apr. | May | | |
| [Groundwater] | | | | | | | |
| Panatina Bores | 122,700 | 102,600 | 113,200 | 97,500 | 121,300 | 111,460 | 1,337,520 |
| Mataniko JICA Bores | 91,100 | 69,000 | 78,800 | 76,800 | 75,000 | 78,140 | 937,680 |
| Mataniko SIWA Bores | 63,100 | 59,100 | 64,600 | 60,000 | 64,200 | 62,200 | 746,400 |
| Kombito JICA Bores | 49,900 | 53,800 | 59,500 | 61,500 | 69,000 | 58,740 | 704,880 |
| White River JICA Bores (For emergency) | --- | --- | --- | --- | --- | (110,000) | (1,320,000) |
| Groundwater - Total | 326,800 | 284,500 | 316,100 | 295,800 | 329,500 | 310,540 | 3,726,480 39.7% |
| Groundwater - Total (Potential) | | | | | | (420,540) | (5,046,480) |
| [Spring] | | | | | | | |
| Kombito Spring Source | 53,600 | 48,400 | 48,400 | 48,000 | 48,000 | 49,280 | 591,360 |
| Rove Spring Source | 64,300 | 40,000 | 55,800 | 55,000 | 57,900 | 54,600 | 655,200 |
| Konglai Spring Source - Pumped System | 251,800 | 219,500 | 238,600 | 223,600 | 260,100 | 238,720 | 2,864,640 |
| Konglai Spring Source - Gravity System | 120,500 | 124,000 | 141,500 | 133,900 | 125,800 | 129,140 | 1,549,680 |
| Spring -Total | 490,200 | 431,900 | 484,300 | 460,500 | 491,800 | 471,740 | 5,660,880 60.3% |
| Total (m ³ /month) | 817,000 | 716,400 | 800,400 | 756,300 | 821,300 | 782,280 | 9,387,360 |
| Total Production (Potential) | | | | | | (892,280) | (10,707,360) |
| Total (m ³ /day) | 26,355 | 24,703 | 25,819 | 25,210 | 26,494 | 25,716 | |

Source : SIWA



Source : JICA Study Team

Figure B1.4-3 Water Sources in 2005

(2) Pumping Stations

There are two kinds of pumping stations as follows.

- Bore (or well) pumping station: pumping up groundwater and transfer the water to receiving tank or water reservoir.
- High lift pumping station: transferring water from the receiving tank to water reservoir.

Bore pumping stations and high lift pumping station in White River Borefield are not in operation because of damages during ethnic tension. It is expected that these pumping stations will be rehabilitated in 2006 under the follow-up cooperation by JICA.

High lift pumping station of Konglai Spring source is transferring biggest volume of water and consuming largest electric power.

Table B1.4-10 Existing Pumping Station in Honiara

| System | Source Type | Name of Pump Station | Type of Pump Station | Specification | Design Head (m) | Design Capacity (m ³ /min) | Condition | Remarks |
|--|-------------|----------------------|---------------------------------------|--|-----------------|---------------------------------------|-----------|------------------|
| White River High Level | Spring | White River | High Lift | Southern Cross - Starline 125 x 100-200 (55kW) | 65 | 3.30 | W | Duty |
| | | | | Southern Cross - Starline 125 x 100-200 (55kW) | 65 | 3.30 | W | Duty |
| | | | | Southern Cross - Starline 125 x 100-200 (55kW) | 65 | 3.30 | W | Duty or Stand-by |
| White River Bores | Groundwater | White River | Bore | Grundfos SP46-8 (13kW) Bore Pump (W1) | 80 | 0.90 | N/W | Emergency |
| | | | | Grundfos SP46-8 (13kW) Bore Pump (W2) | 80 | 0.90 | N/W | Emergency |
| | | | | Grundfos SP46-8 (13kW) Bore Pump (W3) | 80 | 0.90 | N/W | Emergency |
| | | | | Grundfos SP46-8 (13kW) Bore Pump (W4) | 80 | 0.90 | N/W | Emergency |
| | | | High Lift | Southern Cross 80 x 50-200 (18.5kW) High Lift Pump | 80 | 1.22 | N/W | Emergency |
| | | | | Southern Cross 80 x 50-200 (18.5kW) High Lift Pump | 80 | 1.22 | N/W | Emergency |
| Mataniko | Groundwater | Mataniko | Bore | Grundfos SP27-9 Bore Pump | 45 | 0.45 | W | Duty |
| | | | | Kelly and Lewis 65 x 40-200 (15kW) High Lift Pump | 64 | | N/W | |
| | | | High Lift | Southern Cross 65 x 40-200 (15kW) High Lift Pump | 64 | | N/W | |
| Mataniko - JICA | Groundwater | Mataniko | Bore | Southern Cross 100 x 65-200 (30kW) High Lift Pump | 50 | 4.26 | W | Duty |
| | | | | Grundfos SP46-7 (11kW) Bore Pump (M1) | 70 | 0.45 | W | Duty |
| | | | | Grundfos SP46-7 (11kW) Bore Pump (M2) | 70 | 0.45 | W | Duty |
| | | | | Grundfos SP46-7 (11kW) Bore Pump (M3) | 70 | 0.45 | W | Duty |
| | | | | Grundfos SP46-7 (11kW) Bore Pump (M4) | 70 | 0.45 | N/W | |
| | | | Grundfos SP46-7 (11kW) Bore Pump (M5) | 70 | 0.45 | W | Duty | |
| | | | High Lift | Southern Cross 80 x 50-315 (37kW) High Lift Pump | 100 | 0.90 | W | Duty |
| Southern Cross 80 x 50-315 (37kW) High Lift Pump | 100 | 0.90 | | W | Duty | | | |
| Kombito | Groundwater | Kombito | Bore | Southern Cross 80 x 50-315 (37kW) High Lift Pump | 100 | 0.90 | W | Stand-by |
| | | | | Southern Cross NAD-10F6XX (15kW) Bore Pump (K1) | 80 | 0.90 | W | Duty |
| | | | | Southern Cross NAD-10F6XX (11kW) Bore Pump (K2) | 80 | 0.60 | W | Duty |
| | | | | Southern Cross NAD-10F6XX (11kW) Bore Pump (EU1) | 80 | 0.60 | N/W | |
| Panatina | Groundwater | Panatina | Bore | Southern Cross NAH-10F6XX (37kW) Bore Pump (BH1) | 85 | 1.80 | W | Duty |
| | | | | Grundfos SP27-19 Bore Pump (BH2) | 85 | 0.60 | W | Duty |
| | | | | Grundfos SP46-7 (11kW) Bore Pump (BH3) | 85 | 0.60 | W | Duty |

Source : SIWA

W : Working N/W : Not Working

(3) Water Reservoirs

There are 17 water reservoir stations and their capacity is about 10,000m³. However, one-third of the reservoirs are not in use for the following reasons.

- Since most of the reservoir is made of steel and degraded by operation over service life, there is much leakage from the bolt holes of the reservoir.
- White River JICA Tank is not used because there is no water from the JICA Borefield which were damaged and out of use under the ethnic tension.

Table B1.4-11 Existing Water Distribution Reservoirs

| System | Tank Name | Condition | Elevation | | | Type | Capacity (m ³) | Structure |
|------------------------|-----------------------------|-----------|--------------|--------------|--------------|---------------|-------------------------------|-----------------------------------|
| | | | GL | HWL | LWL | | | |
| Mataniko | Lower West Kolaa-1 | IU | 53.8 | 57.3 | 54.5 | Ground | 455 | Steel Panel |
| | Lower West Kolaa-2 | NIU | 53.8 | 57.3 | 54.5 | Ground | 455 | Steel Panel |
| | Tuvaruhu Tank | IU | 21.5 | 25.0 | 22.0 | Ground | 70 | Reinforced Concrete |
| Panatina | JICA | IU | 43.7 | 46.8 | 44.4 | Ground | 600 | Steel Panel |
| | SICHE | NIU | 35.0 | 37.4 | 35.3 | Ground | 180 | Steel Panel |
| White River Wells | White River Tank (JICA) | NIU | 59.0 | 63.9 | 59.7 | Ground | 1,200 | Steel Panel, 600 x 2 units |
| Kombito | Borderline (EU) Tank | IU | 76.3 | 83.0 | 77.0 | Ground | 2,650 | Steel Panel |
| White River High Level | Vura | IU | 40.6 | 46.1 | 41.3 | Ground | 230 | Steel Panel |
| | East Kolaa | IU | 82.3 | 87.4 | 83.0 | Ground | 455 | Steel Panel |
| | West Kolaa | NIU | 87.9 | 97.4 | 94.1 | Elevated | 455 | Steel Panel |
| | Skyline (SIWA) | IU | 109.6 | 113.8 | 112.0 | Ground | 455 | Steel Panel |
| | Skyline (JICA) | NIU | 111.3 | 113.8 | 112.0 | Ground | 480 | Steel Panel |
| | Mbokonavera | NIU | 85.8 | 90.1 | 86.5 | Ground | 455 | Steel Panel |
| | Tittinge | NIU | 130.5 | 134.8 | 131.2 | Ground | 455 | Steel Panel |
| | Lengakiki | IU | 80.4 | 83.6 | 81.1 | Ground | 230 | Steel Panel |
| | Upper Tasahe | IU | 151.2 | 154.6 | 151.9 | Ground | 910 | Steel Panel, 455 x 2 units |
| | Vavae | NIU | 67.0 | 72.2 | 67.3 | Ground | 180 | Steel Panel |
| | Tavio | NIU | 52.4 | 61.1 | 58.7 | Elevated | 50 | Steel Panel |
| | | | | | | | IU | 6,055 |
| | | | | | | | NIU | 3,910 |
| | | | | | | | Total | 9,965 |

IU = In Use NIU= Not In Use

Source : SIWA

(4) Water Treatment Facilities

There are no water treatment facilities except chlorination disinfection facilities which are located at the water source facilities.

For the spring water source, there are many complaints from the residents especially for high turbidity of the tap water after heavy rain in the catch basin of the source. Therefore, in the facility plan for the target year 2010, some considerations should be taken to prevent high turbidity.

(5) Water Distribution Pipelines

(a) Existing water distribution pipelines

Total length of water distribution pipelines in Honiara is about 122km as shown in Table B1.4-12. Pipe diameter ranges from 13mm to 450mm. There are four types of piping material – PVC, polyethylene (PE), galvanize iron (GI) and cast iron. PVC pipes account for 64% of the total length. GI and cast iron pipes which account for 29% are no longer used.

Table B1.4-12 Existing Water Distribution Pipelines

| Pipe Material | Pipe Diameter (mm) | Construction Year | | | | | | | | Pipe Length (m) | Percentage (%) | |
|---------------|--------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|----------------|--|
| | | '66 to '70 (m) | '71 to '75 (m) | '76 to '80 (m) | '81 to '85 (m) | '86 to '90 (m) | '91 to '95 (m) | '96 to '00 (m) | '01 to '05 (m) | | | |
| PVC | 20 | | | | | | | 131 | | | 131 | |
| | 25 | | 391 | | | | | | | | 391 | |
| | 30 | | 80 | | | | | 586 | | | 666 | |
| | 40 | | 1,767 | 313 | 3,161 | | | | | | 5,240 | |
| | 50 | 110 | 5,472 | 1,580 | 2,530 | | | 319 | | | 10,011 | |
| | 60 | | 739 | | | | | | | | 739 | |
| | 75 | 1,385 | 5,592 | 2,586 | 1,074 | 922 | 1,985 | | | | 13,543 | |
| | 100 | 2,425 | 4,015 | 2,811 | 6,189 | | 3,329 | 34 | | | 18,803 | |
| | 150 | 1,564 | 3,993 | 944 | 2,057 | 635 | 3 | 1,020 | 1,000 | | 11,215 | |
| | 200 | | 1,311 | | 3,364 | 2,586 | 9 | | | | 7,269 | |
| | 225 | | 625 | | 3,835 | | 1,116 | 11 | | | 5,586 | |
| | 250 | | | | | | 492 | 68 | | | 560 | |
| | 300 | | | | 2,026 | 1,624 | | | | | 3,650 | |
| Total | | 5,484 | 23,984 | 8,233 | 24,237 | 5,766 | 7,969 | 1,132 | 1,000 | 77,806 | 63.6% | |
| PE | 13 | | | | 4 | | | | | 4 | | |
| | 20 | | 54 | | 100 | | | 400 | 500 | 1,054 | | |
| | 25 | 246 | 197 | | 885 | | | | | 1,327 | | |
| | 32 | 60 | 137 | | 405 | | | | | 602 | | |
| | 40 | | 789 | 374 | 463 | | | 140 | | 1,766 | | |
| | 50 | 895 | 1,631 | 549 | 556 | | 9 | 418 | 500 | 4,557 | | |
| | Total | 1,201 | 2,807 | 923 | 2,413 | 0 | 9 | 958 | 1,000 | 9,311 | 7.6% | |
| GI | 13 | | | | 4 | | | | | 4 | | |
| | 20 | 124 | 126 | | | | | | | 251 | | |
| | 25 | 726 | 871 | | | | | | | 1,597 | | |
| | 30 | 406 | 389 | | | | | | | 795 | | |
| | 40 | 1,300 | 605 | | | | | | | 1,905 | | |
| | 50 | 2,987 | 2,441 | 1,758 | 1,419 | | | | | 8,605 | | |
| | 75 | 1,316 | 2,062 | | | | | | | 3,378 | | |
| | 100 | 2,793 | 792 | 2,361 | 824 | | | | | 6,770 | | |
| | 150 | 289 | | | | | | | | 289 | | |
| Total | 9,941 | 7,286 | 4,120 | 2,246 | 0 | 0 | 0 | 0 | 23,593 | 19.3% | | |
| Cast Iron | 100 | 3,392 | 666 | | | | | | | 4,058 | | |
| | 150 | 3,634 | | 727 | | | | | | 4,361 | | |
| | 200 | 2,254 | | | | | | | | 2,254 | | |
| | 225 | 786 | | | | | | | | 786 | | |
| | 450 | 186 | | | | | | | | 186 | | |
| Total | 10,252 | 666 | 727 | 0 | 0 | 0 | 0 | 0 | 11,645 | 9.5% | | |
| Grand Total | | 26,879 | 34,744 | 14,002 | 28,896 | 5,766 | 7,978 | 2,090 | 2,000 | 122,354 | 100.0% | |
| | | 22.0% | 28.4% | 11.4% | 23.6% | 4.7% | 6.5% | 1.7% | 1.6% | 100.0% | | |

Source : Water Supply Capital Works Plan Prepared by SIWA

According to Water Supply Works Plan by SIWA for the years from 1996 to 2016, average life of each material is set as follows.

Table B1.4-13 Average Service Life for Piping Material

| Pipe Material | Service Life (year) | Remark |
|---------------|---------------------|---------------------------------|
| PVC | 40 | Standard deviation: 10 years |
| PE | 35 | |
| GI | 25 | |
| Cast Iron | 70 | |

Source : Water Supply Capital Works Plan Prepared by SIWA

Based on the above average service life, about 31km of pipes should be replaced within not more than 5 years.

B1.4.4 Hydraulic Analysis of Existing Water Distribution Network

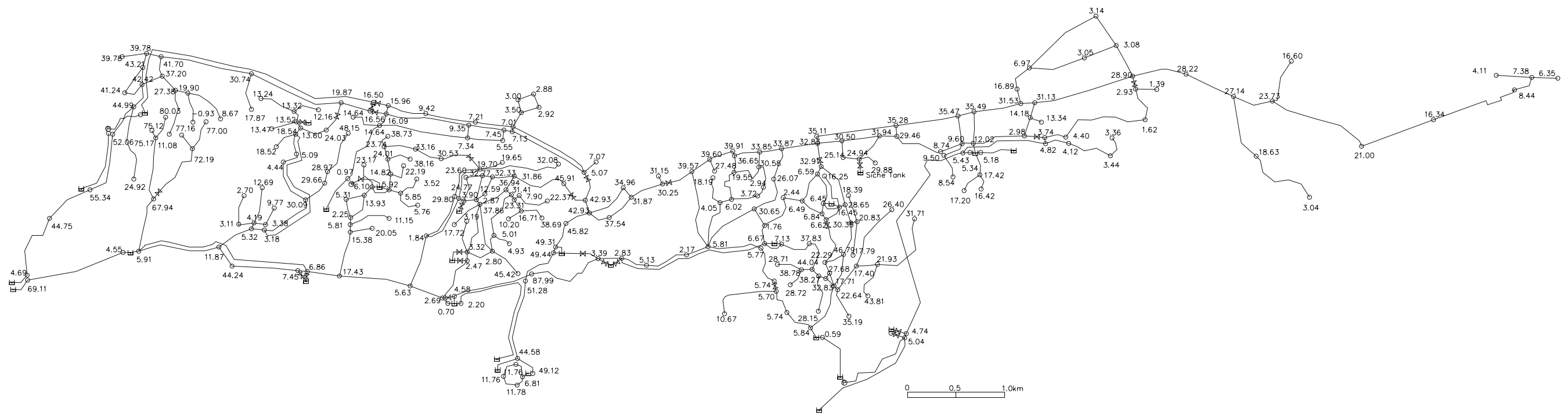
(1) Result of Network Analysis

Through hydraulic analysis of the existing water supply network, effective water pressure has been obtained as shown in Figure B1.4-3. All the results from the hydraulic analysis are attached in Annex-6.

(2) Low Pressure Areas

Water pressure is one of the important factors for stable water supply. In general, the water pressure at the end of the water distribution pipelines should have at least 1.5kg/cm² (or 1.5MPa).

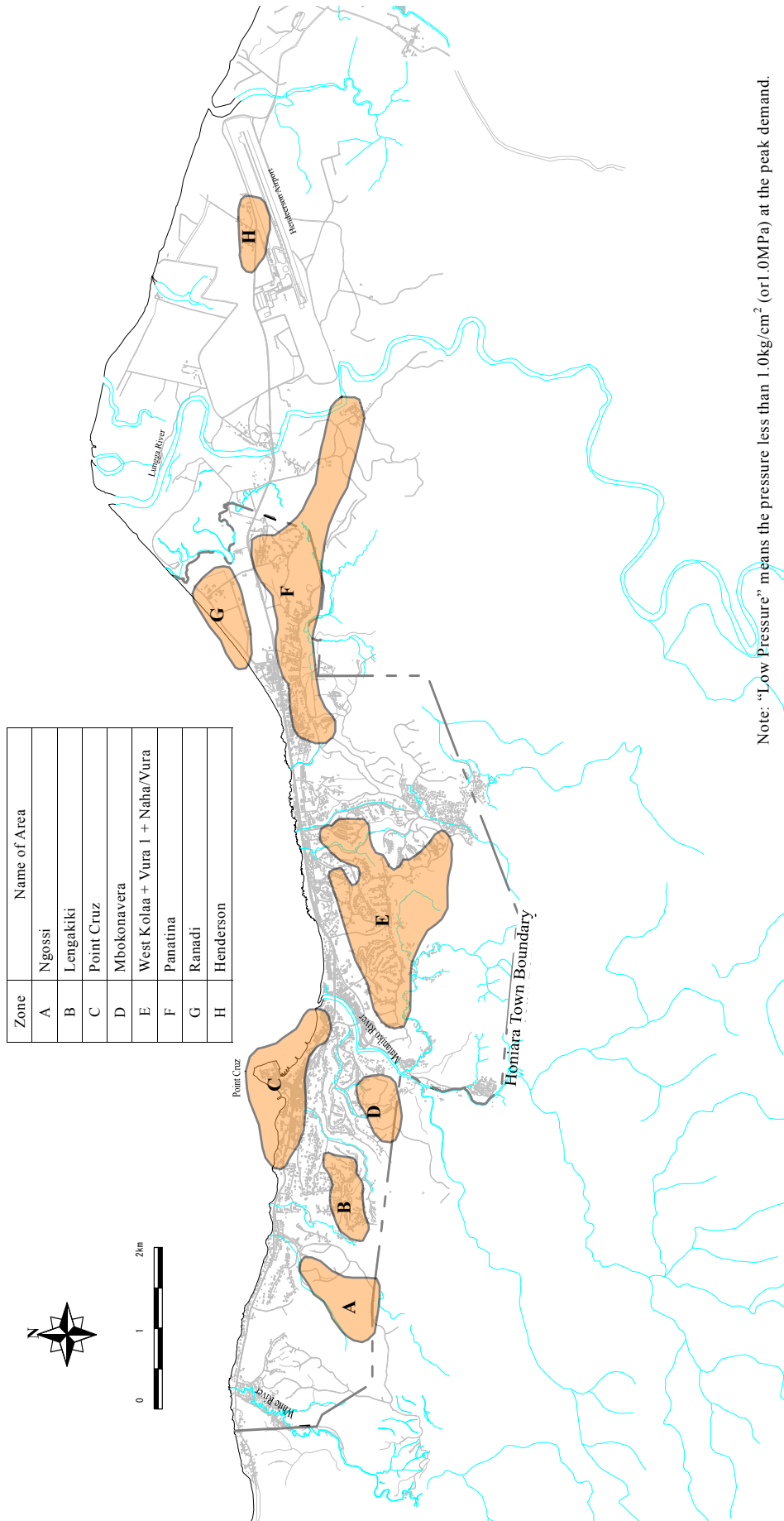
However, as shown in Figure B1.4-6, low water pressure areas of less than 1.0kg/cm² (or 1MPa), are scattered in the whole of Honiara city. The number of people suffering such a low pressure at the peak demand is estimated as 14,500 (approx. 31% of the served population).



Note : All figures are in meters and indicate effective water head.

Source : JICA Study Team

Figure B 1.4-4 Effective Water Pressure in 2005



Source : JICA Study Team

Figure B1.4-6 Current Low Water Pressure Areas (2005)

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 B1.5-1 and Table B1.5-2.

Table B1.5-1 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 B1.5-2 Groundwater Sources for Water Supply by SIWA

| Borehole No. | Diameter (inch) | Depth (m) | Yield ¹⁾ (m ³ /day) | S.W.L ²⁾ (GL-m) | D.W.L ³⁾ (GL-m) | Depth of screen (GL-m) | Aquifer | Current use* ⁴⁾ | | |
|--------------|-----------------|-----------|---|----------------------------|----------------------------|------------------------|-------------------------|--|--|---|
| White River | W-1 | 8 | 80 | (880) | -0.7 | 9 | 47-59/65-77 | • Sandstone of Honiara Beds | | |
| | W-2 | 8 | 80 | (880) | -0.8 | 8 | 40-58/70-76 | | | |
| | W-3 | 8 | 80 | (880) | -0.5 | 6 | 38-44/56-74 | | | |
| | W-4 | 8 | 80 | (880) | -0.5 | 16 | 38-44/56-74 | | | |
| Mataniko | M-1 | 8 | 100 | 703 | 6 | 8 | 22-25/37-43/55-67 | • Sandstone of Honiara Beds • Mbonehe Limestone | ○ | |
| | M-2 | 8 | 100 | 850 | 7.0 | 12 | 19-25/37-43/55-67 | | ○ | |
| | M-3 | 8 | 100 | 1160 | 5.2 | 9 | 35-31/37-49/91-94 | | ○ | |
| | M-4 | 8 | 100 | 0 | 6.1 | - | 19-28/34-40/88-94 | | | |
| | M-5 | 8 | 50 | 1380 | 4.7 | 9 | 23-44 | | ○ | |
| | No.1 | 6 | 48.2 | 720 | 2.0 | 24.5 | 28.5-34.5 | | • Sandstone of Honiara Beds • Mbonehe Limestone | ○ |
| | No.2 | 6 | 90 | 0 | | 26.7 | 27.5-33.5/41.7-48.2 | | | |
| | No.3 | 6 | 99 | 0 | | - | 78-99 | | | |
| Kombito | K-1 | 8 | 80 | 1,020 | 6.5 | 17 | 38-50/62-74 | Sandstone and limestone of Honiara Beds | ○ | |
| | K-2 | 8 | 80 | 750 | 2.3 | 18 | 32-38/44-50/56-62/68-74 | | ○ | |
| | No.1 | 10 | 19.8 | 0 | 2.8 | - | 15~18 | | | |
| | No.2 | 10 | 60 | 0 | Flowing bore | - | 42-60 | | | |
| Panatina | No.1 | 6 | 64 | 2350 | 5.0 | 20.5 | 44.8-64 | Sandstone of Honiara Beds | ○ | |
| | No.2 | 6 | 64 | 680 | | 40.5 | 59.7-64.3 | | ○ | |
| | No.3 | 6 | 48 | 670 | | 20.2 | 44.8-51.5 | | ○ | |
| Ndondo Creek | - | 5 | 15 | 130 | 2.0 | 5.9 | unknown | Alluvial sand | | |

Note : 1) Water intake volume is from SIWA showing average value of June 2005

2) S.W.L is Static Water Level

3) D.W.L is Dynamic Water Level

4). ○ means "in use"

Source : SIWA

(1) Spring Sources

Main rock formation of Honiara City area is limestone, and SIWA took water from springs for drinking. Large fracture system in limestone has developed large cave system where water is flowing like

underground rivers. This is represented by White River (Konglai) Spring. On the other hand, small fractures have formed small springs from which groundwater is seeping out gradually. They are represented by Rove Spring and Kombito Spring. SIWA currently makes use of three springs for water supply. White River Spring is the biggest spring in the suburbs of Honiara City. Water of Matanggungulu River, which is flowing in the west of white River, falls into sinkholes and reaches spring point of White River through cave system.

(2) Groundwater Sources

Groundwater sources for water supply by SIWA are shown in Table B1.5-2. There are 29 boreholes that were drilled in the past, of which 20 boreholes were successful including 11 boreholes by JICA that were drilled in 1997. As shown in Table B1.5-2, aquifer of the existing boreholes is Honiara Beds.

(3) Water sources other than SIWA

Use of spring water is common for domestic purpose by many residents especially in Kombito area. Hand-dug well (shallow well) is not common in Honiara City. Domestic water tank is widely used to store rainwater because rainfall is available throughout year.

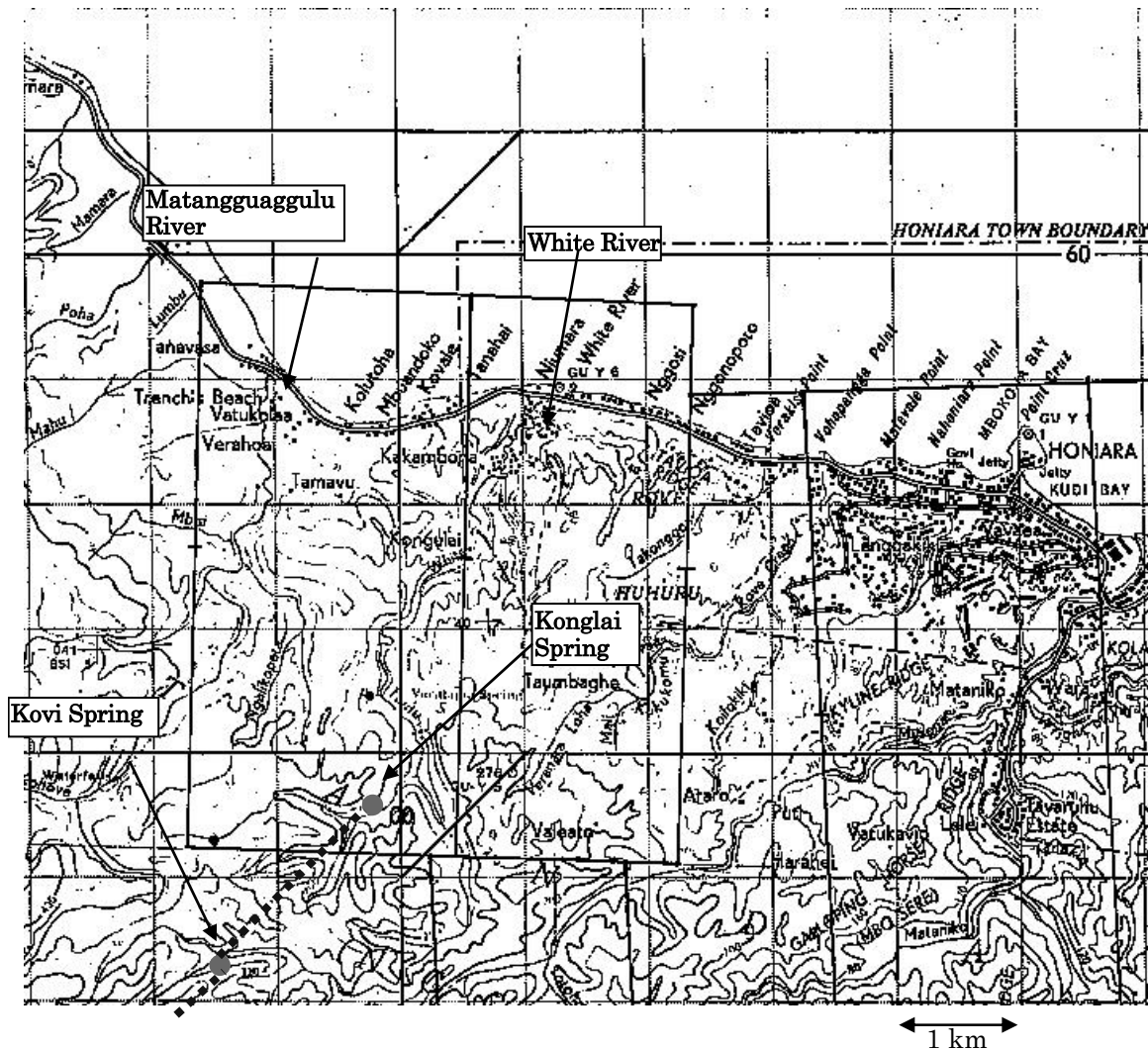
There are few boreholes in Honiara City except for SIWA boreholes. So far there are only three private boreholes in Honiara City. There is regulation that drilling new boreholes must be reported to SIWA and must be registered to MNR. However, its duty is not strictly fulfilled, and SIWA/MNR do not have every information on the existing boreholes. This situation must be improved.

(4) Reduction of discharge from Konglai Spring

Konglai spring is the biggest water sources for water supply for Honiara. Konglai Spring has become in use since 1984 as main water source for water supply to Honiara. However, amount of discharge from the spring has seriously reduced since October 2005. Amount of discharge has not yet recovered when this study is going on in March 2006. Characteristics of Konglai spring and reduction of discharge is summarized below.

Location

Konglai Spring is located at the small branch in the middle of White River. It is impressive at junction between the branch and the main course that the branch has rich in water though main river has only little water in contrast. River water flowing in the down- of White River is mostly from Konglai Spring.

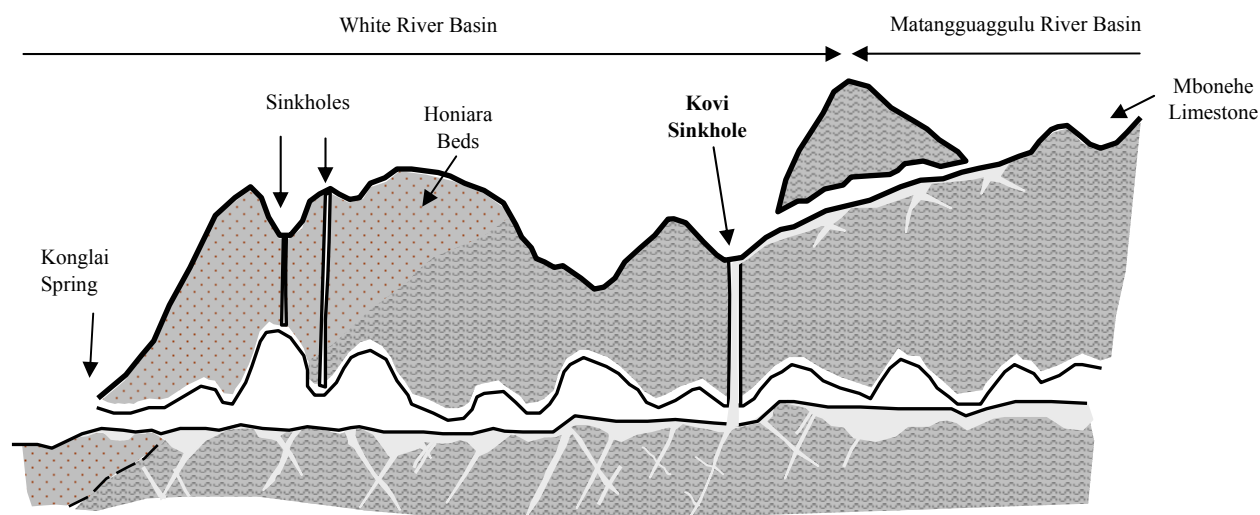


Source : JICA Study Team

Figure B1.5-1 Location of Konglai Spring and Kovi Sinkhole

Geological structure of Konglai Spring

Water flowing within cave system appears in spring point of Konglai. River water other than White River provides water into this cave system. Mbonehi limestone is widely distributed in White River basin and neighboring river basins. There are many sinkholes in the area, which are vertical holes developed by erosion of limestone due to rainfall. Sinkholes reach cave system of underground, and much surface water falls into the cave system though sinkholes (see Figure B1.5-2). It is said that water falling into Kovi sinkhole, which is located in the middle- area of White River, is main water source of Konglai Spring (see Figure B1.5-1). Kovi sinkhole is located in White River basin. It is assumed that water from Matanguaggulu River appears at immediate up part of Kovi sinkhole crossing water-shed. There are several faults crossing above two river basins, which cause connection of river water of the two basins though undergrad case system.



Source : JICA Study Team

Figure B1.5-2 Image of Cave System of Konglai Spring to Kovi Sinkhole

Blockade of sinkhole providing water to Konglai spring

In the past 10 years, water discharge from Konglai Spring was occasionally reduced. SIWA and Ministry of Natural Resources carried out field survey, and they got conclusion that reduction in Konglai spring water is caused by blockage of Kovi Sinkhole. Reduction of spring water of Konglai Spring is continuing since October 2005. Situation has not yet recovered at the end of March 2006. Serious reduction of Konglai Spring water in the past is listed in Table B1.5-3.

Table B1.5-3 Record of Blockages of Konglai Spring

| Year and Period of Blockage | Situation | Reason | Countermeasure | |
|------------------------------|--|---|---|--|
| | | | Water source | Water supply |
| October 1995 to January 1996 | Discharge from Konglai spring was reduced to 1/3 of ordinary water supply volume. | Kovi sinkhole was blocked by gravel and driftwood caused by flood after heavy rain. | Blockage was removed by cleaning. | Water was supplied by rationing. Japanese Grant Aid project was carried out to solve this accident. |
| 1998 | Discharge from Konglai spring was reduced for 3 month. | | | |
| 2004 April to 2004 October | Discharge from Konglai spring was reduced frequently | | | |
| Since October 2005 to date*1 | Discharge from Konglai spring has been reduced to less than 40% of than in the normal condition. | | SIWA staff tried to clear debris in Kovi sinkhole in December 2005, but so far blockage is not removed. | Water is being supplied by rationing. To compensate reduction, counter measures below will be taken. 1) Operation of boreholes in white River area. 2) Increase of pumping rate of Mataniko boreholes. |

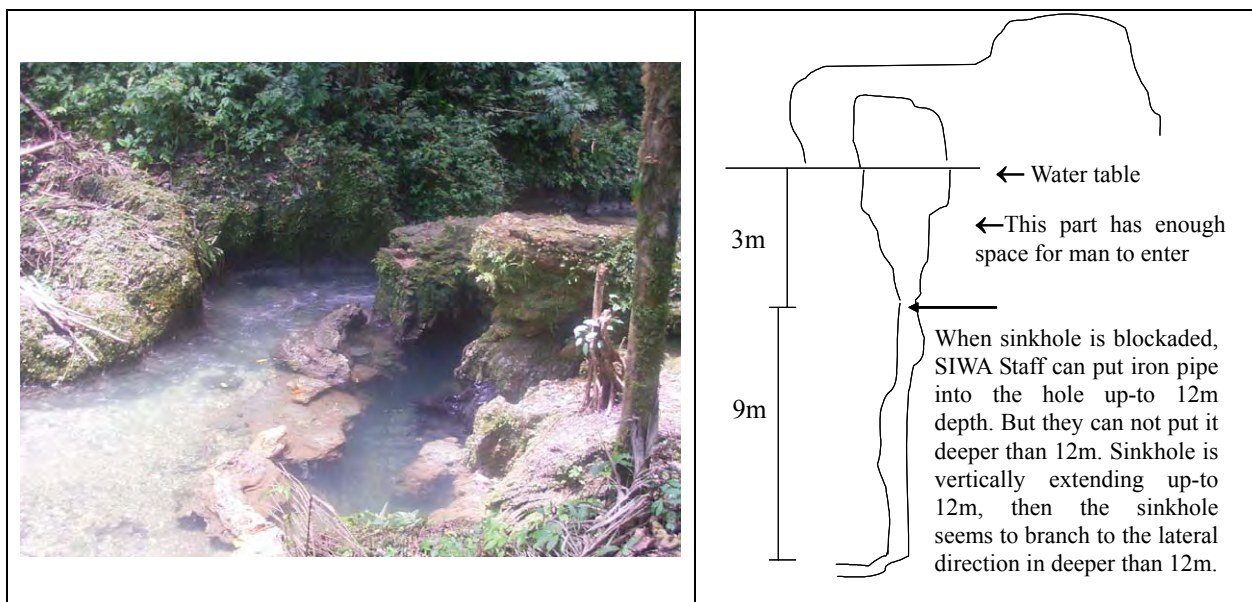
Note : 1. Situation of blockage in Konglai Spring remains the same as of the end of June 2006.

Source : SIWA

Other than serious blockage shown in Table B1.5-3, there were small blockages of Kovi Sinkhole more than five times per year since 1995. Sinkholes were blocked with sand, gravel, driftwood or plants caused by heavy rain and flood. Whenever blockage happened, SIWA staff got rid of materials blocking the sinkhole, and they pushed iron stick into the sinkhole to remove blockage by pushing materials down into sinkhole. However, above method has been not effective so far. Blockage seems becoming more serious as materials inside the sinkhole has been accumulated since 1995. It can not be predicted when blockage is released.

Current discharge from Konglai Spring

From the study in the past, it is clear that main water source to Konglai Spring is river water falling into Kovi Sinkhole. However, surface water from the other small sinkholes and groundwater seeping into the cave connecting to Konglai Spring seems important water source for Konglai Spring. Consequently, in spite of reduction of entering water from Kovi Sinkhole, Konglai Spring will not dry-up by getting water from the other water sources. Even after reduction of discharge, Konglai spring still produces 40% (5000m³/day) of the usual water constantly. SIWA takes all water from Konglai Spring. After heavy rainfall, spring water increases immediately, sometimes recovers 100% of usual water. But it is momentary recovery. It should be noticed that spring water after heavy rainfall has high turbidity.



Source : JICA Study Team

Figure B1.5-3 Blockaded Konglai Spring (December 2005)

Future use of Konglai Spring

Konglai Spring has two problems below:

- (1) Kovi Sinkhole is vulnerable to blockade by flood
- (2) It is restricted by landowner for SIWA to get access to Kovi Spring to remove blockage.

There is no prediction whether Kovi Sinkhole will recover or not. In the long run, it seems that discharge from Konglai Spring will gradually be reduced due to accumulation of materials inside the sinkhole.

SIWA dispatched its staff to Kovi Sinkhole to recover Konglai Spring three times in October to November 2005. Then SIWA is requested payment for their access to Kovi Sinkhole by landowner. It is a problem that the landowners restrict SIWA to restore Kovi Sinkhole. The same situation happened when Kovi Sinkhole was blocked for a long period in 1995. At that time, SIWA was partially restricted to make access to the sinkhole. For the blockage in 1995, the Minister of Land negotiated

with the landowners and paid for recovery of Konglai Spring.

Maintenance of Konglai Spring is difficult because it is vulnerable to heavy rainfall, and its restoration depends on landowner. Therefore, water from Konglai Spring should be gradually replaced by groundwater from boreholes.

B1.5.2 Water Quality

(1) White River

(a) Results of water quality analysis in lab

Water Source:

White River area has five (5) water sources. Bore W1 to Bore W4 and Konglai Spring.

Water samples were collected from Konglai spring and Bore W1 to W4. It is found that the analysis results of these bores satisfy with WHO guideline value except Total Coliform Bacteria. Total Coliform Bacteria is more than 200(MPN/mL) at Bore W1 and 4(MPN/mL) at Bore W3.

(b) Evaluation of Water Quality

- According to the results of water quality analysis, tap water of White River system does not have serious problem.
- Although Manganese is not detected at water sources, the content of Manganese exceeds WHO guideline value at tap. It is considered that Manganese is mixed into a water distribution pipe in process of water distribution.

(2) Rove Creek

(a) Results of water quality analysis in lab

Water Source:

Water sample was collected from Rove spring.

The analysis results do not exceed WHO guideline value. Total Coliform Bacteria is more than 200(MPN/mL) at the water source.

(b) Evaluation of Water Quality

Regarding water quality survey and water quality analysis in Rove creek, the evaluation results can be summarized as below:

- According to the results of water quality analysis, tap water of Rove systems does not have serious problem.
- DO value does not indicate remarkable change from up to down area.
- COD value does not indicate contamination of sea water.

(3) Mataniko River

Water samples were collected from JICA Bore M-2, M-4, SIWA Bore -1 and a tap of Mataniko Skyline system and Mataniko SIWA system.

(a) Results of water quality analysis in lab

Water Source:

Manganese (Mn) content of each bore exceeds WHO guideline value. Total Coliform Bacteria is more than 200(MPN/mg) at Bore M-2 and Bore M-4.

(b) Evaluation of Water Quality

Regarding water survey and analysis in Mataniko river, the evaluation results can be summarized as below:

- According to the results of water quality analysis, tap water of Mataniko systems has no problem.
- Manganese content is decreased at tap water. Manganese can be changed insoluble substance by oxidation thorough the water pipe from bore to tap. It means that insoluble substance is increased in process of water distribution.
- Existence of Manganese may be caused by distribution of geology.
- DO change indicate that Mataniko river is contaminated in the lower reach of the river.
- COD indicate sea water is contaminated in the rainy season.

(4) Kombito creek

Water analysis samples were collected at upper, middle of the river and the Spring-1, 2 and new spring source, tap of Kombito K-1/K-2 system and Kombito spring system. Water analysis samples were also collected from the Mamulele spring and the Mt. Austin spring as new spring sources.

(a) Results of water quality analysis in lab

Water Source:

The analysis results don't exceed WHO guideline value. Total Coliform Bacteria is 5(MPN/mL) at Bore K-1 and 17(MPN/mL) at Bore K-2.

(b) Evaluation of Water Quality

Regarding water survey and analysis in Kombito creek, the evaluation results can be summarized as below:

- According to the results of water quality analysis, tap water is considered as contaminated by Coliform Bacteria. And content of Total Coliform Bacteria is increased at a tap as compared with water source. It is assumed that Coliform Bacteria is going mixed and increasing in process of water distribution.
- DO change indicate that river water is highly contaminated at survey point No.3. There is a small hog farm at up area of survey point No.3.

(5) Panatina area

Water samples were collected from bore-1, 2, 3, Panatina tank and tap water of Panatina system.

(a) Results of water quality analysis in lab

Water Source:

The analysis results do not exceed WHO guideline criteria. Total Coliform Bacteria has not been detected at each Bore.

(b) Evaluation of Water Quality

Regarding water survey and analysis in Panatina area, the evaluation results can be summarized as below:

- No water quality item of Panatina Bores exceeds WHO guideline value. Water of the Panatina Bores and tap water have no problem.

(6) Lungga River

Water samples were not collected.

(a) Evaluation of Water Quality

Regarding water survey and analysis in Lungga river, the evaluation results can be summarized as follows:

- Lungga river is the largest river of Honiara area. It is difficult to evaluate the water quality of the Lungga river from only water survey result.
- According to DO value, each result of survey point No.1 and No.2 does not indicate a remarkable difference and considering from high DO value, Lunga river does not show remarkable contamination.

B1.6 Sewerage System

B1.6.1 Issues for Sewage Drainage and Treatment Service

Issues for sewage drainage and treatment service in Honiara are summarized as shown in Table B1.6-1.

Table B1.6-1 Current Situation and Issues for Sewerage System in Honiara

| Component | Current Situation | Issues to be solved |
|------------------------|---|---|
| Sewage collection | Only about 13% of the population (7,450 persons) has connection to sewer system of SIWA as registered. Other 87% of the people (52,915 nos.) have septic tank. | SIWA has no plan to expand sewer system for short and mid-term goal because wastewater treatment system can not be realized under the small investment budget of SIWA and the expansion of sewer network will result in just increasing the pollutant in the public water body. |
| | Taking sludge from septic tanks of the ordinary households is usually done by Honiara City Council or private maintenance company. However, they can not cope with the requirements from the people because of the shortage of manpower and vehicles. Therefore, sewage is flooding from the tank and drained into the river, causing contamination of the river. | SIWA is desirous of taking over the operation and maintenance of the septic tanks. SIWA will do a regular maintenance of the tank and make a proper treatment of sludge in the sludge treatment facility to be constructed at the Alligator Creek. |
| Drainage and discharge | Sewage drained by sewer pipeline in some areas is designed to be discharged into the sea by outfalls. However, the outfall structures are very old and have been damaged in cyclones over the years. The sewage generally now discharges at or near the shoreline. Therefore, there will be some fear that this situation causes pollution and a hazard to human health. | The outfall structure needs rehabilitation or restructuring. In the study, the water quality survey at the seashores was executed. It indicates that the sea water is not contaminated by sewage. This is because the sewage volume discharged into the sea (2,400m ³ /day) is very small. |
| Treatment | <ul style="list-style-type: none"> ➤ There are three (3) communal septic tanks in Tuvaruhu, Vara Creek and Rove area. These tanks serve only for about 50 households. ➤ Central Hospital has its own wastewater treatment plant. ➤ Private companies such as Solbrew Brewery and Solomon Tobacco have their own wastewater treatment plant. ➤ There are no other treatment facilities in Honiara. | Investment budget which SIWA can allocate for improvement of infrastructure is very small and SIWA does not have technical staff to do operation and maintenance of the full-scale wastewater treatment plant. Therefore, formulation of the plan for wastewater treatment facility is not practicable in this study. |

Source : SIWA

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

(1) Sewage Volume

Sewage volume in Honiara can be estimated from the current water distribution volume and leakage ratio in the water supply system as follows.

Table B1.6-2 Sewage Volume in Honiara

| Population (2005) | Water Distributed (m ³ /day) | Effective Water Ratio | Water Supplied (m ³ /day) | Connected to Sewer (person) | Discharge per Person (LCD) | Discharged to River and Sea (m ³ /day) |
|-------------------|---|-----------------------|--------------------------------------|-----------------------------|----------------------------|---|
| 66,402 | 25,719 | 0.6 | 15,431 | 7,450 (11.2%) | 334 | 2,490 (16.1%) |

Source : JICA Study Team

(2) Water Quality

Field water quality survey has been done in the river, at the river mouth and outfalls in seashore for confirming the extent of contamination by sewage discharge from the surrounding areas.

The location of the survey point and the results of water quality analysis at the site are summarized in Table B1.6-3 below.

Table B1.6-3 Water Quality Survey at Public Waters

| Site Name | Survey Point | Description |
|----------------|---------------------------------------|---|
| White River | Up to down | Decrease of DO indicate that White River is contaminated in the lower reach of the river, especially from survey point No.4 to mouth of the river. Along the lower reach of survey point No.4 of the White River, there exist some villages. It seems that contamination of the river water is caused by the domestic wastewater from the villages. |
| | Entry of the river | DO indicates contamination of water at the mouth of the river. |
| | Seashore near the entry of the river | COD at seashore do not indicate contamination of water. COD value is 2mg/L not more than Japanese guideline value of 2mg/L. |
| Rove Creek | Up to down | DO is not show remarkable change from up to down. |
| | Entry of the river | DO does not indicate high contamination at the mouth of the river. |
| | Sea shore near the entry of the river | COD at sea do not indicate contamination of water. COD value ranges from 0 to 2mg/L. |
| Mataniko River | Up to Down | Decrease of DO at down, from survey point No.1 to mouth of the river. Along the Mataniko River, the lower reach of survey point No.1, there exist some of villages. It seems that contamination of the river water is caused by the domestic wastewater from the villages. |
| | Entry of the river | DO indicate contamination at the mouth of the river. |
| | Sea shore near the entry of river | COD indicate contamination at sea shore in rainy season. |
| | Outfall of sewage discharge | DO around waste water outfall are decreasing toward to down. It indicate that Mataniko River is contaminated at down. |
| Kombito Creek | Middle reach | DO value indicate that river water shows high contamination at survey point No.3. There is a small hog farm at up of survey point No.3. |
| Lungga River | Middle reach | According to DO value, each result of survey point No.1 and No.2 does not indicate a remarkable difference and considering from high DO value, Lunga river does not show remarkable contamination |
| Outfalls | | Honiara area has eleven(11) outfalls in its coast line and two(2) outfalls along the Mataniko river(DO change of outfalls along the Mataniko river are shown above). Some of outfall show high contamination of sea water and it was caused by concentration of waste water from residential area at the morning time. Although COD shows high value in the morning, the other survey results of each point is less than 2mg/L. It is considered that sea water does not show remarkable contamination except during the concentrate of waste water. So far, sea water does not show remarkable contamination in Honiara costal zone. Although drain pipes extend to offshore, there are many drain pipes that break at near the beach and waste water is leaking from there. Remarkable contamination of sea water is not shown at that point, however, some points have strong smell and residents live near the points. Therefore it is considered that repairing and amendment of drain pipes are needed. |

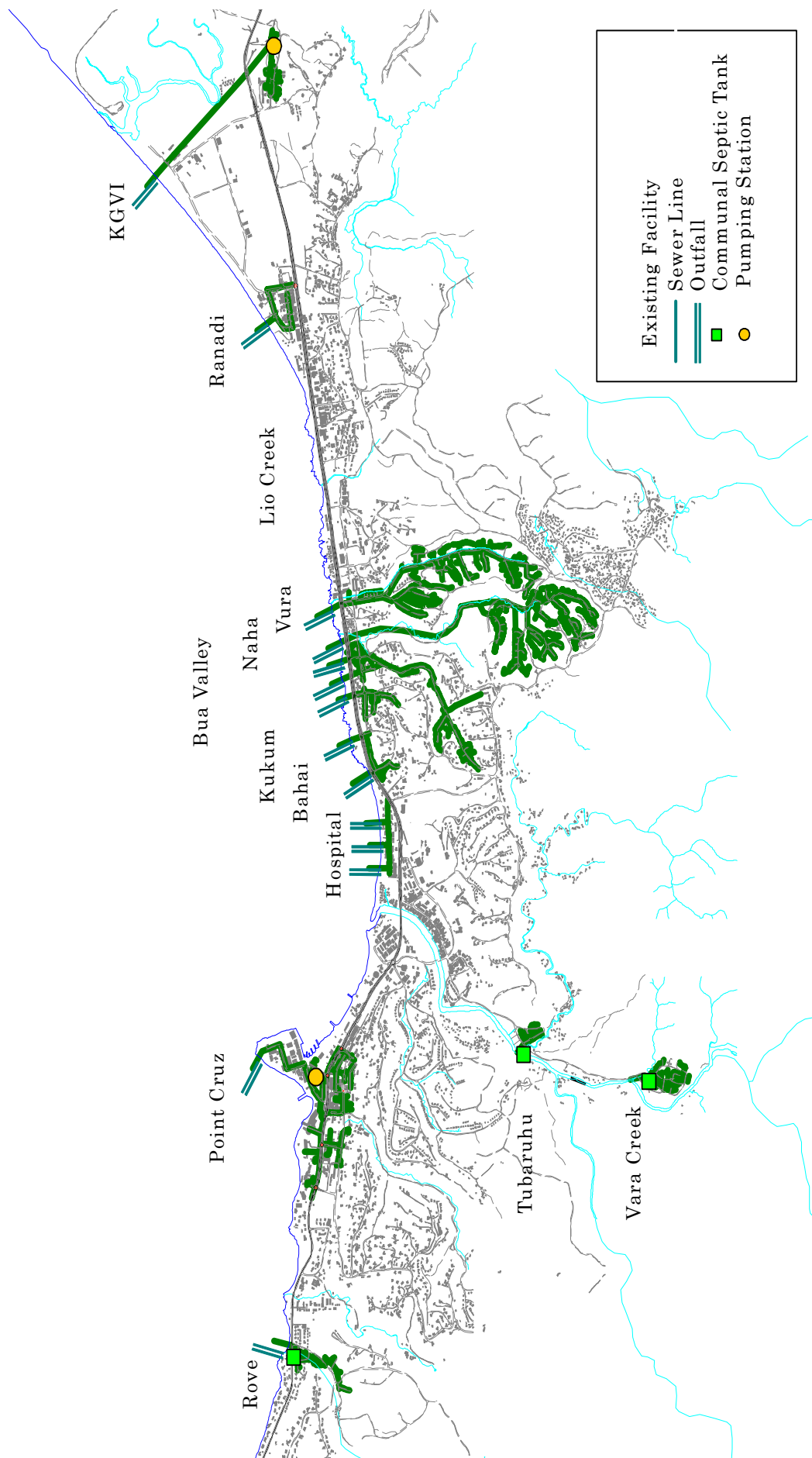
Source : JICA Study Team

B1.6.3 Outline of Existing Sewerage System

As mentioned in Table B1.6-3, 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.

Layout of the existing sewerage system is shown in Figure B1.6-1.



Source : JICA Study Team

Figure B1.6-1 Existing Sewerage System in Honiara

Conditions of existing sewerage facilities for each sewerage area are mentioned as follows.

(1) Rove

Rove system is about 1.8 km west of Point Cruz. The current serviced area actually mainly lies within the Tasahe valley catchment, on either side of the Tasahe valley road. The system drains to a septic tank and thence to an outfall, which as a result of storm damage now discharges just below the shoreline.



Rove Outfall

(2) Point Cruz

(a) Overview

Point Cruz catchment may be thought of as all the sewers currently draining to the Point Cruz Pumping Station (PS) and comprising two separate sub-catchments:

- Point Cruz West - a main sewer runs along Mendana Avenue to a point opposite the Honiara Tama Sports Ground, some 700 m from the PS. Minor branches southwards serve properties to the 'Anthony Saru' building on Hibiscus Avenue, and up Mud Alley to serve a 250 m length of Hibiscus Avenue including the King Solomon Hotel.
- Point Cruz East - a main sewer serves the main town centre including Mendana Avenue as far east as the Shell depot (350 m from the PS), with minor branches southwards to serve properties up to and behind Hibiscus Avenue.



Point Cruz Outfall

Outfall has been damaged by storm and discharges just along the shoreline.

(b) Point Cruz PS

The pumping station is of the wet-bore/dry bore type. It contains 3-number of Sigmoid pumps fitted with 7.45 kW motors, each of which is designed to discharge 34.05 L/s with 5.79 m head. In addition, the recent placement of a submersible pump in the wet bore was undertaken to boost peak wet-weather performance.

Sewage pumping stations normally collect a quantity of grit and debris in the wet-bore. They need to be cleaned out regularly to maintain bore capacity and to ensure grit does not pass through the pumps.



Point Cruz Pumping Station

(3) Mataniko River System

(a) Vara Creek

This small settlement is located in the valley of a branch creek, about a kilometer up of the Chinatown bridge. The village is fully sewered - all household wastes drain to a communal septic tank that is located near the confluence with the Mataniko River. Treated water from communal septic tank is discharged to Mataniko River. The septic tank is managed by SIWA, but cleaning and desludging work is subcontracted to maintenance section of Honiara City Council or private sector. When the study team inspected it, untreated wastewater overflowed on the top slab of the tank.



Vara Creek Communal Septic Tank

(b) Tuvaruhu

Another small settlement is located in about a kilometer up from Vara Creek. This village is also fully seweraged to a septic tank. The septic tank is also managed by SIWA. Effluent from outlet is discharged into the creek through the soak away pit. The septic tank is located near the Mataniko bore and there is a worry that effluent may contaminate water source of the bore.

It is estimated that the amount of wastewater generated from Vara Creek and Tubaruhu villages exceed maximum capacity of existing communal septic tanks in both cases.

Both tanks need cleaning out regularly and the opportunity should be taken to check their internal conditions at the same time. Suitable arrangements need to be set in place for regular desludging thereafter.



Tuvaruhu Communal Septic Tank

(4) Kola'a

Central Hospital - National Referral Hospital -

(a) Overview

The Central Hospital— also known as the 'National Referral Hospital' is a large facility comprising wards, operating theatres, day clinic, kitchen and laundry, mortuary and post-mortem room, etc. It occupies a site of some 6 ha north of the Kukum Highway just east of the Mataniko River.



Discharge Point at Central Hospital

This has included new foul drainage and a small treatment plant. Facilities within the compound belong to the hospital, not to SIWA.

Though it is stated that there are three to six outfalls in the yard of the hospital, not all of the outfalls have been identified because some of them are damaged or no longer in use. These may have extended into the sea initially, but have been cut short and now end above the shoreline.

(b) Wastewater treatment plant

The treatment plant is of the 'rotating biological contactor' type, is located in the front yard of the hospital on the west boundary. The rotating plant is housed in a small, green fiberglass shed, which appears to limit the access of the air needed for effective treatment. It is fed by an inlet pump station (submersible - two number fixed pumps with valving in the wet bore) and accompanied by pre- and post- settling basins, which have no scum baffles or sludge removal equipment. There is no disinfection of the final effluent. The plant does not discharge to an outfall, but to the storm drain along the front boundary of the hospital.

Although wastewater from medical activities may contain chemical substances which may cause serious health hazard to human body, treatment process is minimal.

(5) Baha'i

There are two outfalls which are only 250 m apart from each other and both are located at the shore. The line of the west outfall pipe could be seen under water and there were signs of an obvious sewage slick in the sea. Leakage from the crack of outfall was identified. The east outfall could be followed to its current end on the edge of a small islet.



Baha'i Outfall West

(6) Kukum/Mbua Valley

There are three outfalls named 'Kukum'. Nos. 1 and 2 each serve a small pocket of development between the highway and the hills behind. The No. 3 system was later extended at or near its upper end to form the outlet to the Mbua Valley scheme. It is therefore sometimes called by that name. In this report, the name "Mbua Valley" is applied.

All three outfalls are close together - within 250 m - and No 1 (West) is only 300 m from the Baha'i (East) outfall. The No. 1 outfall is located offshore from the car park of the 'Club Supreme' Casino on Kukum Highway, while No. 2 is located at the other end of the casino complex, beyond the adjacent squash courts. Both appeared to be discharging into relatively shallow water.



Kukum Outfall West



Kukum Outfall East



Mbua Valley Outfall

(7) Naha Valley

This is another substantially-developed densely settled area stretching back into the hills. The outfall pipeline has a long land section (about 800 m) without any connections. The outfall has been broken by storm damage and not been repaired yet.

According to Honiara City Council, this outfall had been used to dispose of sludge from septic tanks. However, there were complaints from citizens against disposal of untreated sludge into the sea so that the city council stopped disposal of sludge at this outfall (precisely, manhole of Naha Valley outfall) and started transporting of sludge to the landfill site.



Naha Valley Manhole

(8) Vura

This is yet another substantially-developed, densely settled area stretching back into the hills. The outfall is larger than many others, having regard to the catchment size. SIWA intends to replace the present cast iron outfall pipe deteriorated for many years with a new polyethylene pipe.



Vura Outfall

(9) Ranadi

(a) Ranadi West

The Ranadi industrial estate include the area (about 10 ha) which has a sewerage service. The outfall pipeline runs through the yard of glass industry and the tip of outfall is anchored on the shore. This outfall has been replaced after ethnic tension. The former pipe made of cast iron has been replaced with PVC-made one.



Ranadi Outfall

(b) Solbrew Brewery

According to Aus AID report, the brewery has its own wastewater treatment plant, of the anaerobic type, possibly a UASB reactor. The treatment plant discharges to a stormwater outlet, leading to the shore. The company management indicated that they would take a commercial decision on whether to discharge to sewer (at such time as it may be provided). The cost of compliance with the new

Environment Act would be a major factor in this. During the survey period, the study team did not identify the existence of treatment plant.

(10) King George VI School

This is a self-contained system serving this residential school. The sewer network drains to the 'KGVI' pumping station which discharges through a kilometer long rising main to a 250 m gravity outfall. Along the gravity section the Solomon Soap factory has a service.

The outfall has been broken off under the sand and washed away completely. In present, untreated industrial wastewater containing soapy water from Solomon Soap factory is discharged at the coast and a white liquid with a highly soapy smell boring up just at the water line was observed.



Cost near the KG VI Outfall

The pump station comprises a compound with a small building containing two fixed submersible 'Lee Howl Non-clog' pumps driven by ground-level 3 kW motors. All pipe work and valves are located within the wet bore, an difficult arrangement for maintenance. One fixed pump had a missing motor and its place had been taken by a submersible pump of unknown size.



KG VI Pump Station

The pumping station was not operating when the site was inspected because King Gorge School was closed during vacation. Water level of the wet bore was below the operation level because there was no inflow generated from the school. Moreover, it seemed that electricity had not been supplied since before. It was assumed that service of electricity had been stopped due to SIWA's default of payment for electric bill.

B2 Mid-term Facility Improvement Plan

B2.1 Water Demand Projection

B2.1.1 Design Population

(1) Population inside City Boundary in 1999

For the design population at the target year of 2010, the population adopted in the AusAID report shall be applied in this Study. The population projection in the report is based on the latest national census conducted in 1999. The national census population inside the city boundary in 1999 is as shown in Table B1.2-1.

As shown in the table, the population within the Honiara city boundary in 1999 census was 49,107. Although ethnic tension on Guadalcanal at the time of the census resulted in many people leaving Honiara and returning to other provincial centers and villages, it is assumed that all these people have returned to Honiara after the termination of ethnic tension.

Therefore, the population of 1999 census is applied as a basis of future population projection in this Study.

(2) Design Population in 2005 and the Target Year of 2010

The national birth rate was estimated as 2.8% in the 1999 National Census. According to the AusAID report, the population growth rate for Honiara adopted is 3.5% to allow for migration into the city. This rate shall also be adopted in this report.

Meanwhile, there are urban developed areas adjacent to and still outside Honiara city boundary, which are included in SIWA's service area. The population outside the city boundary is estimated as 10% of the population of the inside city boundary.

Thus, the design population for Honiara city in 2005 and 2010 to be applied for the facility improvement plan in this Study shall have a population inside the city boundary and that of the outside urban area. The design population for the facility improvement plan is estimated as follows.

Table B2.1-1 Design Population Projection for Honiara City in 2005 and 2010

| Year | Population inside city boundary | Population outside city boundary | Design Population | Household | Average Number of Family Member |
|------|---------------------------------|----------------------------------|-------------------|-----------|---------------------------------|
| 2005 | 60,365 | 6,037 | 66,402 | 9,352 | 7.1 |
| 2010 | 71,695 | 7,170 | 78,865 | 11,108 | 7.1 |

Source : Predicted by the Study Team using data from Department of Statistics.

B2.1.2 Number of Customers and Served Ratio

(1) Number of Customers

According to the AusAID report, it has been assumed that the number of domestic customer will increase at the rate of 5.9% p.a. until 2010 and the number of large water users such as commercial, government and major customers will increase by 1.0% p.a. Thus, the number of customers in 2010 as shown in Table B2.1-2 shall be adopted.

Table B2.1-2 Number of Customer in 2010

| Customer's Name | Number of Customer |
|-----------------|--------------------|
| Domestic | 7,238 |
| Commercial | 648 |
| Government | 208 |
| Major customers | 274 |
| Total | 8,368 |

Source : Predicted by the Study Team using data from SIWA.

(2) Served Ratio

The served ratio in 2010 is estimated through the number of active customer. Using the obtained data as in Table B2.1-1 and Table B2.1-2, the served ratio of 2010 is calculated as follows.

Table B2.1-3 Served Ratio in 2010

| Year | Population | Customer | Served Population | Served Ratio (%) |
|------|------------|----------|-------------------|------------------|
| 2010 | 78,865 | 8,368 | 61,520 | 78.0 |

Source : Calculated by the Study Team using data from SIWA

B2.1.3 Water Consumption

(1) Water Consumption in 2010

The water consumption in 2010 is shown in Table B2.1-4.

Table B2.1-4 Water Consumption in 2010

| Category | Population | Customer | Effective Water Consumption | Effective Water Consumption | Served Pop. | Per Capita Consumption |
|-------------------|------------|----------|-----------------------------|-----------------------------|-------------|------------------------|
| | (No.) | (No.) | (m ³ /year) | (m ³ /day) | | |
| Domestic | | 7,238 | 3,692,998 | 10,118 | 61,520 | 164 |
| Large Users | | 1,130 | 3,005,614 | 8,235 | | |
| - Commercial | | 648 | 1,684,046 | 4,614 | | |
| - Governments | | 208 | 752,996 | 2,063 | | |
| - Major Customers | | 274 | 568,572 | 1,558 | | |
| Whole Honiara | 78,865 | 8,368 | 6,698,612 | 18,352 | 61,520 | 298 |

Source : Calculated by the Study Team using data from SIWA

(2) Per Capita Consumption for Domestic Customers

As shown in the above table (Table B2.1-4), per capita consumption for domestic customers is 164L/cap/day in average. However, it actually varies from 150 to 183L/cap/day in the water distribution areas as shown in Table B2.1-5. Therefore, actual per capita consumption (150 to 183L/cap/day) shall be applied to the network analysis of the water supply system in Honiara city.

Table B2.1-5 Per Capita Consumption for Each Water Distribution District

| Water Distribution District | Per Capita Consumption (LCD) |
|-----------------------------------|---------------------------------|
| Konglai Spring (Gravity) - Tasahe | 150 |
| Tasahe | 171 |
| Titinge - Skyline | 171 |
| Rove Spring | 153 |
| Mataniko | 147 |
| Skyline - Mataniko | 153 |
| Borderline - Kombito | 158 |
| Panatina - Kombito | 183 |
| Average | 164 |

Note : For water distribution district, refer to Figure B2.3-2.
Source : SIWA

(3) Large Water Users' Consumption

Consumption of the large water users in 2005 is as shown in Table B2.1-6. The consumption in 2010 has been estimated using growth rate of 1.0% p.a.

Table B2.1-6 Large Water Users' Consumption in 2010

| User's Name | Ave. Dauly Consumption (m ³ /day) |
|--------------------------|---|
| Prison | 499 |
| Mendana Hotel | 284 |
| King Solomon Hotel | 200 |
| Iron Bottom Sound Hotel | 200 |
| Honiara Hotel | 200 |
| Quality Motel | 200 |
| Casino Hotel | 200 |
| SICHE Kukum campus | 347 |
| SICHE Panatina campus | 347 |
| Betikama High School | 168 |
| King George VI School | 168 |
| Solbrew | 315 |
| Central Hostpital | 736 |
| Port Authority | 1,261 |
| Solomon Soap | 42 |
| Ranadi Industrial Area-1 | 189 |
| Ranadi Industrial Area-2 | 179 |
| Ranadi Industrial Area-3 | 179 |
| CBD 1: Works | 410 |
| CBD 2: PM's Area | 410 |
| CBD 3: NPF Area | 473 |
| CBD 4:Shops | 473 |
| Henderson Airport | 210 |
| Chinatown 1 | 273 |
| Chinatown 2 | 273 |
| total | 8,236 |

Notes:

SCHIE = Solomon Islands College of Higher Education

CBD = Central Business District

PM = Prine Ministrer

NPF = National Provident Fund

Source : SIWA

B2.1.4 Water Demand

Although some of the water distribution pipelines will be rehabilitated up to 2010 by own effort of SIWA, effective water ratio for 2010 is considered as 0.6 which is applied for the water demand in 2005 because the leakage ratio will be increased up to 2010 due to further deterioration of water supply system.

As shown in the table, maximum daily water demand in 2010 is 30,587m³/day.

Table B2.1-7 Daily Water Demand in 2010

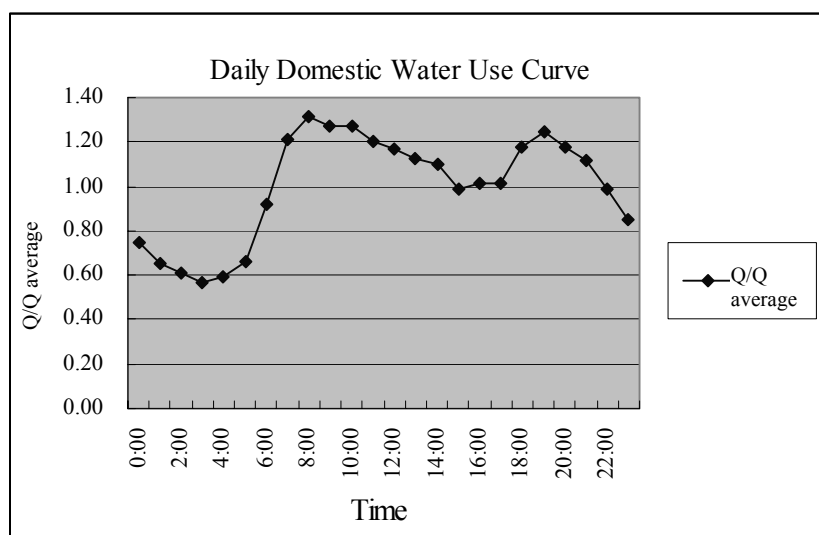
| Category | Customer (No.) | Effective Water Consumption per year (m ³ /year) | Effective Water Consumption per day (m ³ /day) | Served Pop. (No.) | Per Capita Consumption (LCD) | Per Capita Water Demand (LCD) | Max. Daily Water Demand (m ³ /day) |
|-----------------------------|-------------------|--|---|-------------------------|------------------------------------|--|--|
| Domestic | 7,237 | 3,692,998 | 10,118 | 61,520 | 164 | 274 | |
| Large Users | 1,131 | 3,005,614 | 8,235 | | | | |
| -Commercial | 648 | 1,684,046 | 4,614 | | | | |
| -Governments | 208 | 752,996 | 2,063 | | | | |
| -Major Customers | 274 | 568,572 | 1,558 | | | | |
| Whole Honiara | 8,368 | 6,698,612 | 18,352 | 61,520 | 298 | 497 | 30,587 |
| Effective water ratio = 0.6 | | | | | | | |

Source : Calculated by the Study Team using data from SIWA

B2.1.5 Daily Water Consumption Patterns

(1) Domestic Demand Daily Variations

The domestic demand daily variations were observed to obtain the hourly peak factor through the flow measurement in the leakage survey at the model areas. The daily domestic water use curve compiled as a basis for planning is as shown in Figure B2.1-1.



Source : JICA Study Team

Figure B2.1-1 Domestic Daily Water Usage Curve

From the above curve, a peak daily demand rate of 1.4 times the daily average usage has been adopted for planning water supply facilities.

(2) Large Water Users Daily Water Variation

According to the AusAID report, the peak daily demand ratio of large water users is considered slightly less than that of domestic daily water usage. Thus, the peak daily demand ratio of large

water users is set as 1.3 for planning.

(3) Seasonal Demand Variations

According to the water production volume from January to May 2005, the seasonal demand variations are from 0.92 to 1.05. Therefore, it has been assumed that demands are constant throughout the year.

B2.2 Potential Projection of Water Source Development

B2.2.1 Surface Water and Spring

(1) Criteria of exploitable surface water

Normal river flow

Exploitable discharge of surface flow is commonly defined as the difference of (low-water discharge) and (normal flow of the river). Normal flow is composed of maintenance flow discharge and intake water volume at downstream area. In objective rivers, no water intake facilities at downstream area is identified. Therefore, normal flow is equivalent to the maintenance flow discharge.

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

Exploitable flow discharge shall be defined as follows,

$$\begin{aligned} &\text{Exploitable flow discharge} \\ &= (\text{Low-water flow of the river}) - (\text{Maintenance flow discharge}) \\ &\text{Maintenance flow discharge} \\ &= 0.3\text{m}^3/\text{s}/100\text{km}^2 \times \text{Area of river basin}(\text{km}^2) \end{aligned}$$

Environmental aspect

As an another criteria, exploitable discharge was evaluated from the point of social environmental aspect, such as local people water use, condition of water quality such as turbidity and bad smell. Even if river flow is exploitable from the point of normal discharge aspect, when water use of local people or water quality is seemed to be deteriorated at field survey, the potential of water exploitation is evaluated to be difficult.

(a) Honiara area

Below table shows the summary of exploitable surface water use in Honiara area. White river, Rove Creek and Kombito rivers have a little room to exploit water flow in terms of keeping normal river flow, however those are used by local people living in the water source area for tapping, bathing, washing. And the downstream portion of the rivers functions as a drain, so dirty domestic waste water pour into the rivers, which deteriorate the river environment such as white turbidity and smelling bad. This means the current water flow volume at downstream area have not enough to clarify the river flow, therefore current water flow volume shall be kept for environmental aspect.

For this reason, exploitation potential of surface water flow shall be avoided.

Table B2.2-1 Summary of Exploitable Surface Water in Honiara Area

| Water resource | Potential of exploitable surface water | |
|----------------|--|--|
| | From normal flow | From environmental aspect |
| White river | $0.022\text{m}^3/\text{s}(1,900\text{m}^3/\text{s})$ | 0 |
| Rove creek | $0.040\text{m}^3/\text{s}(3,456\text{m}^3/\text{s})$ | 0 |
| Mataniko river | $1.099\text{m}^3/\text{s}(94,954\text{m}^3/\text{s})$ | $1.099\text{m}^3/\text{s}(94,954\text{m}^3/\text{s})$ |
| Kombito Creek | $0.016\text{m}^3/\text{s}(1,382\text{m}^3/\text{s})$ | 0 |
| Lungga river | $14.87\text{m}^3/\text{s}(1,284,768\text{m}^3/\text{day})$ | $14.87\text{m}^3/\text{s}(1,284,768\text{m}^3/\text{day})$ |

Source : SIWA

On the other hand, as Mataniko and Lungga River have large water flow discharge due to their large basins, those have enough room to accommodate water demand for Honiara area.

(b) White River

Most of the river flow is originated from Konglai Spring. And distribution of water use of it is shown in Table B2.2-2.

Table B2.2-2 Distribution of Konglai Spring Water

| Utilization of spring water | Volume of water (m ³ /s) |
|--------------------------------------|--|
| River basin | 10.2km ² |
| Extract to pump station | 0.130m ³ /s |
| Spill out to the river | 0.053m ³ /s |
| (Specific flow of the river) | 0.52m ³ /s/100km ² |
| Total water volume of Konglai Spring | 0.183m ³ /s |

Source : SIWA

From the spring, water of 0.13 m³/s (11,232m³/day) is withdrawn to the pump station for the domestic use in Honiara area as SIWA water resources. Rest of the spring water, which is spill out from the basin, is approx 0.053m³/s. (4,579m³/day) as the result of field survey. Totally yield of water is estimated to be approx. 0.183m³/s. About 71% of spring water is exploited as of 2005.

On the other hand, Maintenance stream flow is estimated about 0.031m³/s from it is basin.

$$\begin{aligned} \text{Maintenance flow} &= 0.3\text{m}^3/\text{s}/100\text{km}^2 \times \text{area of river basin } 10.2\text{km}^2 \\ &= 0.031\text{m}^3/\text{s} \end{aligned}$$

Therefore, potential of exploitation volume is about 0.022m³/s.

$$\begin{aligned} \text{Exploitable volume} &= 0.053\text{m}^3/\text{s} - 0.031\text{m}^3/\text{s} \\ &= 0.022\text{m}^3/\text{s} \end{aligned}$$

On the other hand, domestic waste water inflows into the river at the downstream area and make the quality of the river water deteriorated and smelled. This means that the current river flow have not enough volume to clarify the waste water. If river flow decrease, deterioration of river water would be proceed. From the point of water quality, current through-flow volume from the spring is recommended to keep downstream environment.

Thus, further extract of spring should be avoided from the environmental aspect.

Table B2.2-3 Exploitable Surface Water of White River

| Criteria | Potentiality of exploitation of river flow | |
|----------------------|--|-----------------|
| | Volume of water | Occupation rate |
| Maintenance flow | 0.022m ³ /s(1,900m ³ /day) | 41.5% |
| Environmental aspect | 0 | 0 |

Source : SIWA

(c) Rove Creek

Table B2.2-4 shows the river flow distribution of Rove Creek.

Table B2.2-4 River Flow Distribution of Rove Creek Water

| Distribution of river flow | Volume of water (m ³ /s) |
|---------------------------------------|---|
| Area of basin | 4.8km ² |
| River flow | 0.036m ³ /s |
| (include spring water) | 0.015m ³ /s |
| Spill out from SIWA resources | 0.018m ³ /s |
| Total flow of river | 0.054m ³ /s |
| (Specific flow of river of the river) | 1.1m ³ /s/100km ² |

Source : SIWA

In Rove creek, river flow is about 0.036m³/s including small spring of about 0.015m³/s yield of water, and the spill out flow of 0.018m³/s from exiting SIWA resource. Totally 0.054m³/s of water flows to the downstream area.

Maintenance stream flow of the Creek is estimated about 0.014m³/s. From this point, about 0.040m³/s river flow have a probability of exploitation.

$$\begin{aligned} \text{Maintenance flow} &= 0.3\text{m}^3/\text{s}/100\text{km}^2 \times \text{area of river basin } 4.8\text{km}^2 \\ &= 0.014\text{m}^3/\text{s} \end{aligned}$$

$$\begin{aligned} \text{Exploitable volume} &= 0.054\text{m}^3/\text{s} - 0.014\text{m}^3/\text{s} \\ &= 0.040\text{m}^3/\text{s} \end{aligned}$$

However, this river flow is used as tapping water, bathing and washing at upstream area. And further, there is a Botanic Garden at the downstream area of outlet of river valley, where rove creek flow feed its natural environment. To keep the environment condition of the garden and to keep local people water use, it is important to maintain through-flow water. Thus further extract of water from the creek should be avoided.

Table B2.2-5 Exploitable Surface Water of White River

| Criteria | Potentiality of exploitation of river flow | |
|----------------------|--|-----------------|
| | Volume of water | Occupation rate |
| Maintenance flow | 0.040m ³ /s(3,456m ³ /day) | 74.1% |
| Environmental aspect | 0 | |

Source : SIWA

(d) Mataniko River

Table B2.2-6 shows the river flow distribution of Rove Creek.

Table B2.2-6 Distribution of Mataniko Creek Water

| Distribution of river flow | Volume of water (m ³ /s) |
|------------------------------|---|
| Area of basin | 57.8km ² |
| River flow | 1.272m ³ /s |
| (Specific flow of the river) | 2.2m ³ /s/100km ² |

Source : SIWA

Mataniko River has relatively large basin of 57.8km², so that water flow volume is large as 1.272m³/s, and 2.2m³/s/100km² as specific flow, which is larger than Japanese standard of maintenance flow of 0.3m³/s/100km².

Potential of exploitation of the river flow is estimated as follows,

$$\begin{aligned} \text{Maintenance flow} &= 0.3\text{m}^3/\text{s}/100\text{km}^2 \times \text{area of river basin } 57.8\text{km}^2 \\ &= 0.173\text{m}^3/\text{s} \end{aligned}$$

Therefore, potential of exploitation volume is about 0.022m³/s.

$$\begin{aligned} \text{Exploitable volume} &= 1.272\text{m}^3/\text{s} - 0.173\text{m}^3/\text{s} \\ &= 1.099\text{m}^3/\text{s} (94,954\text{m}^3/\text{day}) \end{aligned}$$

Table B2.2-7 Exploitable Surface Water of White River

| Criteria | Potentiality of exploitation of river flow | |
|----------------------|---|-----------------|
| | Volume of water | Occupation rate |
| Maintenance flow | 1.099m ³ /s(94,954m ³ /day) | 86.4% |
| Environmental aspect | 0 | 0 |

Source : SIWA

(e) Kombito Creek

Table B2.2-8 shows the river flow distribution of Rove Creek.

Table B2.2-8 Distribution of Mataniko Creek Water

| Distribution of river flow | Volume of water (m ³ /s) |
|----------------------------|--|
| Area of basin | 10.7km ² |
| Useful River flow(spring) | 0.048m ³ /s |
| Specific flow of the river | 0.45m ³ /s/100km ² |

Source : SIWA

In Kombito Creek, two (2) springs at upstream area originate the creek flow, which is useful for domestic water. Total water flow is about 0.048m³/s from them. Specific is about 0.45m³/s/100km². This specific discharge is the smallest in all study area. And in the down stream area of creek, domestic waste water inflows into the creek, which deteriorate water quality in white turbidity and bad smell. And further, this through-flow water is used as tapping, washing, bathing by the local people. Maintenance stream flow is estimated about 0.032m³/s.

$$\begin{aligned} \text{Maintenance flow} &= 0.3\text{m}^3/\text{s}/100\text{km}^2 \times \text{area of river basin } 10.7\text{km}^2 \\ &= 0.032\text{m}^3/\text{s} \end{aligned}$$

Therefore, potential of exploitation volume is about 0.022m³/s.

$$\text{Exploitable water} = 0.048\text{m}^3/\text{s} - 0.032\text{m}^3/\text{s} = 0.016\text{m}^3/\text{s} (1,382\text{m}^3/\text{day}).$$

However, from the view point of conserving the creek environment, it should be keep the current through-flow not to deteriorate the water quality further more.

Table B2.2-9 Exploitable Surface Water of White River

| Criteria | Potentiality of exploitation of river flow | |
|----------------------|--|-----------------|
| | Volume of water | Occupation rate |
| Maintenance flow | 0.016m ³ /s(1,382m ³ /day) | 33.3 % |
| Environmental aspect | 0 | 0 |

Source : SIWA

(f) Lungga River

Table B2.2-10 shows the river flow distribution of Rove Creek.

Table B2.2-10 Distribution of Mataniko Creek Water

| Distribution of river flow | Volume of water (m ³ /s) |
|----------------------------|--|
| Area of basin | 377.0km ² |
| River flow | 16.0m ³ /s |
| Specific flow | 4.2 m ³ /s/100km ² |

Source : SIWA

Discharge of Lungga River is approx. 16.0m³/s and specific discharge is 4.2m³/s/100km². According to the existing data, discharge at river mouse is about 24.0m³/s on average, and maximum flow is about 43.0m³/s in February and minimum flow is 16.0m³/s in August. Minimum flow date is almost same with the result of flow measurement in this Study.

For Japanese rivers, maintenance flow discharge is set up a standard of approx. 0.3m³/s/100km². When we apply this specific discharge to the Lungga River, maintenance flow discharge will be 1.131m³/s, with its basin of 377.0km².

$$\begin{aligned} \text{Maintenance flow} &= 0.3\text{m}^3/\text{s}/100\text{km}^2 \times \text{area of river basin } 377.0\text{km}^2 \\ &= 1.131\text{m}^3/\text{s} \end{aligned}$$

Therefore, potential of exploitation volume is about 0.022m³/s.

$$\begin{aligned} \text{Exploitable volume} &= 16.0\text{m}^3/\text{s} - 1.131\text{m}^3/\text{s} \\ &= 14.87\text{m}^3/\text{s} (1,284,768\text{m}^3/\text{day}) \end{aligned}$$

As above mentioned, minimum discharge of Lungga river is about $16.0\text{m}^3/\text{s}$. If exploitation of the river flow is allowed until specific flow of white river, approximately $14.87\text{m}^3/\text{s}$ ($1,284,768\text{m}^3/\text{day}$) can be developed.

Table B2.2-11 Exploitable Surface Water of White River

| Criteria | Potentiality of exploitation of river flow | |
|----------------------|---|-----------------|
| | Volume of water | Occupation rate |
| Maintenance flow | $14.87\text{m}^3/\text{s}$ ($1,284,768\text{m}^3/\text{day}$) | 92.9 % |
| Environmental aspect | 0 | 0 |

Source : SIWA

B2.2.2 Groundwater

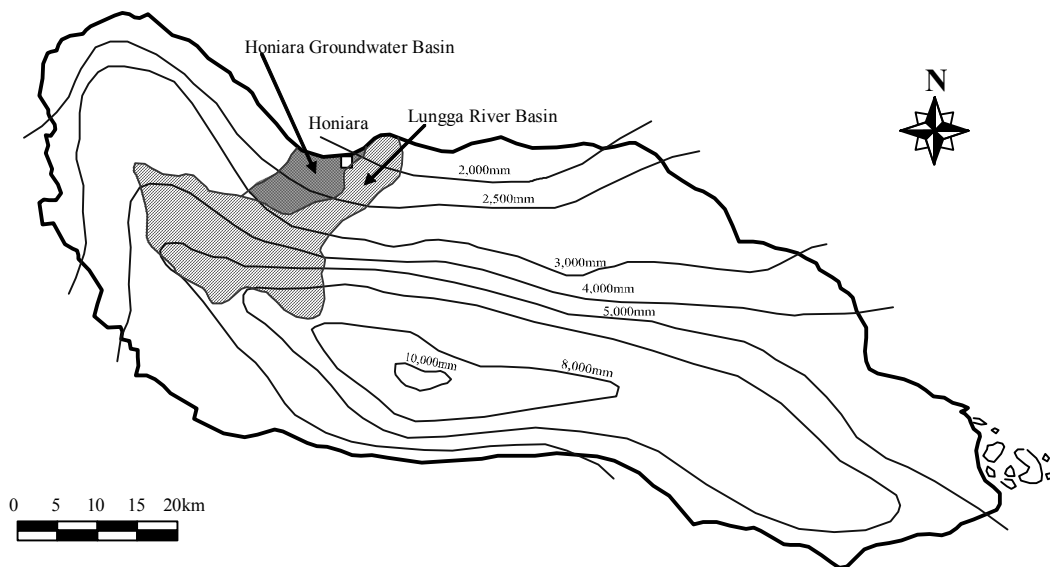
(1) Water Balance and Groundwater Potential of Honiara Groundwater Basin

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

$$\text{Precipitation} = \text{Evapo-transpiration} + \text{River Discharge} + \text{Groundwater flow to the sea} \\ (\text{Direct runoff} + \text{Base flow})$$

$$\text{Groundwater Potential} = \text{Base flow} + \text{Groundwater flow to the sea}$$

Honiara Groundwater Basin is divided into 4 river basins, namely, White River, Rove Creek, Mataniko River and Kombito Creek. Mataniko River Basin has the biggest area of above 4 river basins. However, there was no long-term discharge observation for water balance analysis for Mataniko River. Situation of data accumulation is the same in case of the other rivers. On the other hand, there is long-term discharge data for Lungga River, which flows in the south of Honiara Groundwater Basin. This data has been accumulated in MNR, and it has enough accuracy for water balance analysis. Therefore, water balance on Honiara Groundwater Basin should be analyzed based on water balance of Lungga River Basin.



Source : MNR

Figure B2.2-1 Lungga River Basin and Honiara Groundwater Basin

< Water balance of Lungga River Basin >

Annual water balance of Lungga River Basin is analyzed shown below.

$$\begin{array}{rcccccc}
 \text{Precipitation} & = & \text{Evapo-transpiration} & + & \text{Direct run-off} & + & \text{Base flow} & + & \text{Groundwater flow to the sea} \\
 4,400\text{mm} & & 1,400\text{mm} & & 890\text{mm} & & 970\text{mm} & & 1,140\text{mm} \\
 (100\%) & & (32\%) & & (20\%) & & (22\%) & & (26\%)
 \end{array}$$

Parameters in water balance analysis were estimated by method shown in Table B2.2-12.

Table B2.2-12 Estimation of Parameters in Water Balance Analysis

| Items | Method to estimate |
|-----------------------------|--|
| Precipitation | Precipitation was estimated from data of MEWMR. See Figure B2.1-1. |
| Evapo-transpiration | Evapo-transpiration was estimated taking into account of information below. (1) Evapo-transpiration=long-term observed pan-evaporation of Honiara city \times (0.75~0.8) (2) Result of the existing study on water balance. Reports below were reviewed. <ul style="list-style-type: none"> • Well Investigation in Panatina Valley (UNDP, 1989) • Hydrogeological Assessment of the White River Catchment Area and White River Source (UNDP, 1978) • Preliminary Water Resources Assessment of the Ngoti Sub-catchment near Honiara (UNDP, 1994) |
| Direct run-off | Direct run-off and base-flow was calculated from daily discharge data of Lungga River observed by MEWMR from 1992~1994. |
| Base flow | |
| Groundwater flow to the sea | Groundwater flow to the sea= Precipitation – Evapo-transpiration – Direct run-off – Base flow |

Source : MNR, SIWA, JICA Study Team

Precipitation and the other natural condition are different between Lungga River Basin and Honiara Groundwater Basin. Therefore, assumption below should be taken into account to apply water balance of Lungga River Basin into Honiara Groundwater Basin.

- (a) Evapo-transpiration seems to be the same between Lungga River basin and Honiara Groundwater Basin.
- (b) Ratio of (Direct run-off): (Base flow): (Groundwater run-off to the sea) is equal between Lungga River Basin and Honiara Groundwater Basin.

Based on assumption above, groundwater balance and groundwater potential are analyzed as shown below:

< Water balance and groundwater potential in Honiara Groundwater Basin >

$$\begin{array}{rcccccc}
 \text{Precipitation} & = & \text{Evapo-transpiration} & + & \text{Direct run-off} & + & \text{Base flow} & + & \text{Groundwater flow to the sea} \\
 2,500\text{mm} & & 1,400\text{mm} & & 324\text{mm} & & 355\text{mm} & & 421\text{mm} \\
 (100\%) & & (56\%) & & (13\%) & & (14\%) & & (17\%)
 \end{array}$$

$$\begin{array}{rcccccc}
 \text{Groundwater Potential} & = & \text{Base flow} & + & \text{Groundwater flow to the sea} & = & 776\text{mm/year} & \div & 700\text{mm/year} \\
 & & 355\text{mm} & & 421\text{mm} & & & &
 \end{array}$$

Accuracy of water balance analysis above depends on fluctuation of precipitation. Annual of precipitation will change year by year. So the groundwater potential also will change year by year following change of precipitation. Annual precipitation of Honiara city changed within $\pm 30\%$ range for the past 20 years, following which groundwater potential also had changed year by year.

(a) Groundwater Development Potential

Amount of groundwater pumped-up from boreholes should be less than groundwater potential that was analyzed by water balance analysis. The smaller is amount of groundwater that is pumped-up