

**Demand Management and Conservation Project  
Field Investigation in South Tarawa, Kiribati**

13 to 20 October 1998

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Project Manager

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## **Acknowledgments**

I would like to acknowledge the assistance of all the people met during the visit to Tarawa especially, to Mr Taboia Metutera, Acting Water and Sewerage Manager of the Public Utilities Board (PUB) and his staff for their support.

## **Introduction**

The purpose of this trip was to:

- Collect information and observe current water sector practices for the Taiwan-funded demand management and conservation project.
- Undertake investigations to assist unacceptable water.
- Identify sections of pipeline of likely leakage.
- Train local staff in the principles of demand management and in the use of equipment to assess reticulation losses.
- Discuss the future SOPAC Water Resources Unit work program with Kiribati Government staff.

This report documents the people visited, activities carried out and data collected during the trip. A separate technical report will be prepared for demand management and conservation practices and recommendations.

**13 October 1998, Tuesday**

**Departed** Suva for Tarawa via Nadi at 05:25

**Arrived** at Tarawa at 10:30 and was met by Taboia from the Public Utilities Board (PUB).

### **PUB Office**

Taboia briefed me on the current drought situation where there has been no appreciable rainfall for the last six months. This has caused PUB to ration water, thus only providing water for about 1 hour in the morning and 1 hour in the evenings. In Betio, water is also distributed by water truck throughout the day. Taboia provided me with several recent reports that describe the existing condition of PUB's reticulation systems including freshwater, saltwater for flushing toilets and sewerage collection and disposal.

Discussed with Taboia a work plan to be carried out during the visit that included the following:

- review and inspection of existing water supply systems
- flow measurements of existing reticulation systems
- training in the use of flow measurement equipment
- meet with various water sector personnel
- give presentation on demand management and conservation principles; and a brief on the Pacific Water Association.

### **14 October 1998, Wednesday**

The Portaflow 300 water meter was used to measure a flow of 12 l/s in the rising main pipeline (to the airport) (155mm NB class D PVC pipe) at the southern end of the airport causeway. PUB staff were also instructed in the use of the Portaflow meter.

#### **WHO**

Taboia and I met with Dr George J. Slama, the new WHO Country Liaison Officer. George recently arrived in Kiribati after serving 7 years in PNG with the WHO and was eager to know more about the water and sanitation conditions and facilities on Tarawa. On learning that the unaccounted for-water in Tarawa was well over 50% and that we were in the process of locating possible areas of leakage, he advised that WHO may have funds to purchase a portable flow meter for the PUB to use. He requested that a proposal be submitted giving details and justification. A proposal was prepared and is attached as Appendix 1.

We also discussed the joint SOPAC/WHO funding for research work carried out by Greg Berry regarding the safeness of compost generated from composting toilets that have to be established on Christmas Island in Kiribati. There was some concern about the handling of compost that needed to be explored further.

#### **Peace Corps**

Met with Bill Benjamin, Co-country Director in Kiribati. Being a former volunteer, the Peace Corps may provide a source of information especially in the outer islands. The role of Peace Corps is getting away from the teaching of students to the training of teachers and providing technical assistance. A PhD volunteer has just been recruited to assist in the environmental field in Kiribati.

Bill indicated that water engineering assistance may be available through Peace Corps but a government request is required. This possible source of engineering assistance will be discussed with the PUB.

### **UN Outer Islands Water Supply Project**

Met with Mr Win, Team Leader of the UN Outer Islands Water Supply Project. This project is in its last phase and has provided water supplies for many villages and schools in the outer islands of Kiribati. SOPAC had been assisting with the production of manuals for the operation and maintenance of hand pumps and solar pumping water supply systems. Through the project Mr Win developed many good water supply practices specifically suited for rural communities and we must ensure that these are documented for use under similar conditions in other member countries. Mr Win's contract ends in December 1998, however, there are still about three months' work that will remain after his departure that his trained counterparts will complete.

During his seven-year stay in Kiribati he has visited Banaba Island and his trip report has yet to be given to the Water Unit for reference for a proposed visit to Banaba to assess water resources.

Mr Win should be congratulated for his contribution, under very difficult conditions, to improve the standard of living for many people residing on the outer islands of Kiribati.

### **Ministry of Works and Energy (MWE)**

Met with Baranika Kamaie, Hydrogeologist, and discussed the proposed visit to Banaba Island to assist MWE staff in the assessment of water resources. The main delay has been the availability of suitable transportation to Banaba, which is being organised by MEW. It was explained that if suitable transportation could not be arranged between 7 November and 5 December 1998, the proposed trip would have to be postponed until next year assuming that SOPAC resources were available.

We discussed the SOPAC Work Program noting the Ministry of National Resources Development fax dated 1 July 1998 requesting SOPAC's assistance with (1) the Banaba survey; (2) reviewing the existing Water Master Plan; and (3) leakage control. As mentioned above, the Banaba survey is being dealt with, the Water Master Plan review is scheduled for our 1999 work program and leakage control is now being dealt with by this visit through the Demand Management and Conservation Project funded by the Taiwan Government.

**15 October 1998, Thursday**

### **Field Measurements**

The Bonriki water reserve was visited containing 17 galleries all pumping through the chlorination station into the rising main to Betio. Conductivity of the first gallery visited was 700 uS/cm, which is normal for the lens. The water meter at the chlorination station was reading 13.3 l/s (this includes a further six galleries located on Buota). The conductivity measurement at the old gallery located at the chlorination station was 710 uS/cm.

The chlorination station is also the main data collection site for the joint UNESCO/SOPAC groundwater recharge study that commenced in August 1996 and should end later this year by a visit from Dr Ian White the Project Manager. The study has been plagued by vandalism and equipment problems but should still contribute valuable information on the behaviour of the Bonriki groundwater lens.

The Buota water reserve containing six galleries all pumping through the chlorination station into the rising main to Betio was also visited. Water conductivity from the one gallery visited was measured at 690 uS/cm.

### **Saltwater Intakes**

The Portaflow 300 was used to measure a flow rate of 13.4 l/s being pumped from a seawater gallery located on Betio direct into the reticulation system to flush toilets. The system has a design population of 12,000 people with an average design demand of 6.25 l/s.

Similarly 8.1 l/s of seawater was being pumped into the Bairiki reticulation system for toilet flushing with a design population of 3,000 people with an average design demand of 1.56 l/s.

Note that up to a few years ago all three saltwater systems pumped water to an elevated tank for gravity reticulation but now saltwater is being pumped direct into the reticulation systems because of additional use. However this may be causing greater wastage through reticulation and toilet leakages.

All field measurements are shown in Appendix 2.

**16 October 1998, Friday**

### **Field Measurements**

The Bikenibeu saltwater intake was measured at a flow rate of 6.8 l/s being pumped directly into the reticulation system to flush toilets. The system has a design population of 6,500 people with an average design demand of 3.39 l/s

A toilet block was inspected adjacent to the saltwater intake that was in sound condition. However inside it smelled with faeces on the floor and in and around the toilets. Due to its location, lack of water to flush toilets would not appear to be the problem.

A freshwater inflow of about 3 l/s was measured filling the Bikenibeu low level storage tank at King George V School. Note that from the low level stored water is then pumped to an elevated tank that distributes water by gravity to the villages.

With the current drought conditions water is being rationed and only available from 6 to 7 in the morning and 5 to 6 in the evenings. Thus during this time everyone has their taps wide open to fill as many containers as time permits.

Inflows to the Bikenibeu low level tanks near the Fisheries Training Centre was measured at 3.7 l/s.

The in-line water meter (known as the "master meter") located before the Bikenibeu low level tank intakes near the PUB office, was reading about 12 l/s thus leaving only 5.3 l/s to service two-thirds of the population.

A flow measurement made at the southern end of the "long causeway" was also about 12 l/s indicating no loss between the two points.

### **Ministry of Natural Resources Development (MNRD)**

Met with the Kiribati National Representative to SOPAC and the Secretary for Natural Resources Development, Mr Tinian Reiher, and briefed him on my visit.

### **Demand Management Presentation**

A presentation on water demand management and conservation practices was made to the following staff members of PUB:

- Tokia Greg, CEO
- Rameka Takima, Deputy CEO
- Taboia Metutera, Water and Sewerage Manager
- Buibui Timeri, Engineering Manager
- Kirabuke Namai, Finance Manager
- Riteti Eritame, Water and Sewerage Engineer
- Tiaon Bauirtai, Personnel Officer

The presentation is in Appendix 3.

**17 October 1998, Saturday**

### **Leakage Survey of Rising Main**

The strategy was to pump water from the gallery system as normal however all connection to the rising main would be closed. Theoretically, if there was no connection or losses along the 32 km of pipeline the amount pumped into the pipeline would flow from the end of the line. Using the Portaflow 300 flow meter, measurement will be made at various locations along the pipeline to monitor its flow. Differences between measurement point that cannot be explained will be assumed to be losses and will be investigated in more detail.

The following are the results of the survey implemented with the assistance of Taboia and Evire: (See attached map for approximate location of the survey locations.)

<b>Location</b>	<b>Time</b>	<b>Flow (l/s)</b>	<b>Comment</b>
1. Bonriki Chlorination Facility	19:43	12.8	in-line meter, pressure not maximum
2. Airport Causeway North	19:58	11.4	155 NB PVC class D
3. Airport Causeway South	20:10	11.3	155 NB PVC class D
4. Hospital	20:20	0.5	flowing from main, valve not shut off!
5. Mackenzie Corner	20:30	11.0	155 NB PVC class D
6. "Master meter"	20:42	10.3	Portaflow used, site near PUB office
7. Abarao	20:55	9.3	155 NB PVC class D
8. Stewart Causeway East	21:20	8.3	155 NB PVC class D
9. Stewart Causeway West	21:26	8.5	Note flow as increased!
10. Banraeaba	21:36	8.6	Note flow as increased!
11. Antebuka	21:57	8.8	Note flow as increased!
12. Betio	22:25	8.3	225 NB PVC class D In central Betio

13. Betio storage facility      22:40      8.2      In-line meter measurement

The above survey results shows an overall unaccounted for water, from the Bonriki chlorination facility to the end of the pipeline at the Betio storage facility, is 32%. However the increase in flows after Stewart Causeway East would indicate that not all take-off valves were closed at the start of the survey thus affecting the results. It can also be concluded that no 'major' losses occurred indicating that in general the pipeline was performing satisfactorily.

### **18 October 1998, Sunday**

Day of rest. Drafted reports.

### **19 October 1998, Monday**

#### **Field Measurements**

The flow coming from the 6 galleries on Buota at a site on Bonriki near the chlorination facility was measured at 2.4 l/s. This is much less than the 4.3 l/s measured as the sum of the 6 individual gallery flows in February 1996 (from Royds report). The flow at the chlorination facility was measured at 12.2 l/s thus the 17 Bonriki galleries were producing a total flow of 9.8 l/s. Note that the February 1996 measured flow of the sum of the 17 individual galleries was 12.4 l/s. This relates to a 21% loss of the Bonriki gallery production and a 44% loss for the Buota galleries or an overall loss of 27%. Thus further investigations are needed in this area between the galleries and the chlorination facility to optimise the gallery water being produced.

The flow at the north end of the airport causeway was measured at 11.3 l/s and at the south end the flow was 11.2 l/s. There appears to be a loss of about 1 l/s between the chlorination facility and the north end of the airport causeway.

#### **Foundation of the People of the South Pacific (FSP)**

Met with Leonie Smiley, Director of FSP. She was most concerned with the performance of the Atollet composting toilet. FSP have constructed 5 toilets and more are planned but the current toilets appear to have some design/construction problems that allows outside water to enter the vaults and inadequate ventilation to evaporate liquid within the vaults. The resulting compost is wet and partially "baked."



**PUB**

Had a quick debriefing session with Taboia. Generally the results of the field measurements indicates that there does not appear to be any specific major pipeline leakage but many small losses. The area to concentrate on is between the galleries and the chlorination facility.

**20 October 1998, Tuesday**

**Departed** Tarawa for Nauru at 11:30

**Follow-up Actions**

**PUB**

1. Complete technical report on demand management and conservation practices and make recommendations to improve existing freshwater supply.
2. Comment on saltwater and sewerage systems.
3. Develop drought index for South Tarawa. PUB to provide suitable rainfall data.
4. Continue to provide backup technical advice to PUB.

**MWE**

1. Wait to be advised by Baranika when suitable ship is available to carry out water resources survey on Banaba. If no ship is available between 7 November and 5 December then the survey will be postponed until next year.
2. Continue to provide backup technical advice to MWE.

**FSP**

1. Review design of Atollet composting toilet.
2. Provide advice on improvements to existing units already built and in use.

**APPENDIX 1**

**DRAFT PROPOSAL**

## **Proposal to Minimise Water Reticulation Losses**

### **Introduction**

The Public Utilities Board (PUB) seeks assistance in the purchase of a portable flowmeter to assist in the location of water losses within their reticulation systems.

### **Background**

PUB is responsible for providing freshwater as well as saltwater for flushing toilets and the collection and disposal of sewerage for the population of South Tarawa connected to these services. Due to the flat nature of Tarawa all water services must be pumped to operate. In the case of freshwater the water is pumped twice. Thus water systems are very costly to operate and maintain. Currently there is no charge for domestic water services.

During the current drought conditions, freshwater from the groundwater lenses is under much pressure resulting in the rationing of freshwater by PUB. Water losses within the reticulation systems are very high, estimated well over 50%. Thus any reduction in water losses not only relieves drought conditions but also reduces operational costs, and is good for the environment by reducing the amount of freshwater abstracted from the limited groundwater lens systems.

### **Proposal**

PUB proposes to undertake a survey of all reticulation systems by measuring flows at various locations and times so that areas of potential leakage may be identified and repaired. An ongoing monitoring program will also be established. To assist with this worthwhile survey a portable flow meter is required. The portable flow meter can be easily strapped onto pipes to measure flows. By carrying out flow measurements, areas of high losses can be identified and repaired. At the moment PUB have no way of locating pipeline leakage in sandy soils conditions. Any leaks drain downwards so they are not visually seen on the surface unless there is a major pipeline breakage.

It is also proposed to identify leakages within the saltwater system to reduce operational costs and pollution of the groundwater in the areas of the leakages.

The flowmeter can also measure sewerage discharges into the sea, which will provide useful information regarding potential pollution of the reef platform, used extensively for fishing and bathing.

### **Proposal Cost**

PUB have the manpower to implement the survey and may call on the services of the South Pacific Applied Geoscience Commission (SOPAC) to assist with technical advice.

However funds are required to purchase the flowmeter. The following is the flowmeter that PUB wishes to purchase: (Note that PUB staff are familiar in the use of this flowmeter through the SOPAC Demand Management and Conservation Project)

*Portaflow 300 Ultrasonic Liquid Flowmeter  
Agents are Vibration Analysis Services Ltd, New Zealand*

The specification is attached.

Estimated cost including shipment: \$US7,500.

### **Conclusions**

Adequate and affordable freshwater and sanitation facilities are basic needs for all the people of Kiribati. The current freshwater and sanitation systems have problems coping with current demand. Any reduction in leakages will improve living conditions, contributing to better health and a more efficient operation of services provided by PUB.

**APPENDIX 2**

**DATA COLLECTED**

## FIELD MEASUREMENTS

Date/Time	Location	Measurement	Comments
14/10/98 – 09:50	South end of airport causeway	12 l/s	I55 NB PVC class D hole dug to expose pipe (Portaflow)
14/10/98 – 21:30	Otintaai Hotel	1.5 l/min	Leakage of saltwater to flush toilet in hotel room
14/10/98 – 21:45	Otintaai Hotel	185 l/d	Leakage of freshwater from tap in hotel room
15/10/98 – 11:30	Bonriki Treatment Station	13.3 l/s	Meter reading
15/10/98 – 11:10	Bonriki gallery	700 µS/cm	1 <sup>st</sup> gallery on road to treatment station
15/10/98 – 11:10	Bonriki gallery	715 µS/cm	Old gallery at treatment station
15/10/98 – 11:20	Buota gallery	690 µS/cm	Highest gallery on Buota
15/10/98 – 14:50	Betio saltwater intake	13.4 l/s	I55 NB PVC class D? pipe exposed in front of station (Portaflow meter)
15/10/98 – 15:10	Betio saltwater intake	8.1 l/s	IOO NB PVC class D?
16/10/98 – 10:22	Bikenibeu saltwater intake	6.8 l/s	IOO NB PVC class C in pump house
16/10/98 – 10:30	Bikenibeu KGVS freshwater tanks	2.96 l/s	Meter reading
16/10/98 – 10:45	“Master Meter” near PUB office	12.3 l/s	In line meter (150 mm diameter) before off take to KGVS
16/10/98 – 11:00	South end of airport causeway	12 l/s	Portaflow reading intake dug to expose pipe
16/10/98 – 11:20	Bikenibeu tank near old hospital	3.74 l/s	In-flow from main line to storage tanks
17/10/98	Leakage survey results shown in report page 7		
19/10/98 – 13:37	Bonriki near chlorination	2.44 l/s	Flow coming from Buota galleries
19/10/98 – 13:46	Bonriki chlorination facility	12.2 l/s	Meter reading
19/10/98 – 14:00	North end of airport causeway	11.3 l/s	Portaflow reading
19/10/98 – 14:10	South end of airport causeway	11.2 l/s	Portaflow

**APPENDIX 3**  
**PRESENTATION**