CHAPTER 6 REHABILITATION PLAN

6.1 CONCEPT OF THE REHABILITATION PLAN

One of the primary objectives of this Study is to formulate a rehabilitation plan on the existing/damaged water supply system of the 15 towns for the target year 2003. Prior to the extensive field surveys and assessment of the water supply facilities, the Study Team's concept of the damages was centered on violence-related rather than technical incompetence and negligence. However, major findings of the survey indicated that the problems of most water supply system in East Timor are mainly due to operational negligence and sub-standard facilities. Immediate improvement program has to be drawn that will help restore the system, rectify the deficiencies and improve the operational performance. Thus, the concept of the rehabilitation plan was formulated based on the findings of the survey in order to achieve the objectives of the Study.

The concept of the rehabilitation plan for this Study is to improve/rehabilitate the existing water supply system giving due consideration to the following:

- Reliable transmission pipelines
- Adequate water treatment facilities
- Efficient water distribution management
- Reduction of unaccounted-for-water through leakage control
- Maximize service coverage

a.) Reliable Transmission Pipeline

Several towns in the Study Area are suffering from water shortage or complete breakdown of the water supply system due to problems on the transmission pipelines. These problems include damages to the pipe caused by natural calamity or man-made, insufficient pipe capacity, leakage, eroded sections of the transmission mains, illegal service connection, etc. Manatuto and Liquica are the two most seriously affected towns having unreliable water transmission mains. For the past few years, Manatuto was suffering from complete breakdown of the water supply system because certain sections of the transmission main were eroded due to floodwaters. Liquica was facing acute water shortage because part of the intake structures and most of the transmission pipes that were used to convey surface water sources to the service area were carried away by floodwaters.

The findings of the asset mapping on the water supply facilities that includes the investigation of the transmission mains concluded that these scenarios are predominantly due to inappropriate pipe installation, sub-standard facilities, the lack of technical expertise and negligence. Pipes, especially transmission mains are laid above ground and most often located in flood-prone areas without adequate protection. This condition makes the pipelines vulnerable to any type of damage both natural and man-made. As a remedial measure the Study Team included in the rehabilitation plan the realignment of the transmission mains to safer location that is less vulnerable to damage.

b.) Adequate Treatment Facilities

The objective of water treatment is to provide a potable supply – one that is chemically and bacteriologically safe and aesthetically acceptable for human consumption. To achieve this objective is to equip the plant with sufficient equipment and chemicals to be operated by competent workforce with adequate training. The main cause on the degradation of the water quality in Dili and few other towns with water treatment facilities is the lack of qualified operators and laboratory technicians to operate and maintain the WTP. The shortage of treatment chemicals and other laboratory equipment necessary to maintain and monitor the water quality aggravate the above conditions. Therefore, the Study Team had found it essential to include in the rehabilitation plan of the treatment facilities (such as the rapid sand filter, slow sand filter, etc.), the training program for water treatment plant operation and water quality analysis.

c.) Efficient Water Distribution Management

A water utility to become efficient and sustainable requires sound and effective water distribution management. The system starts with the proper design and installation of the facilities (these include the WTP, pumps, mains, reservoirs, valves and fire hydrants), water treatment, effective water distribution and to the efficient collection of water tariff. However, the water distribution management plays the major role because it is where the delivery of the service is determined and judged by the consumers.

The management of the distribution system is generally performed from the treatment plant or from the pumping station where water production and pressures can be controlled. Operations must then be extended into the pipe network to monitor pumps and reservoirs to insure adequate service to all parts of the system. Originally, from the point of production it is essential to ensure that the pressure and volume of water produced is measured and accounted for in order to carry out an effective monitoring for hydraulic performance and deficiencies in the distribution system. The Study Team considers it important to include the monitoring of water flow and pressure as well as water conservation in the rehabilitation plan for the water supply system.

d.) Reduction of Non-revenue Water through Leakage Control

More than 50% of water produced from majority of the town's water supply system are unaccounted due to pipe leakage and wastage. These factors are mainly due to physical leaks from the pipe due to deterioration and damage and the unauthorized or illegal connections.

The reduction of the unaccounted-for-water for most of the water supply system will be accomplished by initiating an extensive leakage detection and repair program. Within the process of leakage detection the illegal connections will be detected, whereby appropriate measures will be required. As part of the JICA's "Quick Project" the leakage control and repair program is being undertaken in Dili by the JICA Study Team with cooperation from UNTAET's Office of Water Supply and Sanitation. Local counterpart personnel are working closely with JICA's Leakage Control Team as part of the program on technology transfer and on-the job training

The program against illegal connections will be undertaken together with hygiene education to the consumers. These unauthorized connections will be dismantled with the option of reconnection thereby educating the people on the importance of safe, and efficient water distribution. In the process, the consumers will be advised on the proper way of carrying the water service connection and the importance of protecting safe water. In so doing, hygiene education will be shared with the people.

e.) Maximize Service Coverage

The household survey conducted by the JICA Study Team revealed that before the violence less than 50% of the urban population in 15 towns/cities in East Timor including Dili is not serviced by piped water supply system. This pre-violence condition of the service coverage indicates that a more severe scenario is expected as a result of the post-referendum violence where damages to the water supply facilities was experienced in most of the towns in East Timor.

The JICA Study Team rehabilitation and improvement plan of the water supply system targets an increase in the service coverage to the urban population. This increase in the served population could be realized through the repair of the existing service connections including installation of water meters. New individual service connections are expected with the increase in water supply. Community distribution of water will be enhanced through the repairs of the damaged public taps.

6.2 REHABILITATION PLAN OF THE WATER SUPPLY SYSTEMS

The rehabilitation plan of the water supply system was formulated based on the general idea of rehabilitation with minimal recurrent cost even though big capital investment is incurred. In the preparation of the long-term strategy for rehabilitation the following were taken into consideration:

- Future water source
- Reliable and safe water supply
- Adequate storage
- Efficient water distribution by zoning of the service area
- Service coverage target

According to the above considerations, the rehabilitation plan is formulated and briefly explained below. In Appendix H detailed discussion of the rehabilitation plan is included.

6.2.1 Reliable Water Source and Transmission Line

1) Dili
   Rehabilitation of Bemos intake, Bemori intake and Benamauk intake
   New transmissio pipe from Bemos to new water treatment plant
   Expansion of Comoro A well and Comoro E well
   Replacement of pump at Kuluhun A well
   New well at Kuluhun C and Bidau 3
2) Atauro
   Tulai spring security fence, concrete box, intake box

Transmission main 75mm x 5km to Beloi

3) Manatuto
   Realignment of transmission pipe
4) Baucau
   Pumping Station No.1 Replacement of pump and generator
   Pumping Station No.2 Replacement of pump and generator
   Pumping Station No.3 New pump and generator
   Completion of transmission main
   New transmission main 100mm x 1.5km, 75mm x 1.0km
5) Los Palos
   Pumping Station No.2 New pump and generator (for raw water and treated water)
6) Viqueque
   Realignment of transmission pipe including pipe bridge
7) Same
   Realignment of transmission pipe including pipe bridge
8) Ainaro
   Repair of raw water transmission conduit
9) Aileu
   Rehabilitation of Mantane river infiltration gallery including collection pipe, generator
10) Maubise
    Repair of 100mm transmission pipe from Erulu spring
    Replacement of transmission pipe from Bucana spring (75mm x 1.7km)
    Rehabilitation of Raikuak Ulun intake including collection chamber, collection weir
    Replacement of transmission pipe (75mm x 0.1km)
11) Gleno
    Rehabilitation of Mota Boot intake including collection pipe, generator
    Repair of transmission pipe (150mm)
12) Ermera
    Reconstruction of Ersoi spring intake
    Reconstruction of Lubulala spring intake
    New intake at Mota Bora river with new transmission pipe (100mm x 6km)
13) Liquica
    Reconstruction of Daulo intake
    Reconstruction of Eanloa intake
    Realignment of transmission pipe from Emilaloa intake (150mm x 4km)
    New transmission pipe from new deepwell (150mm x 1.5km)
14) Suai
    Sukabilaran No.1 well Replacement of pump and generator
    Sukabilaran No.2 well Replacement of pump and generator
    New well construction with transmission pipe (75mm x 1.3km)
15) Maliana
    Rehabilitation of Beremau intake
    Replacement of transmission pipe to 150mm x 75m

6.2.2 Reliable and Safe Water Supply

1) Dili
   New water treatment plant (6,000 m3/day)
2) Atauro
   Haronglerang sercice reservoir flow control and measuring devices etc.

Tolelona I & II and Cementerio service reservoir flow control and measuring devices, chlorinator etc.

3) Manatuto
4) Baucau
   Main reservoir flow control and measuring devices, chlorinator etc.
   Samadiga reservoir flow control and measuring devices, chlorinator etc.
5) Los Palos
   Pumping station No.1 Replacement of pump and generator
   Expansion of water treatment plant
   Elevated service reservoir flow control and measuring devices, chlorinator etc.
6) Viqueque
   Builua spring Security fence
   Break pressure tank Security fence
   Service reservoir flow control and measuring devices, chlorinator etc.
7) Same
   Darelau spring Security fence
   Posto reservoir flow control and measuring devices, chlorinator etc.
8) Ainaro
   Water treatment plant repair and new chlorinator
   Service reservoir flow control and measuring devices, chlorinator etc.
9) Aileu
10) Maubise
   Erulu spring Security fence, drain, public tap
   Service reservoir at Erulu spring flow control and measuring devices, chlorinator etc.
   Pousada reservoir flow control and measuring devices, chlorinator etc.
11) Gleno
   Water treatment plant repair and new chlorinator
12) Ermera
   New water treatment plant from Mota Bora river
13) Liquica
14) Suai
15) Maliana
   Water treatment expansion additional 10l/s
   Rehabilitation of WTP laboratory

6.2.3 Adequate Storage

1) Dili
   Additional storage 1,000m3 at Aspal Goreng, 600m3 at Becusi and 200m3 at Bidaumasau2
2) Atauro
   Beloi reservoir additional 30m3
3) Manatuto
   Additional 330m3
4) Baucau
   New reservoir 100m3 at high zone
5) Los Palos
   Additional 400m3 at water treatment plant
6) Viqueque
7) Same
   Hularua reservoir additional 160m3

Merbati reservoir additional 200m3

8) Ainaro
None
9) Aileu
Additional 85m3
10) Maubise
Additional 30m3
11) Gleno
Additional 300m3
12) Ermera
Additional 80m3
13) Liquica
Additional 140m3
14) Suai
Hospital reservoir additional 100m3
Leogore reservoir additional 20m3
15) Maliana
Sta. Cruz reservoir additional 20m3

6.2.4 Efficient Water Distribution

1) Dili
2) Atauro
3) Manatuto
Distribution main rehabilitation and leakage control
4) Baucau
Replacement of 100mm x 1.3km
5) Los Palos
Distribution main rehabilitation and leakage control
6) Viqueque
Distribution main replacement 75mm and 100mm
7) Same
Distribution main replacement
8) Ainaro
Installation of 150mm x 2.7km (from reservoir No.1)
Installation of 150mm x 1.2km (from reservoir No.2)
Installation of 75mm x 0.4km (from reservoir No.1)
9) Aileu
Upgrade to 75mm pipe
10) Maubise
Replacement of distribution main (75mm x 0.7km and 50mm x 0.5km)
11) Gleno
New pipe installation (150mm, 100mm)
12) Ermera
New pipe installation (100mm x 1km)
13) Liquica
New distribution main (150mm x 5km, 100mm x 4km)
14) Suai
15) Maliana
New distribution main (150mm x 1.5km)

6.2.5 Service Coverage Target

In 15 towns, in order to extend water supply service within the existing service area or adjacent the existing service area, installation of public tap, service connection, water meter is required. Number of these appurtenances is shown in Appendix H.

6.3 PRIORITY OF REHABILITATION

The proposed rehabilitation plan of the water supply system has been formulated and prioritized for implementation according to their degree of urgency. The 15 towns were categorized into 3 (A, B and C) while the water supply facilities were categorized into 2 (1, and 2). In the categorization of the facilities, consideration on the restoration and improvement was clearly distinguished. This is mainly to give a clear picture on the existing condition of the facilities prior to the post-referendum violence and the appropriate actions to be done to improve its efficiency. The parameters used in prioritizing the proposed rehabilitation are as follows:

- Percentage of unserved population
- Condition of the water supply system
- Contribution to socio-economic aspect
- Health risk to water-borne diseases
- Cost-effectiveness
- Status on non-JICA rehabilitation projects

6.4 REHABILITATION (PROJECT) COST

The costs for the present project are estimated in the Tables 6.1 and 6.2. Project costs are summarized as follows:

Project Costs	(Thousand US$)
Construction Costs:	21,001
Engineering Fee:	2,100
Contingencies:	3,465
Total:	26,566

The total project costs for 15 towns is US$ 26.6 million, of which Dili part needs US$ 14.9 million.

Annual costs for operation and maintenance are summarized as follows:

O&M Costs	(Thousand US$)
Personnel Costs:	231
Vehicles:	87
Power:	487
Chemicals:	37
Repair	210
Other Costs:	151
Total:	1,204

Table 6.1 PROJECT COSTS

(*USD)

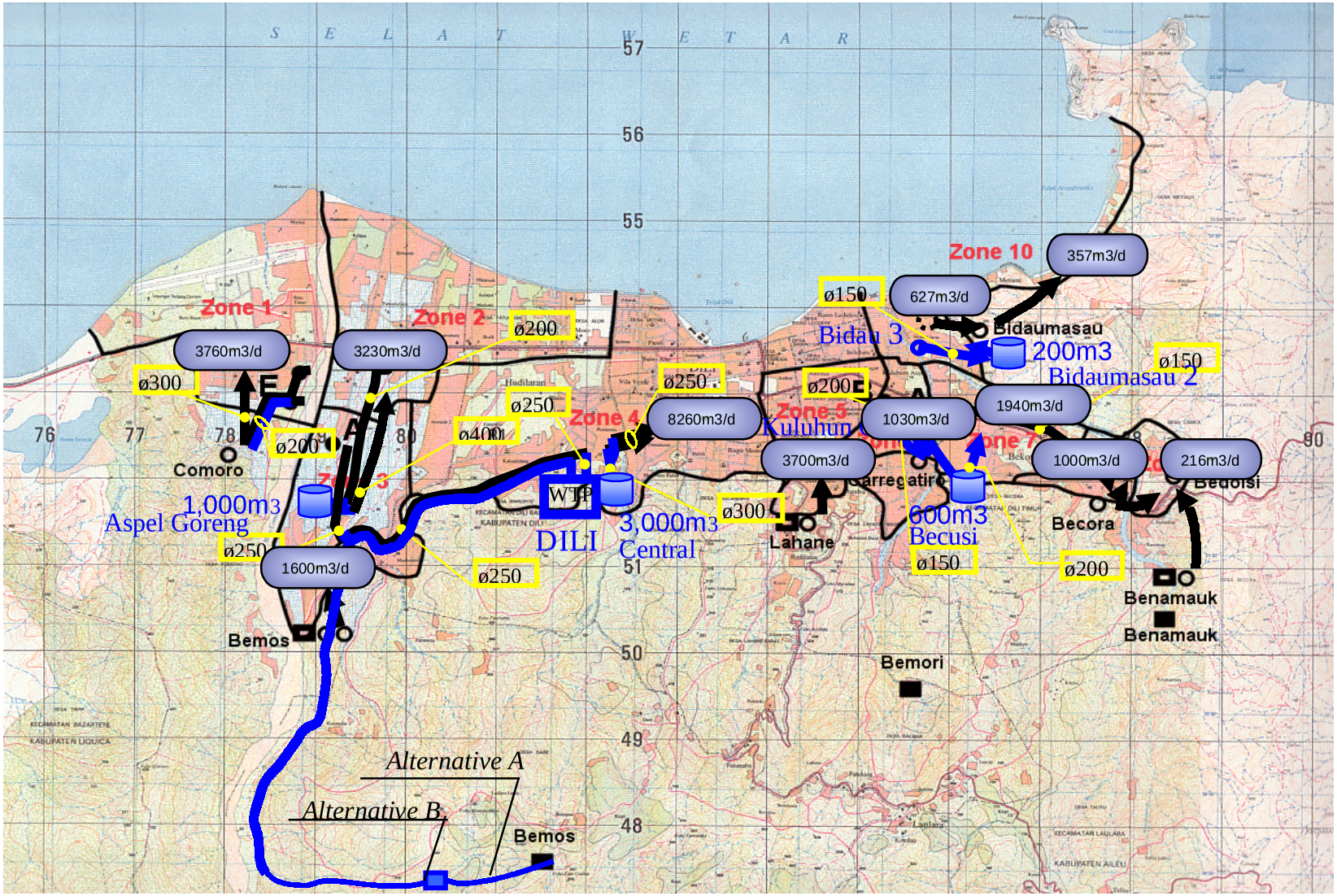
Description	Dili	Atauro	Manatuto	Baucau	Los Palos	Viqueque	Same	Ainaro	Aileu	Maubisse	Gleno	Ermera	Liquica	Suai	Maliana	Total
Civil Work	4,037,870	41,498	45,000	42,875	184,390	265,479	62,779	44,670	79,329	28,219	89,970	141,393	331,040	377,411	565,836	6,337,759
Piping Work	5,146,068	100,578	30,643	42,644	456,660	209,986	82,924	217,290	56,993	122,458	118,720	386,545	1,531,620	148,650	115,134	8,766,913
Mechanical Work	152,039	-	-	186,194	131,771	-	-	-	-	-	-	-	-	207,839	271,319	949,162
Electrical Work	193,125	-	-	183,750	141,250	-	-	-	66,250	-	-	-	-	261,250	181,250	1,026,875
Public Taps	123,000	5,000	25,000	35,000	20,000	15,000	8,000	10,000	10,000	13,000	30,000	13,000	30,000	10,000	-	347,000
Service Connections	2,162,000	27,000	96,000	101,000	128,000	119,000	104,000	60,000	75,000	24,000	81,000	36,000	157,000	132,000	165,000	3,467,000
Miscellaneouse	7,500	7,500	-	12,500	-	7,500	7,500	3,750	-	11,250	3,750	3,750	13,750	13,750	13,750	106,250
Total Construction Cost	11,821,602	181,576	196,643	603,963	1,062,071	616,965	265,203	335,710	287,572	198,927	323,440	580,688	2,063,410	1,150,900	1,312,289	21,000,959
Engineering Cost	1,182,160	18,158	19,664	60,396	106,207	61,697	26,520	33,571	28,757	19,893	32,344	58,069	206,341	115,090	131,229	2,100,096
Sub-Total	13,003,762	199,734	216,307	664,359	1,168,278	678,662	291,723	369,281	316,329	218,820	355,784	638,757	2,269,751	1,265,990	1,443,518	23,101,055
Contingencies	1,950,564	29,960	32,446	99,654	175,242	101,799	43,758	55,392	47,449	32,823	53,368	95,814	340,463	189,899	216,528	3,465,158
Total	14,954,327	229,694	248,753	764,013	1,343,520	780,461	335,482	424,673	363,779	251,643	409,152	734,570	2,610,214	1,455,889	1,660,046	26,566,213

Table 6.2 ANNUAL OPERATION & MAINTENANCE COSTS

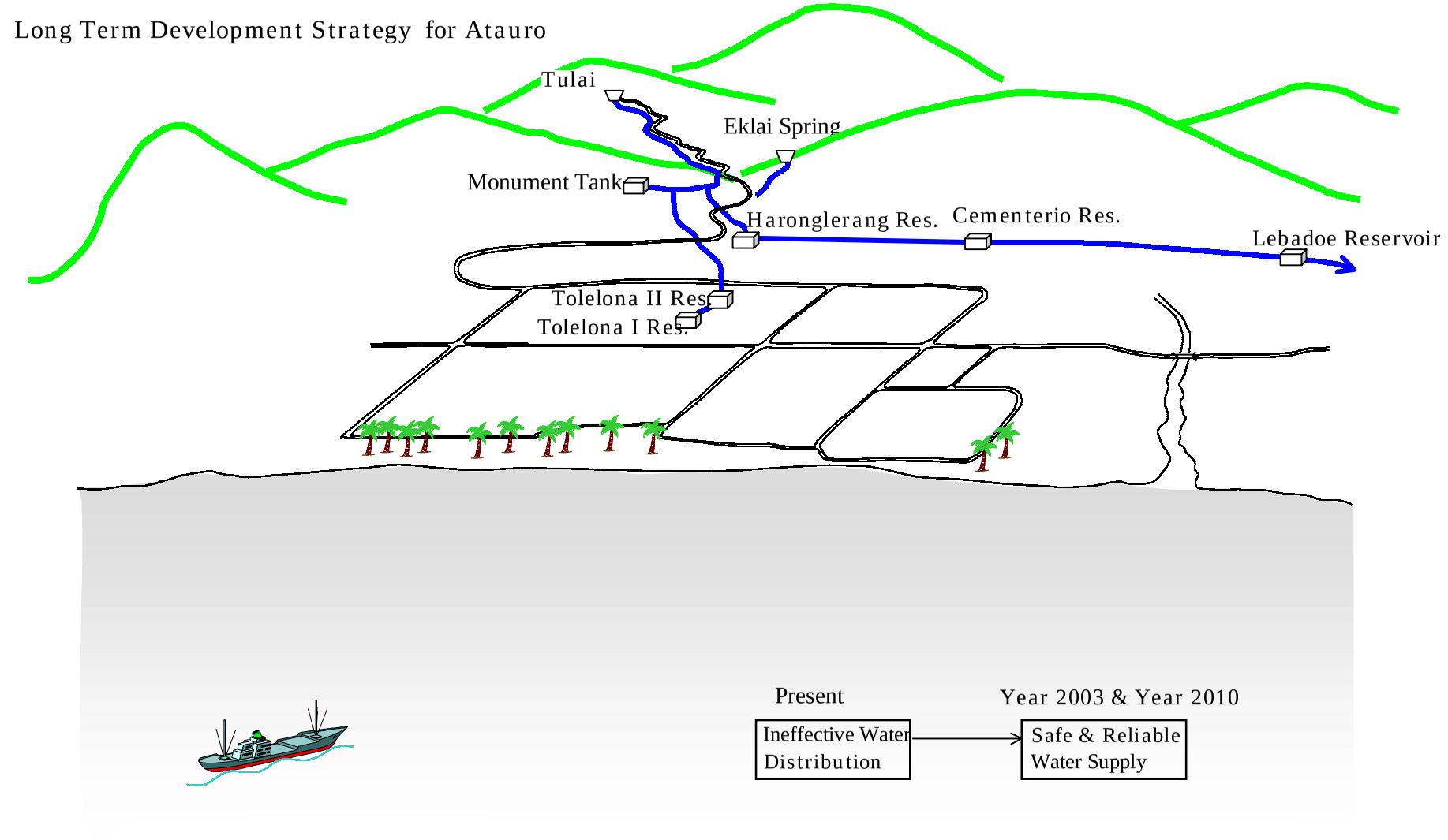
(*USD)

Description	Dili	Atauro	Manatuto	Baucau	Los Palos	Viqueque	Same	Ainaro	Aileu	Maubisse	Gleno	Ermera	Liquica	Suai	Maliana	Total
Mechanical																
WTP																
Chlorine(2mg/L)	2,242	296	1,584	1,697	1,916	1,780	1,560	1,029	1,166	358	1,414	429	2,257	1,914	2,393	22,036
Alum(25mg/L)	8,967														6,504	15,471
Electricity(KWH)	74,460										5,387		14,007			93,855
																0
Pumping Station																0
Electricity(KWH)	145,854		32,324	72,191	71,114				21,550				3,232	19,933	26,937	393,136
Sub-Total	231,523	296	33,908	73,888	73,030	1,780	1,560	1,029	22,716	358	6,801	429	19,497	21,847	35,835	524,497
Institutional																
Personnel	24,040	2,886	16,099	23,556	22,230	16,099	16,099	13,259	16,099	5,726	18,295	6,821	16,099	16,099	17,659	231,066
Vehicle running	12,000	0	6,000	9,000	9,000	6,000	6,000	4,191	6,000	1,809	6,555	2,445	6,000	6,000	6,000	87,000
Repair	118,216	1,816	1,966	6,040	10,621	6,170	2,652	3,357	2,876	1,989	3,234	5,807	20,634	11,509	13,123	210,010
Others	109,047	1,370	3,136	3,455	3,880	3,720	3,136	2,339	2,232	1,010	3,136	1,169	4,730	4,411	4,624	151,395
Sub-Total	263,303	6,072	27,201	42,051	45,731	31,989	27,887	23,146	27,207	10,534	31,220	16,242	47,463	38,019	41,406	679,471
Total	494,826	6,368	61,110	115,939	118,761	33,769	29,447	24,175	49,922	10,892	38,022	16,671	66,960	59,866	77,241	1,203,968

Note; Electricity =0.123 USD/kwh

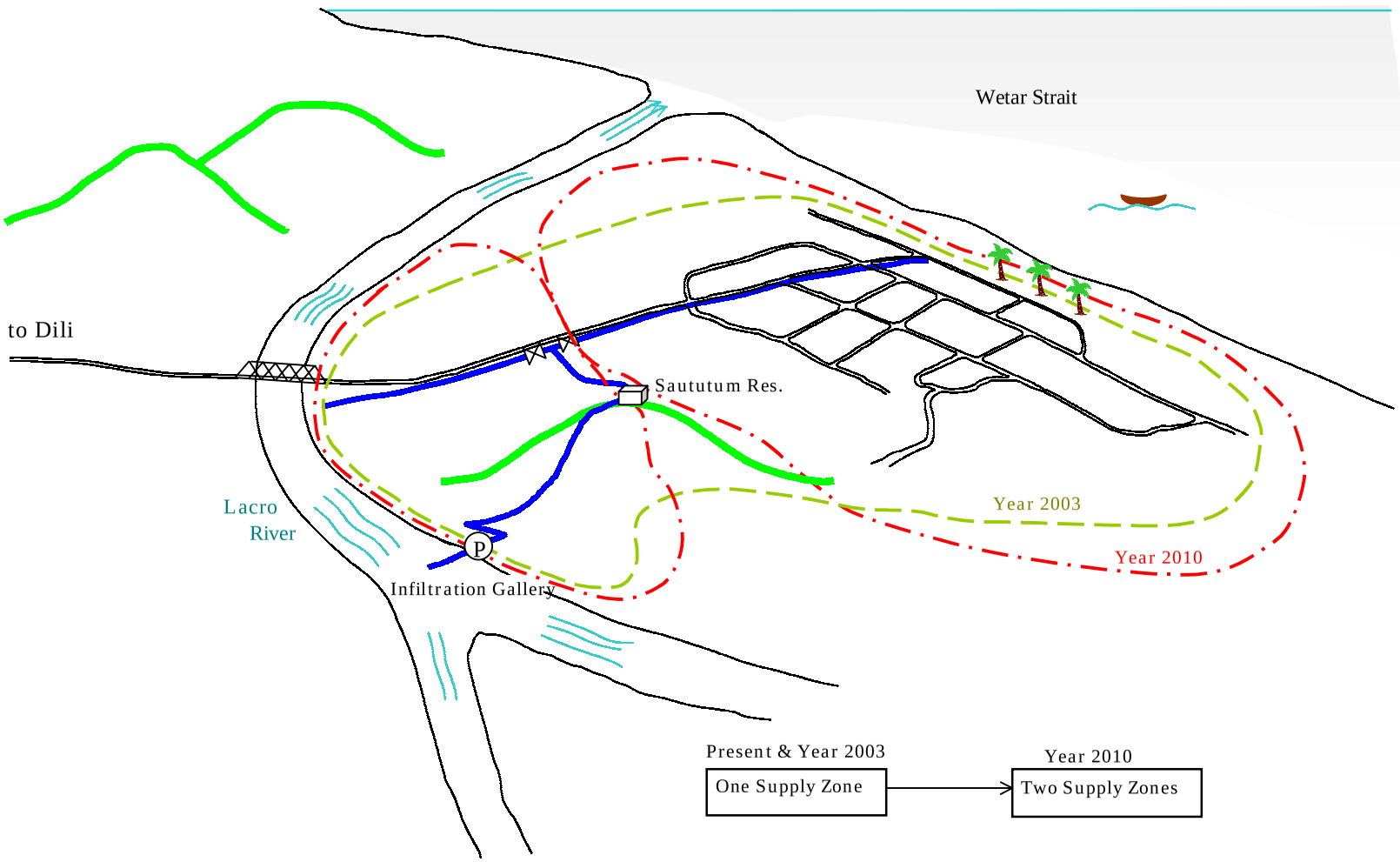


JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Dili	**6.1**



JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Atauro	**6.2**

Long Term Development Strategy for Manatuto

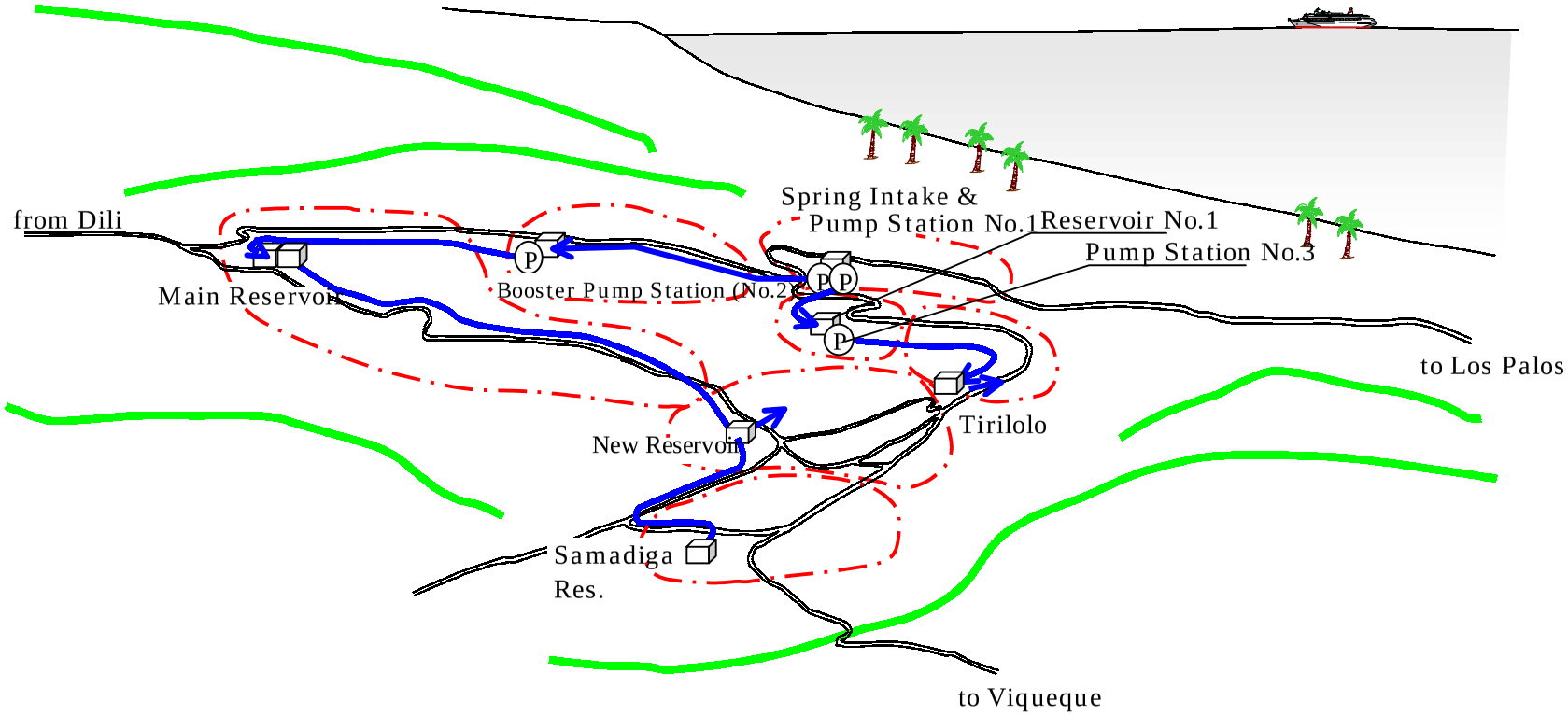


The Study onUrgent Improvement Project for the Water Supply System in East Timor

Long Term Development Strategy for Manatuto

Figure 6.3

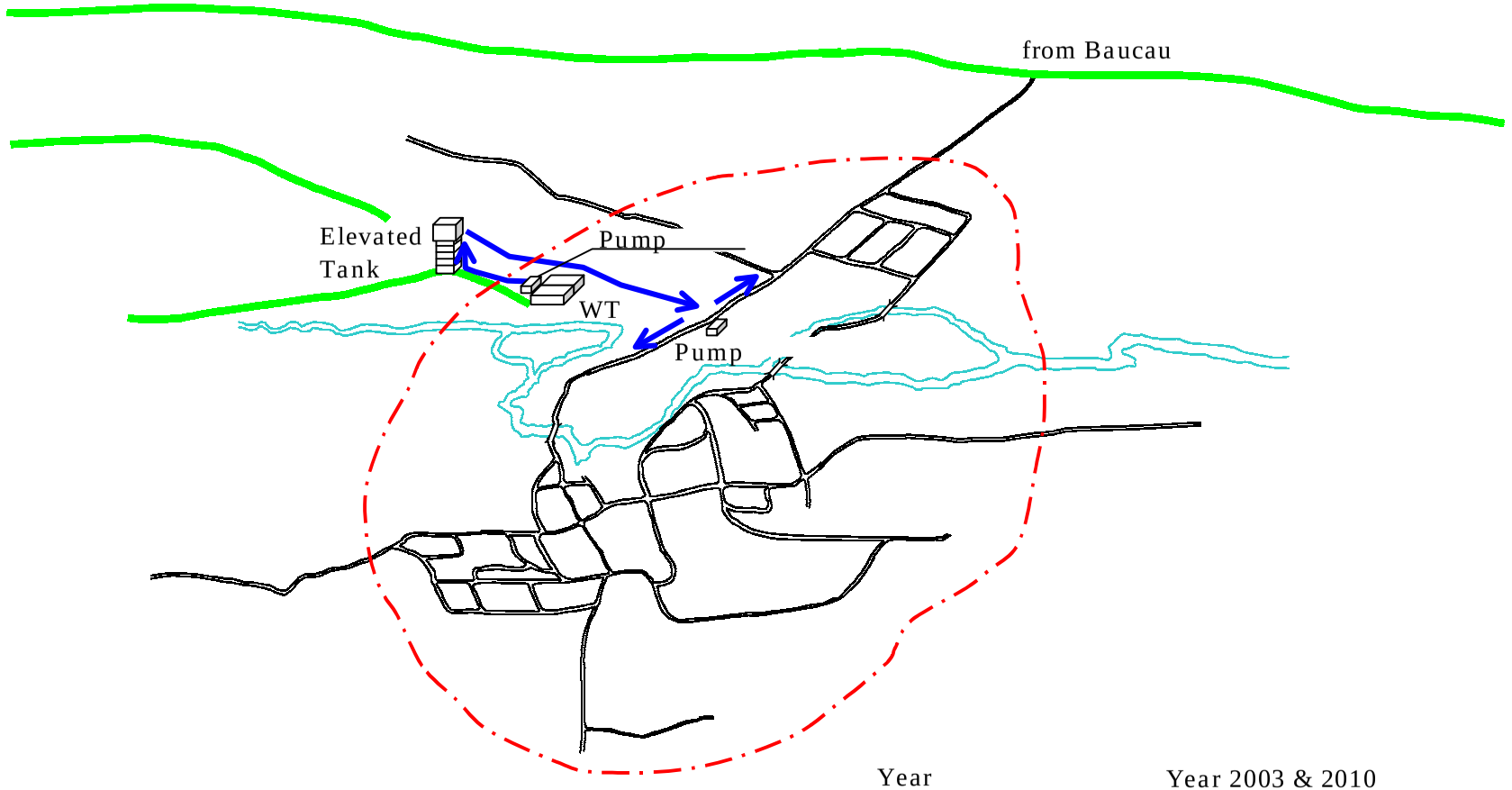
Long Term Development Strategy for Baucau



Present		Year 2003 & 2010
4 Supply Zones (not clear)	→	7 Supply Zones (Transmssion Main Loop in 2010)

JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Baucau	**6.4**

Long Term Development Strategy for Los Palos



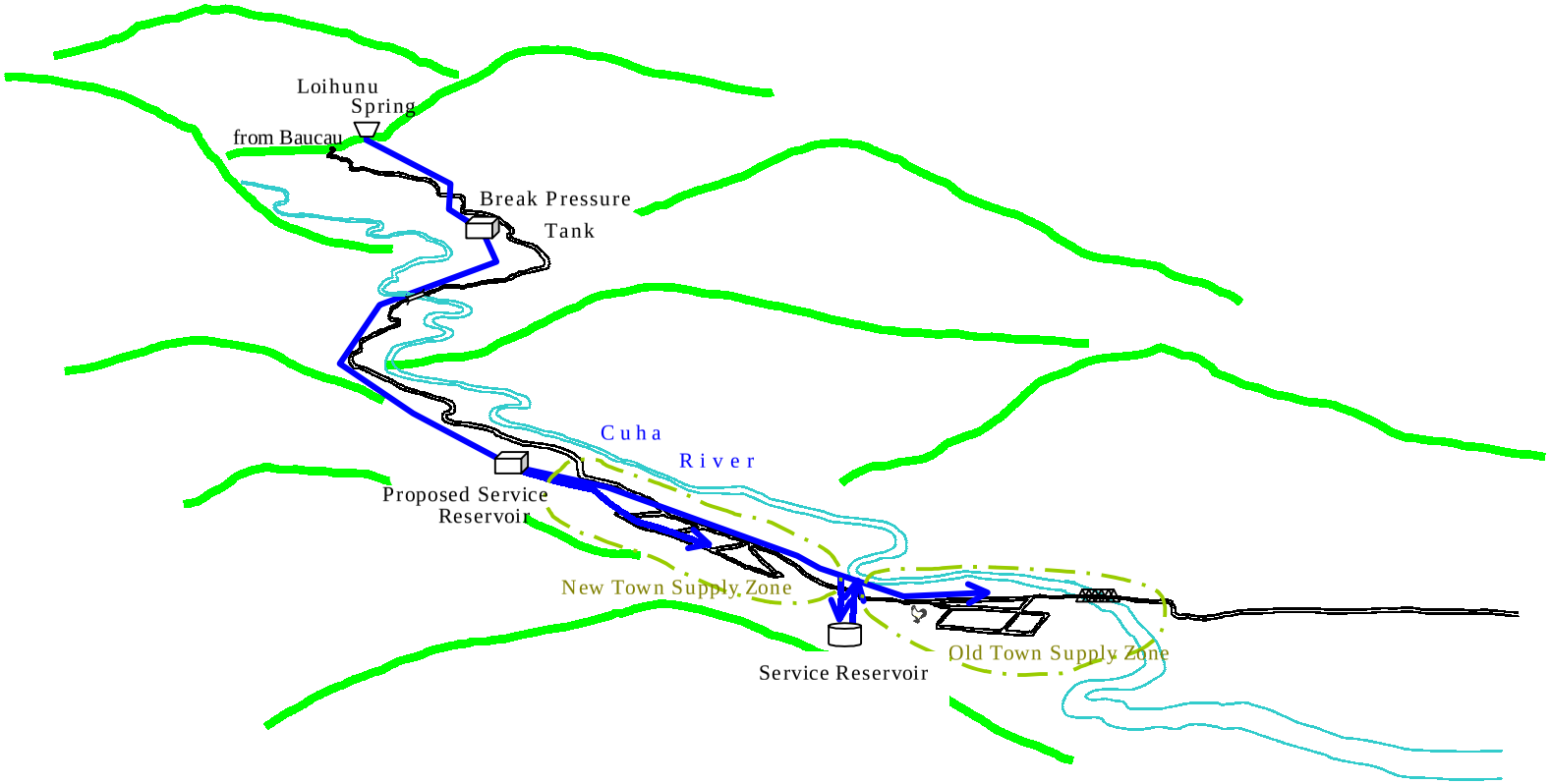
Year	Untreated Water Rationing	→	Year 2003 & 2010 Treated Water One Supply Zone

JICA *The Study onUrgent Improvement Project for the Water Supply System in East Timor*

Long Term Development Strategy for Los Palos

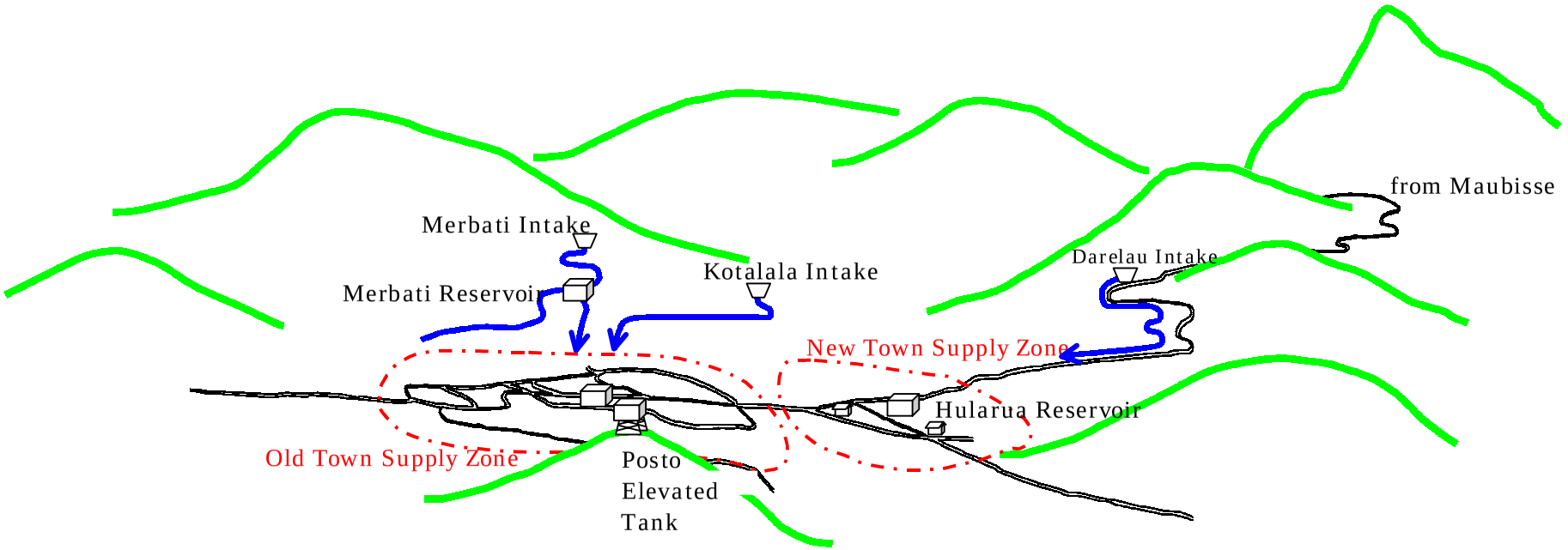
Figure 6.5

Long Term Development Strategy for Viqueque



JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Viqueque	**6.6**

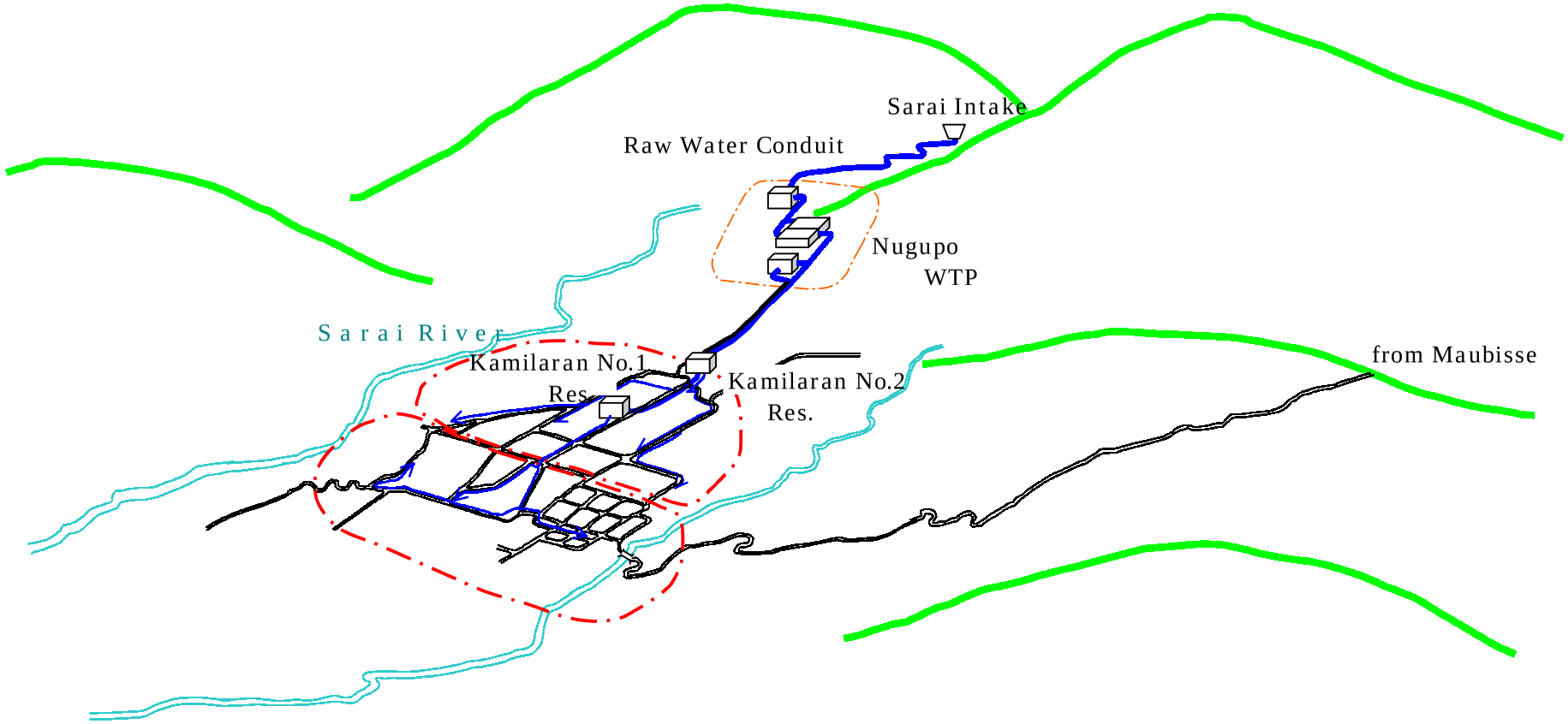
Long Term Development Strategy for Same



Present	Year 2003 & 2010
Two Supply Zones Non-disinfection	→ Two Supply Zones Disinfection at Reservoirs

JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Same	**6.7**

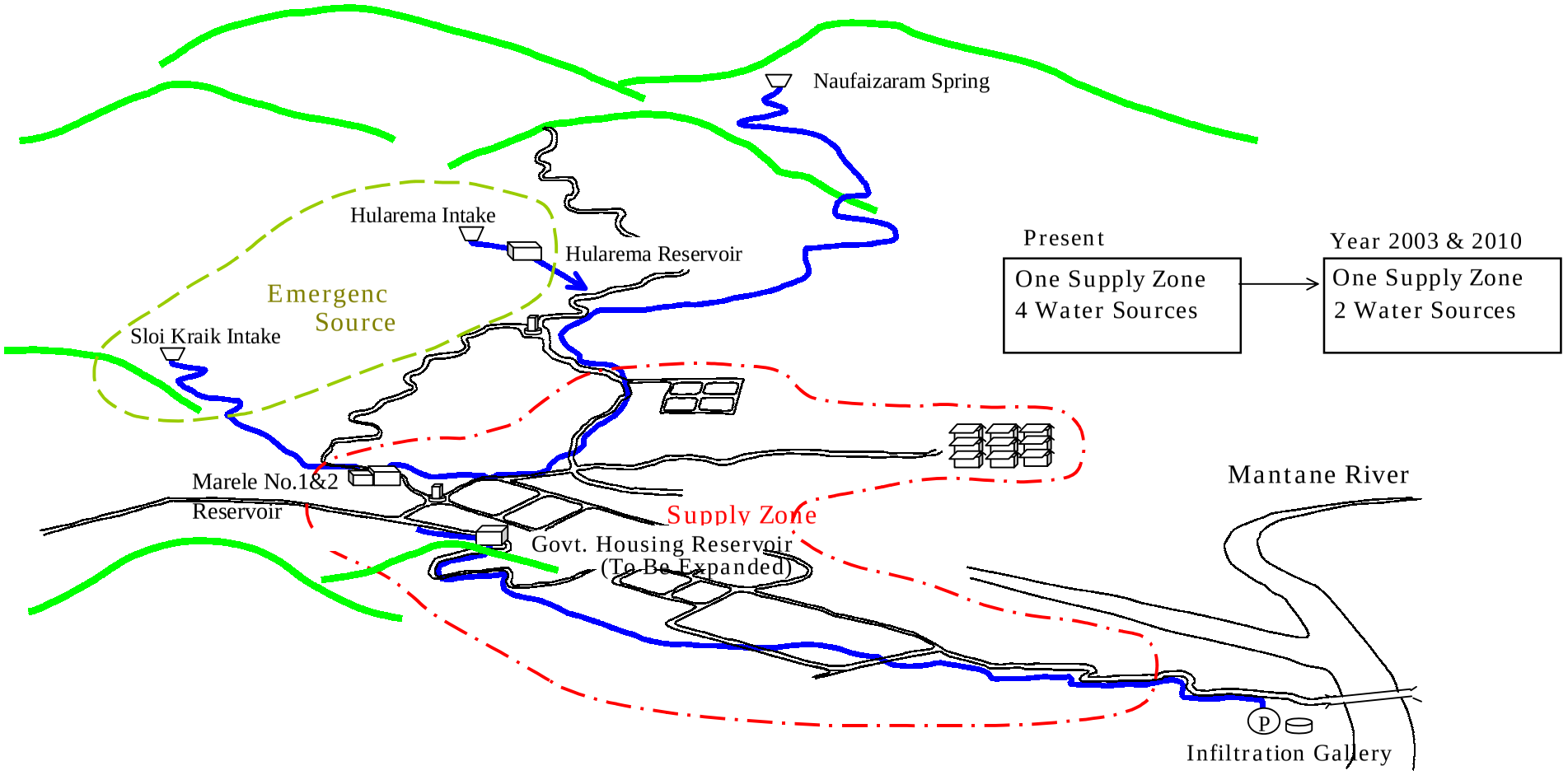
Long Term Development Strategy for Ainaro



Year 1998	→	Year 2003 & 2010
1 Supply Zone		2 Supply Zones (High & Low)

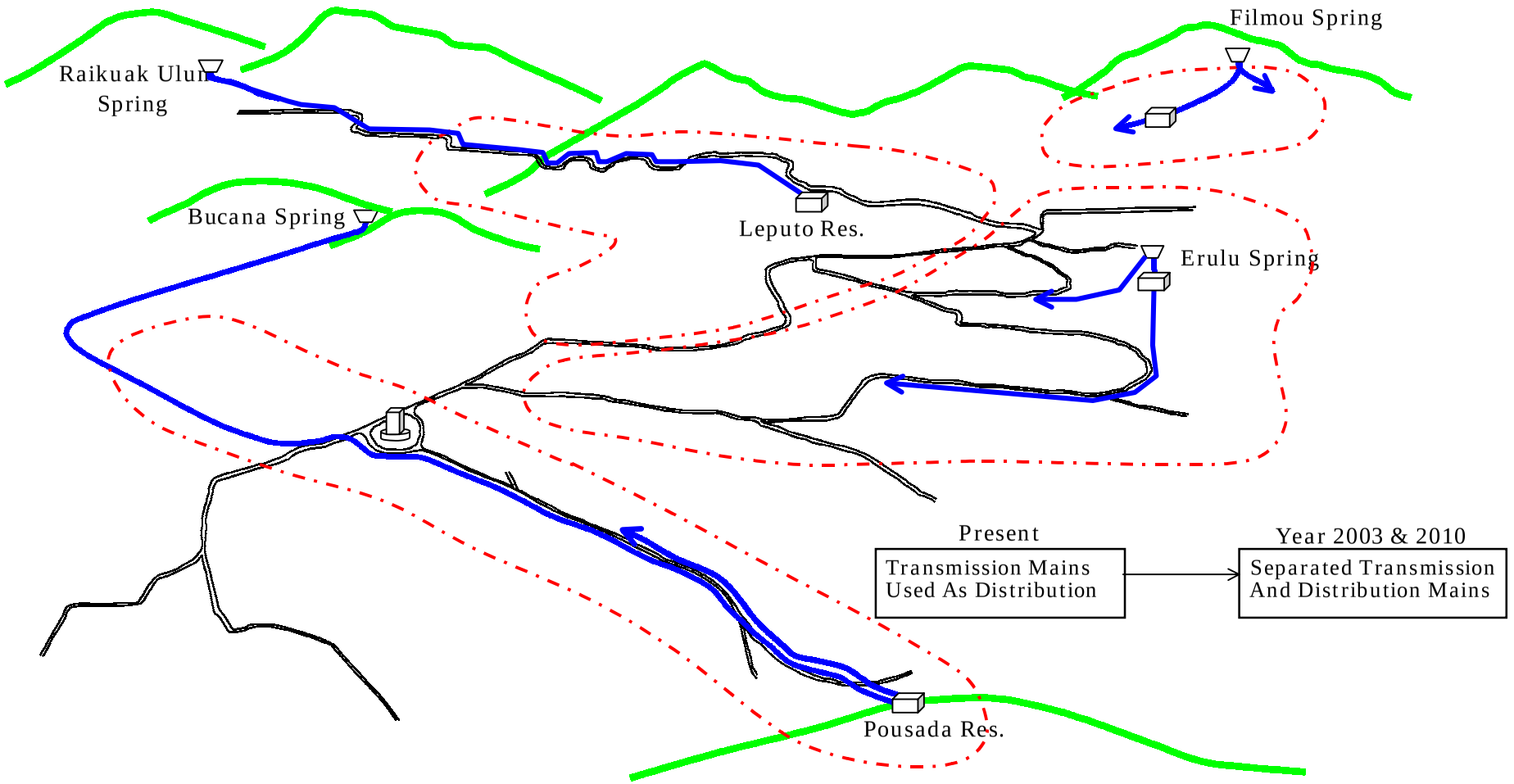
JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Ainaro	**6.8**

Long Term Development Strategy for Aileu



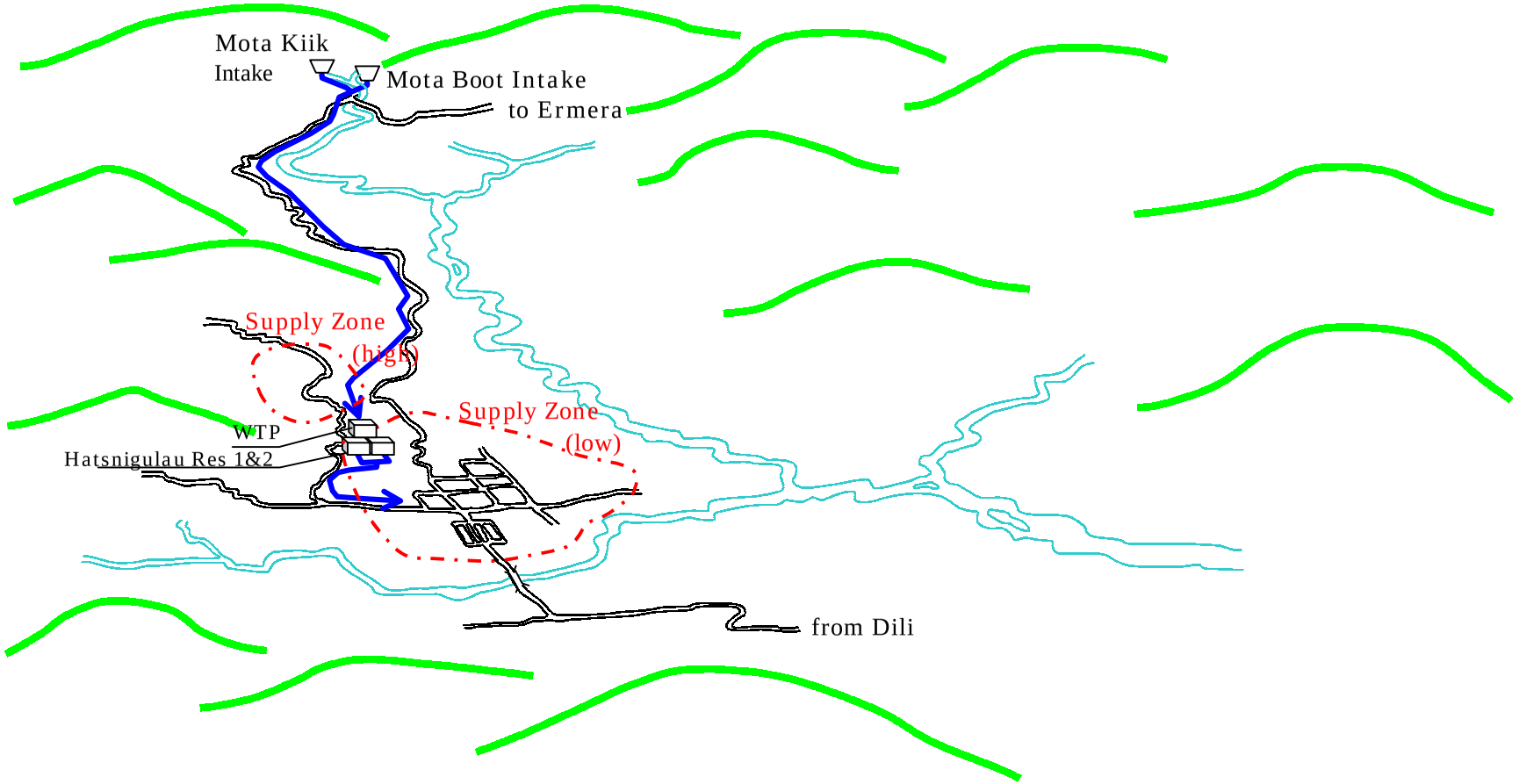
JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Aileu	**6.9**

Long Term Development Strategy for Maubisse



JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Maubisse	**6.10**

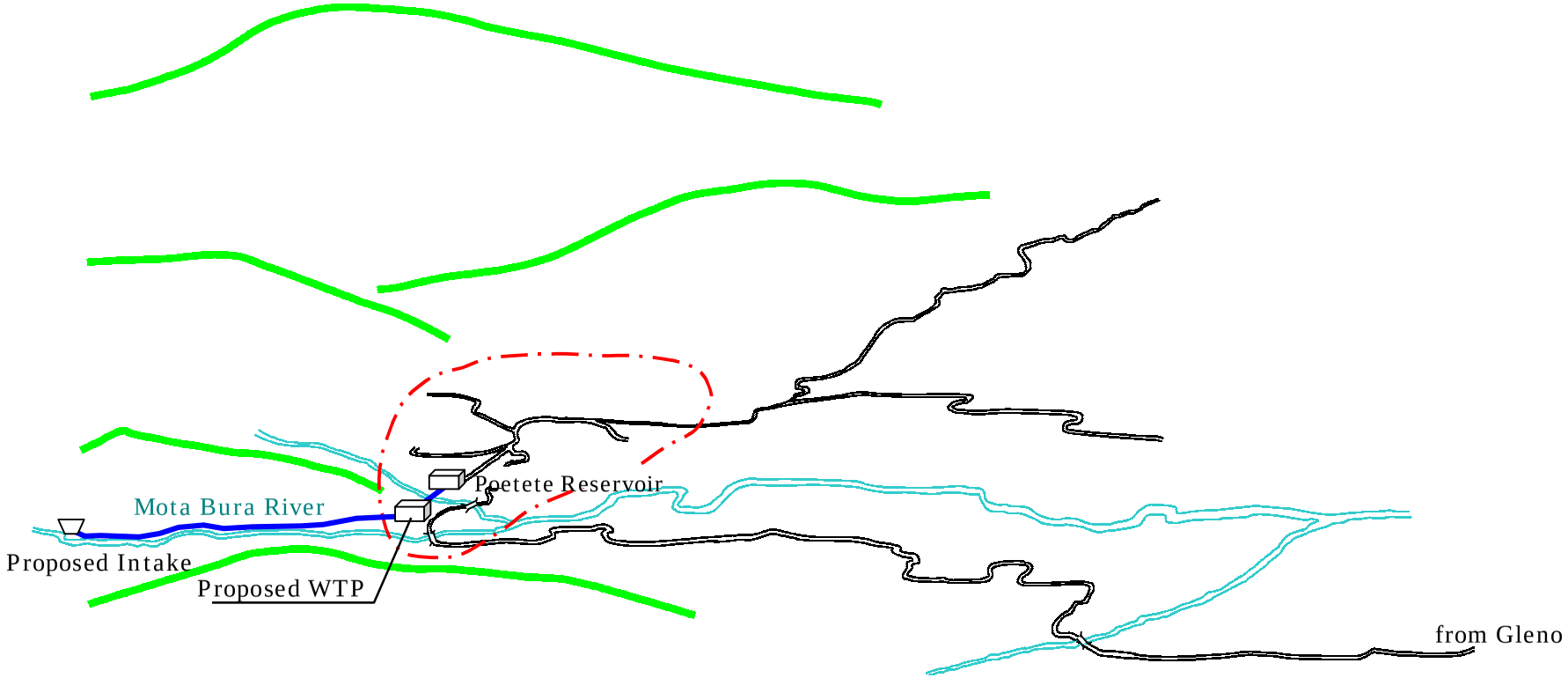
Long Term Development Strategy for Gleno



Present	Year 2003 & 2010
One Supply Zone	→ 2 Supply Zones

JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Gleno	**6.11**

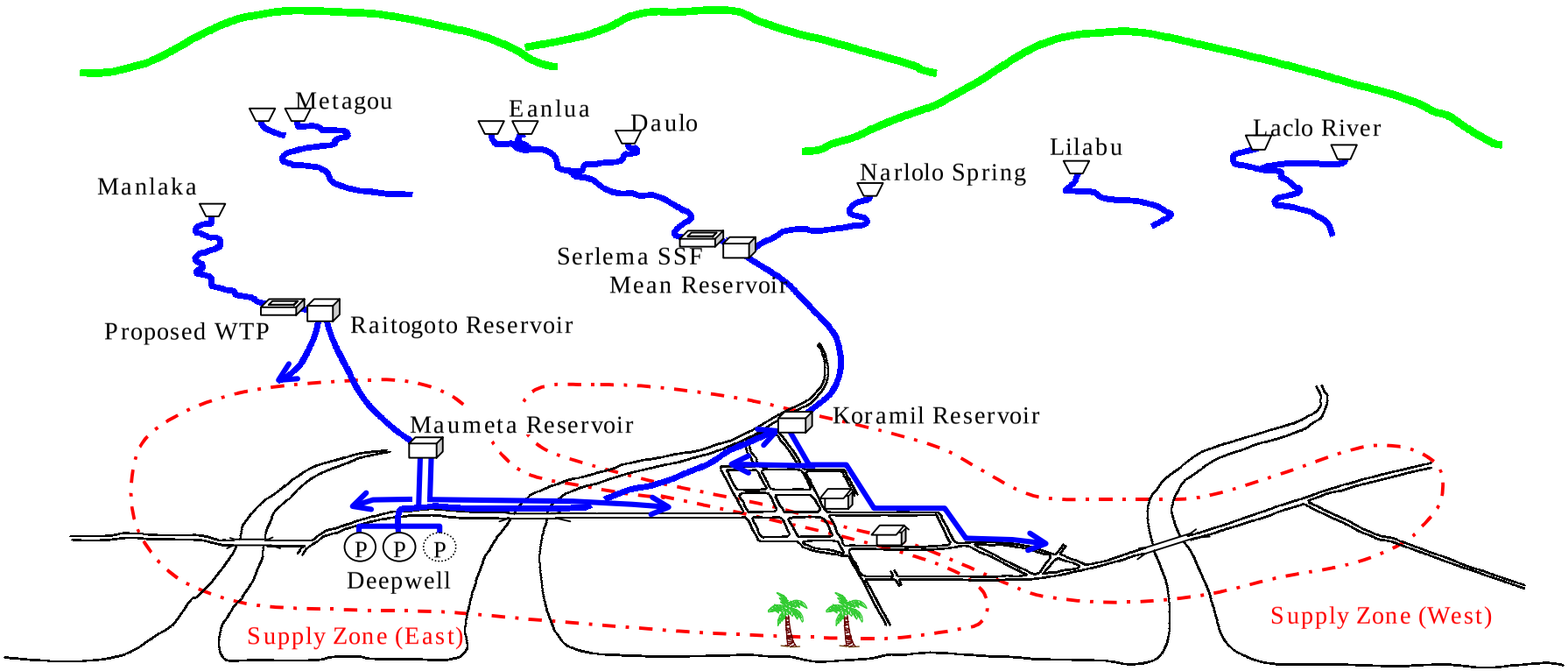
Long Term Development Strategy for Ermera



Year 1998		Year 2003 & 2010
3 Springs	→	One Major Source

JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Ermera	**6.12**

Long Term Development Strategy for Liquica



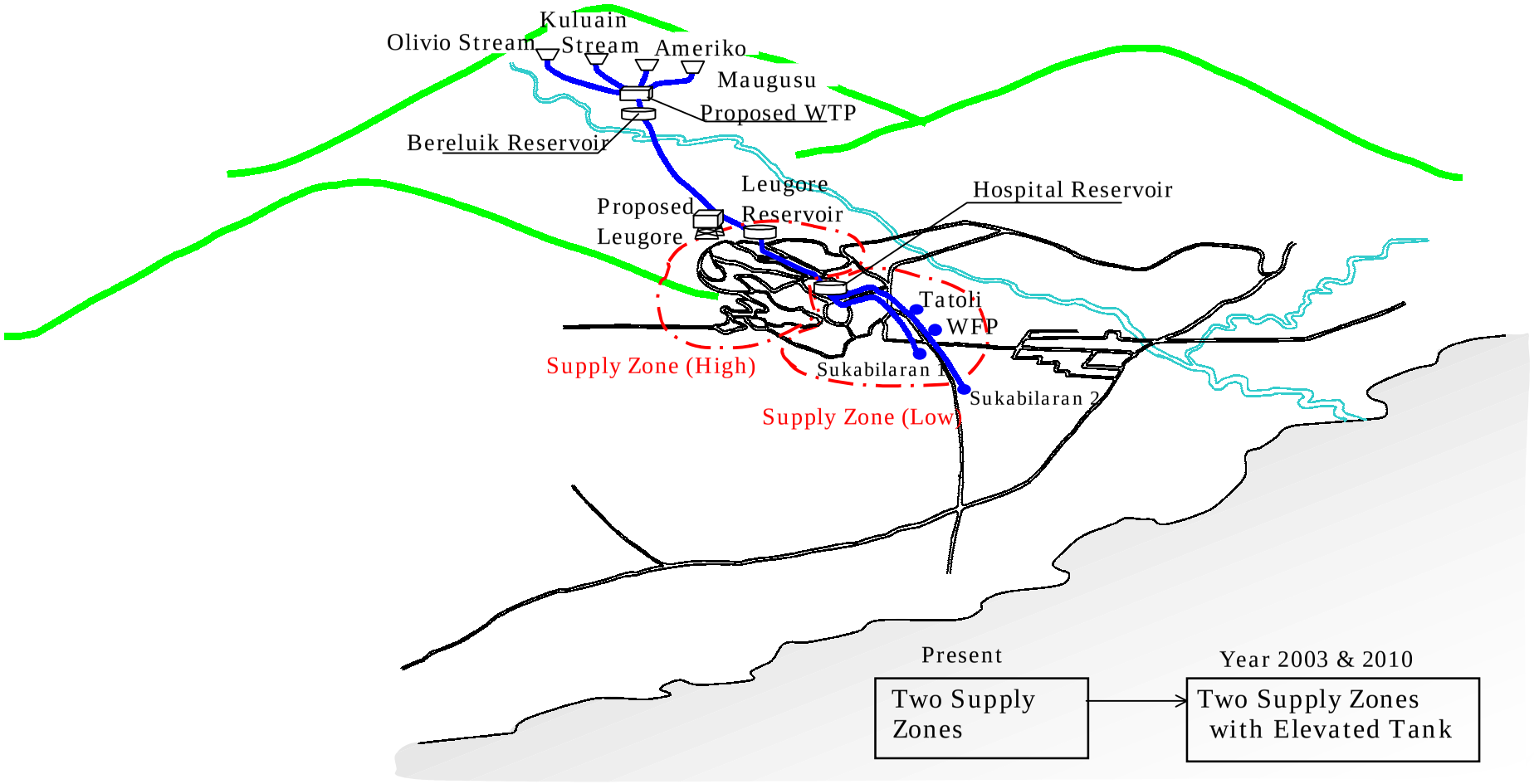
Present	Year 2003 & 2010
Separate Systems	Two Supply Zones

The Study onUrgent Improvement Project for the Water Supply System in East Timor

Long Term Development Strategy for Liquica

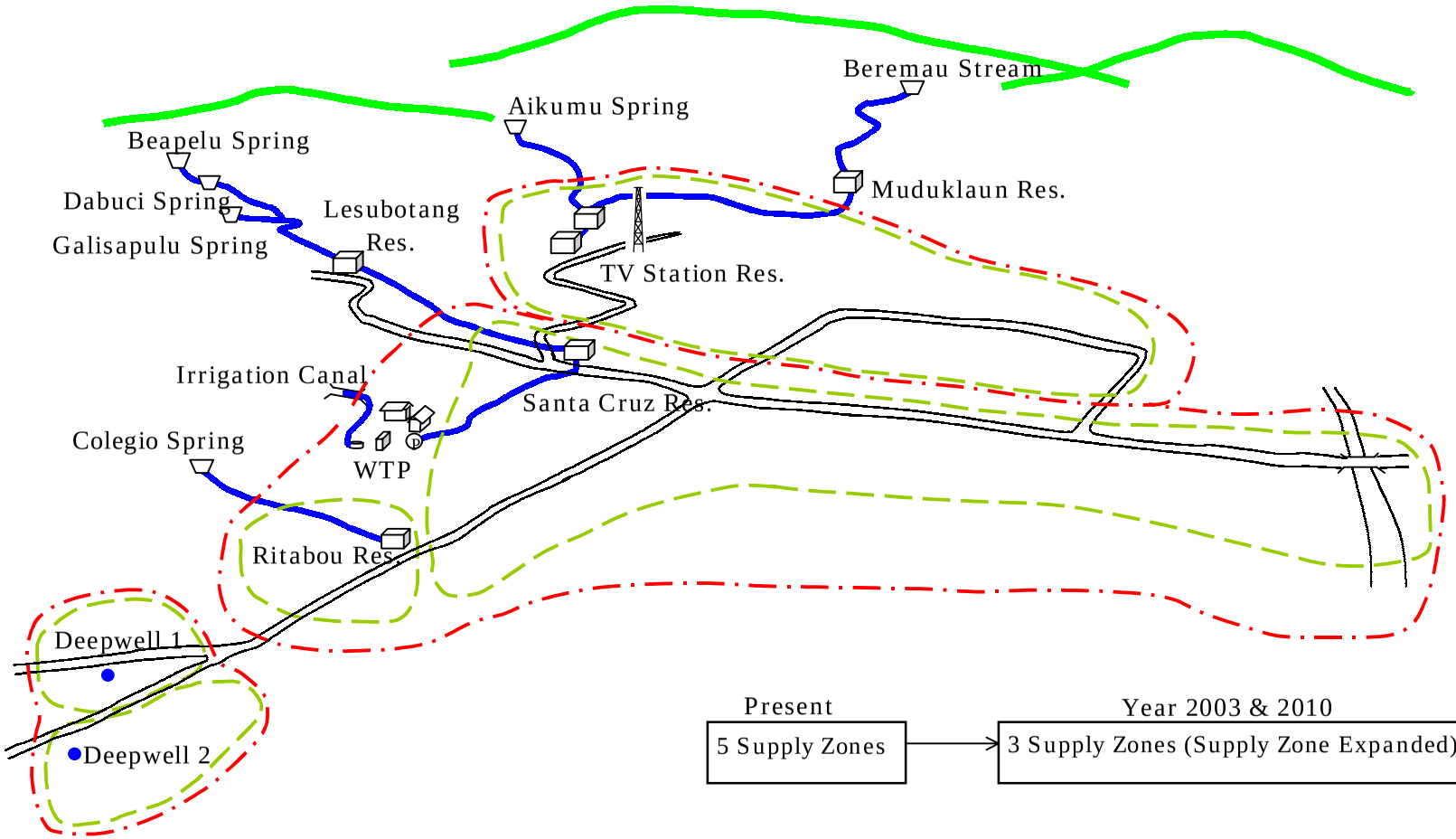
Figure 6.13

Long Term Development Strategy for Suai



JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Suai	**6.14**

Long Term Development Strategy for Maliana



JICA	*The Study onUrgent Improvement Project for the Water Supply System in East Timor*	**Figure**
	Long Term Development Strategy for Maliana	**6.15**

CHAPTER 7 INSTITUTIONAL DEVELOPMENT

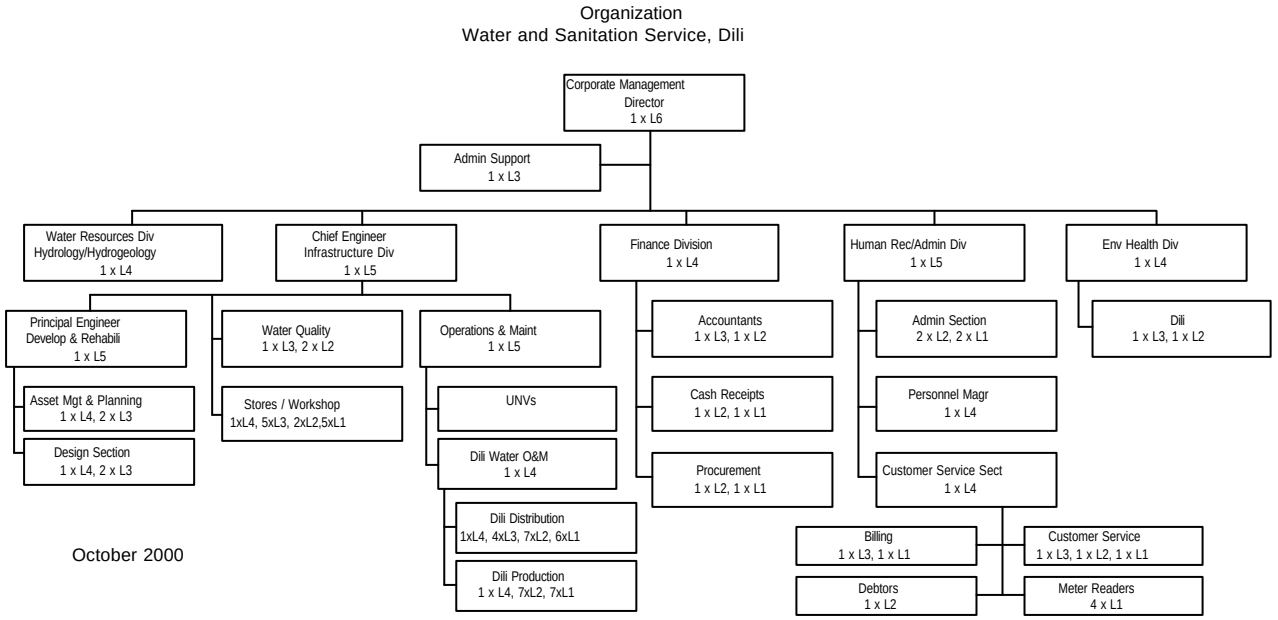
7.1 IMMEDIATE NEEDS

It is emphasized that the damage and malfunction of water supply systems were caused by improper technical standards rather than the violence after the referendum. Improper design, construction work, operation and maintenance were supposedly derived from substandard technical knowledge of those who were at the water supply service. Moreover, most of those engineers and officers departed East Timor and now qualified engineers and administrators barely remain. Number of service personnel is also in short. It is an urgent requirement to secure competent personnel to maintain even the existing status. The institutional as well as technical capacity should be further upgraded, since the present project is proposed to upgrade the technical standards of thus deteriorated facilities of the old water supply systems.

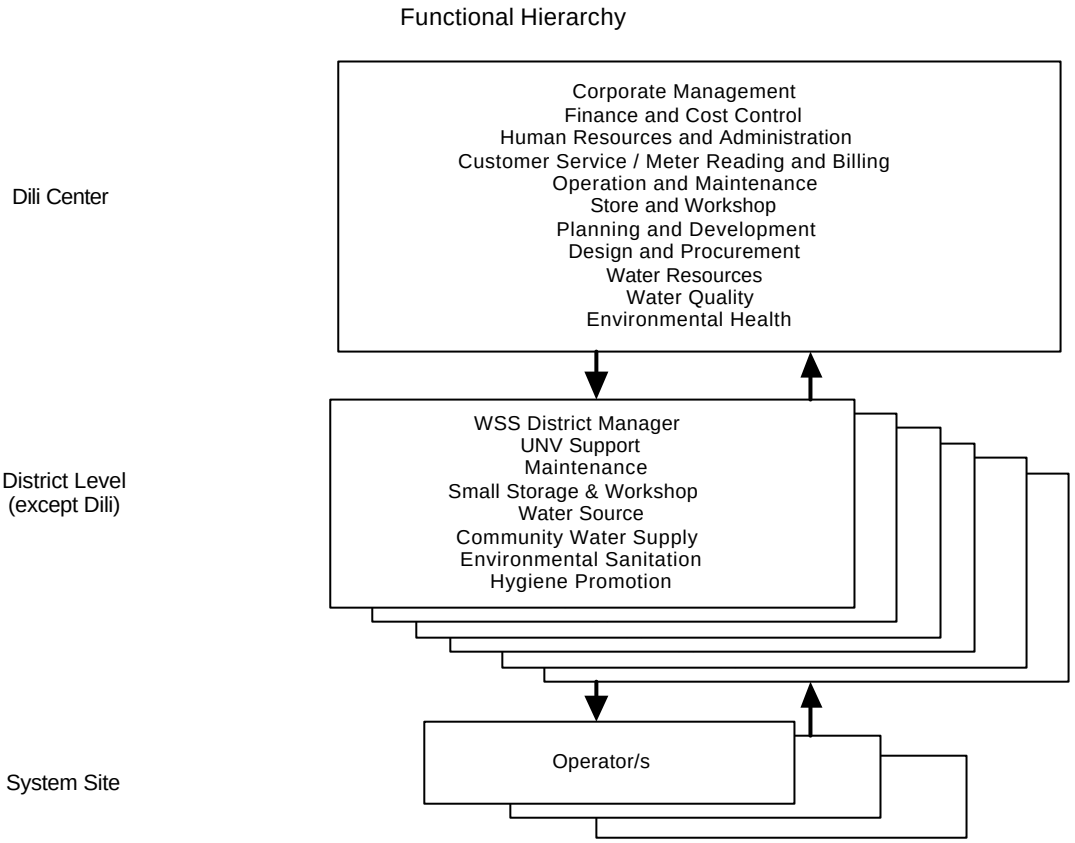
In the regulatory vacuum of the transitional administration, it is not clear whether smaller water supply facilities be owned and maintained by the communities or by the government. Can illegal or unauthorized tapping of the distribution pipe be punished? Cost recovery of the services shall be pursued under the unforeseen government revenue in the immediate future. Is it, however, possible in view of the already low income and affordability of the people? These shall be addressed before or by the time when the rehabilitation work in 15 towns would be completed.

7.1.1 Envisaged Organization of Water and Sanitation Service (WSS) of ETTA

Water Supply and Sanitation Service (WSS) was established under the Department of Infrastructure of ETTA. Besides 6 international staff, it was allocated 153 national personnel framework. Majority of personnel, who were at the water supply service before the referendum, have been already employed on tentative contract base, and will be on the permanent base from January 2001. Among 153 national staff, 63 are employed outside of Dili, and working on repair and maintenance of district water systems.



Basic organizational structure, which WSS envisages, is to keep 50 – 85 core personnel at the Dili center holding functions of administration, finance, human resources, storage, design/engineering, customer services, meter reading, etc., to crew the district subcenters with 5 to 12 personnel on operation and maintenance, small storage, community water supply, environment and sanitation, hygiene promotion, etc., and to post minimum number of system operators at each system.



This functional hierarchy, observably, was assumed with an understanding that the water supply facilities in East Timor could be operated less costly by the centralized management and that the tariff collection, particularly of the metered volume based billing, would not be possible in the immediate future except in Dili. This shrinking organization building due to the reduced budget framework has not yet been tested by application. It is understood that it is the WSS's constrained and tentative strategy to organize itself for the time being.

Personnel already employed include operators, plumbers and laborers, but those with engineering and technical competence are scarce. The business personnel with such disciplines as management, law, finance, accounting, cost control and customer service are to be suitably trained and inducted as and when water supply service is restored to the normal operation.

7.1.2 Personnel Required for Water Supply Services

Before the crisis there were 62 water supply systems reportedly in operation in East Timor, among which 13 systems served for district towns and 49 for sub-district towns and villages. After the exodus of public water supply officers, destruction of facilities and burning of documents, scales and capacity of each system is not exactly known. The present study, after asset mapping, proposed rehabilitation of 15 systems in 12 districts (12 district towns and 3 sub-district towns). The proposed scales of water supply service are tabulated below, in that number of operators are counted on basis of physical requirements of the systems, assuming that the WSS's tentative strategy is applied.

District	Dili		Manatuto	Baucau	Lautem	Viqueque	Manufahi	Aileu
Town	Dili	Atauro	Manatuto	Baucau	Lospalos	Viqueque	Same	Aileu
Population at target year 2003	159,100	2,700	5,900	6,500	14,600	7,800	11,800	4,200
Service ratio (%)	70	50	100	100	50	90	50	100
Planned served population	111,400	1,400	5,900	6,500	7,300	7,000	5,900	4,200
Supply at target year (cu m/day)	23,154	246	1,315	1,409	1,591	1,478	1,295	968
Number of house connections	17,487	193	883	933	1,057	967	863	660
Number of public taps	54	2	10	15	8	10	6	4
Number of operators	16	2	2	7	6	2	2	2

District	Ainaro		Ermera		Liquica	Covalima	Bobonaro	15 Towns
Town	Ainaro	Maubisse	Ermera	Gleno	Liquica	Suai	Maliana	
Population at target year 2003	4,900	2,700	4,300	6,600	12,700	11,800	9,700	265,300
Service ratio (%)	90	70	50	90	70	70	90	72
Planned served population	4,400	1,900	2,200	5,900	8,900	8,300	8,700	189,900
Supply at target year (cu m/day)	854	297	356	1,174	1,874	1,589	1,987	39,587
Number of house connections	533	217	267	743	1,223	983	1,350	28,359
Number of public taps	20	5	5	12	13	20	5	189
Number of operators	2	2	2	6	2	2	4	59

Number of operators shown above is proposed on the minimum required bases and does not include shift crew/s, if necessary. Assuming that average number of operators required for other systems would be somewhat minimum level, say 2, then total number of operators will be153. Including other disciplines at Dili Center and District Subcenters, Total WSS personnel needs will be 300 to 330. This is the minimum estimation.

Operator Requirement	
15 systems (proposed rehabilitation)	59
Other 47 systems (2 operators each)	94
Total number of operators	*153*

District Subcenter Requirement	
13 districts each 5-12 (say average 7)	*91*

Dili Center Requirement	
Dili center	*50 - 85*

Total WSS Requirement	
Water supply and sanitation service	*294 - 329*

The gap between 153 and 300 or 330 will be fairly relieved, if, in smaller systems, the community ownership and operation would be effectively introduced. This implies that inexperienced and unskilled personnel should be trained while operating the existing systems or by the time when rehabilitation work is completed. Training requirements for operators should include not only daily routine operation but also immediate measures against possible accidents. Where system is owned by the community, juridical personality have to be established and roles and responsibility of individual participants shall be legally defined. The service operators need to be so trained that financial transparency and clever entrepreneurship can both be satisfactory, given the cost recovery is seriously pursued. The Capacity Building and Institutional Development Component of PMU under TFET funding is desired to meet these training and regulatory needs.

7.1.3 Actions to be Taken Immediately

It is proposed in the project that the distribution networks in Dili and major towns are significantly improved, that the house connections and the public taps are extensively installed, and that both are to be equipped with water meters. If this is implemented, the water supply service provider will acquire most effective means to eliminate leakages, check unauthorized connections, collect tariff by volume-based billing and thereby minimize unaccounted-for water and wasteful water use. Thus substantially upgraded service facilities shall be put into service for almost a quarter of the national population. The creation of a service provider managed and operated in accordance with modern utility efficiency standards and practices is immediately needed and will require enormous capacity and institution building efforts that should be strategically determined and exercised with *actions*. The prime mover is the execution of tariff toward the eventual cost recovery.

Tariff collection should be practically introduced now and universally implemented in all the piped supply including the public taps. It can be easily started when system is renovated. Thoughts should be inputted to work out an applicable and practicable billing method. Rate of recoverable costs or collected bill may be even low in the beginning. It can be improved as and when the people's economic status become stabilized, affordability to pay grow and the collection system become improved. *Cross subsidizations* should be suggested by the stepped tariff table in that the well-off help the poorer segment of people, among the categories of users in that the large revenue-earning business help the domestic users, and among districts or systems in that the economically privileged regions help the underprivileged areas. On the intermediate stage until the institutional maturity is achieved, another cross subsidy may be suggested among the sectors where the public utility with the easier tariff collection help the utilities that cannot easily enforce the tariff collection by suspending the services.

WSS reckons that it may start the water bill collection in Dili at around July 2001, and in Baucau at the succeeding timing. It is hereby suggested to implement the tariff system in other towns when the water supply system is effectively renovated. It is, however, not easy to collect significant percentage of total bill, as some people may

tend to think that water should be given for free as was done before. It is, therefore, important to let *everyone* know that someone should pay the cost of water supply. *Such publicity activity* should be launched now addressing to and involving donors, NGOs, community leaders and all beneficiaries, and continued until nobody can attempt to question.

It was observed through the leakage control program that most of leakage was derived from unskilled and unauthorized tapping works done for branching from distribution or sometimes transmission pipes. They were not equipped with proper tools and appliances. They have been so extensively made that anyone may suspect if they were publicly allowed. The public, however, must be potentially aware of the fact that the unauthorized tapping works are the cause of malfunctioning of water supply such as low pressure, intermittent or no supply, etc. *A ban*, preferably a criminal ban on them may be enforced with public support when the house connections and the public taps are extensively installed. It was observed that the unauthorized tapping activities were made by those who had no access to water supply. Besides the extensive installation of the house connections, it is important to select *locations of the public taps* very carefully so that any residents from periphery or outside of the served area may have reasonable access. This regulatory action may need to be concurrently taken with establishment of legal ownership of water supply systems and definition of legal responsibility of the water supply service provider.

The last key issue of the universal tariff policy would be *a successful tariff collection from the public taps*. Even if they are, as mentioned earlier, strategically positioned and so structured that only permitted person can approach, management of and tariff collection from the public taps are not an easy exercise. Where a very close neighborhood or a similar interest group shares a public tap, it can be maintained as *a yard connection* held by a user cooperative in that members should collectively be responsible for its maintenance and tariff. If a tap is to serve a wider population with various and conflicting interests, a responsible service person has to be posted for its maintenance and collection of the water charge. It is one suggestion to commission it to *a licensed private vendor*. His retail price to the population and wholesale price to the mobile vendors have to be strictly controlled, though allowing a reasonable margin for his incentive to diligently maintain the tap. This type of commissioning systems is observedly fairly well functioning in many areas in other countries, where the taps are metered. In any case, water from the public taps should be *cautiously priced* so that a house connection owner may not attempt a profitable business.

7.2. INTERMEDIATE AND LONGER TERM REQUIREMENTS

7.2.1 Discharging Duties of the Water Supply Service Provider

Urban water supply service is a natural monopoly servicing for the public interest. It shall, therefore, be strictly regulated to ensure the following major exercises:

- Quality and quantity of distributed water – operation control
- The least cost – cost control, primarily leakage control
- Financial autonomy – cost recovery through tariff collection

The service provider shall supply good potable water to the consumer in the needed quantity and at the needed timing (without interruption). This requires timely expansion of facilities corresponding to the growing demand due to population growth and upgraded lifestyle; technologically sound operation of treatment process and distribution facilities; regular investigation of quality of the produced water; proper maintenance of distribution network so that alien substance may not be delivered; and so on.

As a public utility, water must be supplied at the most inexpensive cost. Cost control can be pursued through technical innovation and through uplifted morale of the provider's employees. In between, leakage control will play a vital role in cost saving. A leakage control program shall be exercised regularly or ceaselessly.

Given the national treasury cannot afford to subsidize the public utility, it should be operated by its own revenue from the public. The poorer segments of people must be secured from paying unaffordable tariff. The escalated tariff table may serve to ensure social equitability and wasteful use of treated water. More importantly, however, tariff rates should not be set by the provider alone. All the participants to the water supply service shall be convened and consulted in the public service pricing, and the agreed procedures of tariff setting shall be legislated.

To achieve these targets, the service provider needs to be regulated, technically upgraded, ethically esteemed and publicly monitored. It should be suggested that the financially autonomous service provider be eventually pursued as the modern public utility standards. It would be also essential that it be monitored by and accountable to the public.

7.2.2 Legislation and Regulation

At the moment, no law or regulation in regard to the water supply and sanitation service is enacted. Basic legislation has to be considered in the following fields:

- Water supply and water supply facilities law
- Authority as well as responsibility of the service provider
- Standards for the quality of potable water
- Environmental law on conservation of water sources
- Control on the groundwater exploitation

Legal concept and definition of water supply facilities shall be established including various technical standards to ensure distribution of safe water. A basic law including ideal, objectives, definition of the water supply and the provider of water supply service will need to be enacted.

A law to establish the service provider will also be needed. Responsibility to supply water, ownership of and right of way to the facilities shall be defined and enforceable tariff collection shall be established. In the case that the provider is not established but supported technically or logistically by national or local government, the community or neighborhood ownership shall be legally established and legal obligation of participants shall be defined. A mechanism should be instituted to monitor and evaluate the provider's performance, in that to what organization the provider is accountable shall be defined.

Control of the quality of drinking water, domestic and industrial wastewater and other water discharge may be regulated in regards to health, hygiene and environmental aspects. Departments of health and environment need to coordinate with departments of infrastructure, industry, etc. to formulate strategies to protect the water-related environment.

Sources of water supply need to be protected. Catchment area of water intake shall be specifically defined. Conservation of soil, flora and vegetation of such catchments shall be legally ensured. Construction of groundwater wells needs to be regulated so that saline intrusion, drawdown of groundwater aquifer and possible land subsidence can effectively be avoided. These legislative actions need to be taken in the context of policy and strategy of the global water resources management.

7.2.3 Institutional Review and Development

During the proposed rehabilitation work for 15 towns and other capital works, it is expected that many donors and NGO's will concurrently undertake various capacity building and institutional development programs. These developments of facilities and institution may take place before the solid sector framework in the national economy is established. Or, it is also anticipated that the maturity of institutional capacity, while growing, may not be sufficiently evolved to operate and maintain the facilities. Institutional review and development shall, therefore, be carried out during the 15 town rehabilitation works.

On the stages of detailed design and supervision of construction works, an institution expert will be mobilized to review the progress of the institutional development programs. His principal duty is to assist WSS in developing organizations and institutional arrangements for the proper and sustainable operation and maintenance of the water supply systems that are to be rehabilitated under the proposed 15 town projects.

To ensure the proper and sustainable operation and maintenance, the institution expert shall:

- Review the progress of capacity and institution building programs,
- Evaluate legal, organizational, financial and personnel resources of the water supply service providers that are evolving,
- Identify, if any, areas and resources that are in short or not sufficiently evolved to the levels required for the proper operation with the modern utility standards and practices,
- Formulate in cooperation with the related offices supplemental program to strengthen the areas and resources requiring enhancement,

- Advise WSS and other water supply service providers, if any, on the practicable implementation of the supplemental program,

- Collaborate and coordinate with WSS, PMU and other related offices during the course of such services.

CHAPTER 8 FINANCIAL PLANNING

8.1 INTRODUCTION

Prior to the national referendum in September 1999, East Timor was the 27th province of Indonesia. The per capita GDP of East Timor is one third of the average national income of Indonesia (USD 1070, 1997).

About 85% of the provincial government budget was the transfer expenditure from the central government of Indonesia. Nonetheless, until the Asian financial crisis in 1997 the regional economy was developing smoothly. GDP per capita has increased from USD 375 to USD 424 in 1994 to 1997, which is equivalent to an annual growth of 10% (real term). However, the Asian financial crisis in 1997 caused the economic activities to drop largely resulting to GDP per capita of USD 215 in 1998 and USD 230 (estimate) in 1999. The depreciation of Indonesia rupee had caused the GDP to drop further until the post-referendum violence when the economy completely collapsed.

This master plan regarding the rehabilitation of the water supplies of 15 cities is aimed for the design year 2003 and made under such environment. However, by the help of many foreign countries and international institutions after the destruction, the socio-economic picture of East Timor is fairly recovering. Although the 150,000 refugees do not return to their original address yet but eventually they will return .The population by district in 1998 before the riot would be appropriate as the base line of population in 2000.

8.2 SCOPE OF FINANCIAL PLAN

This master plan has the target year 2003 and aims the rehabilitation of the water supply systems of 15 cities including Dili. The water supply of the farm village areas of the outside of 15 cities is out of the scope of this master plan. Also the sewerage system is out of the scope.

Capital disbursement will be financed by urgent grant from foreign countries. Therefore this financial plan is focusing the sustainability of operation with respect to O&M expense and tariff revenue.

During the time of the Indonesian administration, the central government supplied the capital disbursement of the water supply of East Timor. However, after independence the financial help from Indonesia become zero. Because the current urgent help is temporary in nature, this master plan must consider sustainability of water supply systems after the urgent international assistance eventually disappear.

Contrary to usual financial analysis, we do not do estimate long term financial activities, annual fund flow and FIRR. Our analysis will be confined to our proposed project (urgent rehabilitation targeting 2003 in 15 cities). We analyze not entire water supply systems in East Timor but the revenue and the cost to operate the water supply systems we have proposed, that is, we treat the proposed systems as if it is independent " virtual entity".

8.3 THE BASIS OF FINANCIAL PLANNING AND PERSPECTIVE OF ECONOMY IN EAST TIMOR

According to the recent ADB Report in East Timor economy (June 2000), the ecomomy in East Timor is still at crisis. GDP per capita estimated from household income survey is USD 113 at average (Table 8.1). Further there are serious regional variations in terms of household income level (Figure 8.1). But we assume the economic confusion post-referendum will be stabilized in 2003 and economy will recover up to the pre-financial crisis level.

The GDP growth rate after 2003, we assumed two cases, 6% or 4%. Regarding population increase, we assume the rate during Indonesian era, i.e. 1.5% annually. Therefore the per capita GDP growth will be 4.5% or 2.5%.

Inflation rate is assumed as 3% annually.

As for per capita GDP in 2003, which is expected to return to the level of pre East Asian economic crisis, we assume USD 428 in 1996 or USD 339 in 1994. Because the year of 1996 was in the bubble economy, it is more conservative attitude to adopt 1994 figure

By economic prospect after 2003, we have developed three cases (Case A, Case B and Case C), which are shown in Table 8.2 and Figure 8.2). Case A is standard case. Case B is more conservative case. Case C is rather presented as a sensitivity analysis to show terrible outcome under lower economic growth.

8.4 COST ESTIMATION

The project cost and O&M cost are summarized in Table 8.3 again. As averaged facility life estimated from the composition of civil works and machine and electric works is 40.9 year, the capital investment will be depreciated at 41-year straight line with 10% salvage value

As for annual growth of O&M cost, personnel expense will increase at per capita GDP growth rate (4.5% or 2.5%) while other component will increase at half rate (2.25% or 1.25%) of per capita GDP growth rate due to technical progress and institutional improvement (Table 8.4).

8.5 WATER SUPPLIED

During the time of the Indonesian administration, only in Dili the water service charges was collected and in the other 14 cities in this Master Plan water was supplied at free charge.

Only Dili has PDAM, which was able to collect the recurrent cost of water supply. But actually even Dili PDAM had to receive financial assistance from central government, i.e., it was financially not independent. Other 14 cities had BDAMs, which were supported by the central government.

From now on, WSS of ETTA is intended to manage the water supply systems in 15 cities as a single entity. As in this master plan, the installment of metering system is planned in all 15 cities; we assume the tariff system by quantity, especially, with progressive nature. During the former administration only 24 % of Dili citizen paid water tariff by meters.

The supply population of 15 cities at 2003 will be 118,820. These population will be covered by 28,359 house connections (including industrial and institutional connections) and 189 public taps. Each house connection supports 6 people and each public tap support 200 person respectively on average.

8.6 TARIFF SYSTEMS AND COLLECTION RATE

Currently in all 15 cities covered by this master plan, no cities collect water tariff. What kind of water tariff system and when it will be introduced is crucial issue to be discussed during UN administration. Anyway, the introduction of water tariff will be done gradually step by step. 93 % of the citizen interviewed expresses the willingness to pay for water charge. The tariff collection will introduced in Dili firstly then will be applied to other cities as soon as possible even if at beginning of tariff collection, the collection rate will be very low. Our expected tariff collection rates are shown in Table 8.5, Table 8.6 and Table 8.7.

The adoption of progressive tariff system will protect poor consumers at the expense of heavy users and will enforce to economize water consumption. Although, there are several poor districts outside Dili, it is still possible for the tariff to be collected in all districts. The revenue in richer districts or subsidy from the general budget might cover the water revenue deficiencies in several poor districts.

8.7 REVENUE FROM WATER SALES

Before the referendum, on average a household in Dili paid 7,000 rupiah monthly as water charge for domestic connection (the monthly electricity charge was 17,000 rupees for a household on average) and including institutional and commercial customers average water charge per connection was more than 13,000 rupee monthly (ADB Framework Report, December 2000).

According to our survey, 40% of respondents had more than 500,000 rupiah monthly income. If we assume 500,000 rupiah as the average city household income, the former water charge is about 1.4 % of household income.

Considering recent inflation and rupee depreciation and applying progressive tariff table for heavy uses and separate tariff system for industrial and institutional customers, it is quite reasonable to assume 1.4 % of per capita GDP per water connection on average. Household size is assumed as 8 people.

As for public taps of 189, it is assumed that except for rural area, the tariff collection for the public taps is considered not feasible.

The revenue prospects in three cases are shown in Table 8.8, Table 8.9 and Table 8.10. Even in 2030, the revenue from Dili District consists of 64-69% of total revenue

(Figure 8.3, Figure 8.4 and Figure 8.5). It is very critical to establish the Dili water supply systems institutionally and financially as soon as possible.

8.8 FINANCIAL ANALYSIS AND EVALUATION

The results of estimation of water revenue and water cost are summarized in Figure 8.6, Figure 8.7 and Figure 8.8. These data are shown in constant dollar (at 2000 year). The depreciation cost will decrease with inflation (assumed as 3% annually).

At Case A (standard case): O&M cost recovered at 2014 fully and total cost recovered at 2021 fully from water tariff.

At Case B (conservative case): O&M cost recovered at 2022 fully and total cost recovered at 2026 fully.

Case C is a worst story to be avoided by every effort. Even at 2030, O&M cost is not covered by tariff revenue and subsidy is required. Thus economic performance of East Timor in future plays critical role.

We strongly recommend achieving financial sustainability by income generation. To achieve this level of income generation, several steps in tariff system and collection efforts will be required and it will take substantial length of time span to achieve.

Eventually, as socio-economic situation will stabilize, annual 6 % of economic growth will be possible in East Timor at real term. As the country economy grows and commercial and institutional users increase, the revenue from water sales will increase.

In order to strengthen the sustainability of the operation, it is recommended to consider privatization of operation or the charge collection by private company. Even, such efforts will be accumulated; the construction cost is unable to recover by tariff revenue. Therefore, the design consideration to economize initial investment is very critical. The low running cost has to be also considered at the planning phase.

Table 8.1 Average Income Per Household (June 2000, ADB Report)

District	Income Per Household 1000 Rp. / Month	Income Per Capita USD / Year	Per Capita GDP USD / Year
Dili			
Dili	501	94	157
High Income Districts			
Ermera	1,011	190	316
Manafahi	551	103	172
Bobonaro	484	91	151
Liquicia	423	79	132
Lautem	364	68	114
Low Income Districts			
Ainaro	246	46	77
Viqueque	203	38	63
Aileu	201	38	63
Manatuto	131	25	41
Baucau	111	21	35
Cova Lima	80	15	25
Average	360	68	113
Average (Ex.Dili)	301	56	94

Assumption: Consumption is 60 % of GDP

Figure 8.1 Average Household Income by Districts (June 2000)

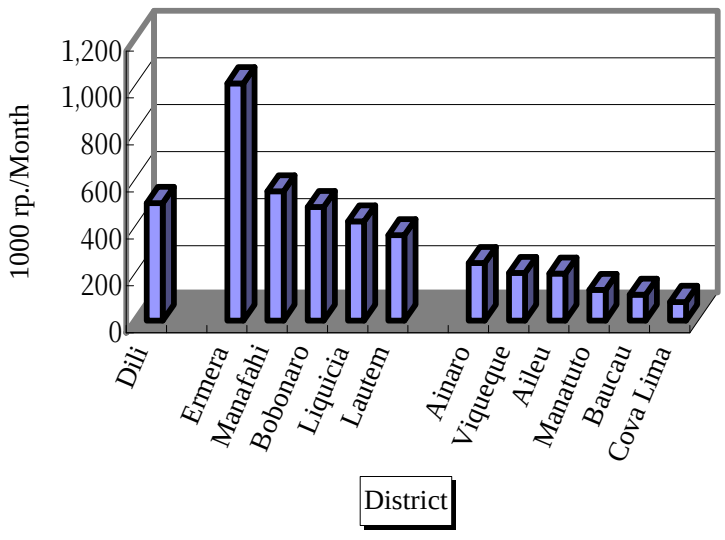


Table 8.2 Prospects of Per Capita GDP in East Timor (Three Cases)

Case A Assumption: Per capita GDP (2003) = Per capita GDP (1996), 4.5% real growth after 2003.

Year	1993	1994	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Per capita GDP (USD)	307	339	373	428	246				428	447	467	488	510	533	557	582	609	636
Exchange Rate (Rp./USD)	2,103	2,181	2,276	2,364	4,667	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Per capita GDP (USD)	665	695	726	758	793	828	866	905	945	988	1,032	1,079	1,127	1,178	1,231	1,286	1,344	1,405
Exchange Rate (Rp./USD)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000

Case B Assumption: Per capita GDP (2003) = Per capita GDP (1994), 4.5% real growth after 2003.

Year	1993	1994	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Per capita GDP (USD)	307	339	373	428	246				339	354	370	387	404	422	441	461	482	504
Exchange Rate (Rp./USD)	2,103	2,181	2,276	2,364	4,667	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Per capita GDP (USD)	526	550	575	601	628	656	686	716	749	782	818	854	893	933	975	1,019	1,065	1,113
Exchange Rate (Rp./USD)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000

Case C Assumption: Per capita GDP (2003) = Per capita GDP (1994), 2.5% real growth after 2003.

Year	1993	1994	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Per capita GDP (USD)	307	339	373	428	246				339	347	356	365	374	384	393	403	413	423
Exchange Rate (Rp./USD)	2,103	2,181	2,276	2,364	4,667	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Per capita GDP (USD)	434	445	456	467	479	491	503	516	529	542	555	569	584	598	613	628	644	660
Exchange Rate (Rp./USD)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000

Source: GDP per capita 1993 - 1997 (ADB Asian Economic Outlook 1999 etc).

Figure 8.2 Prospects of Per Capita GDP in East Timor

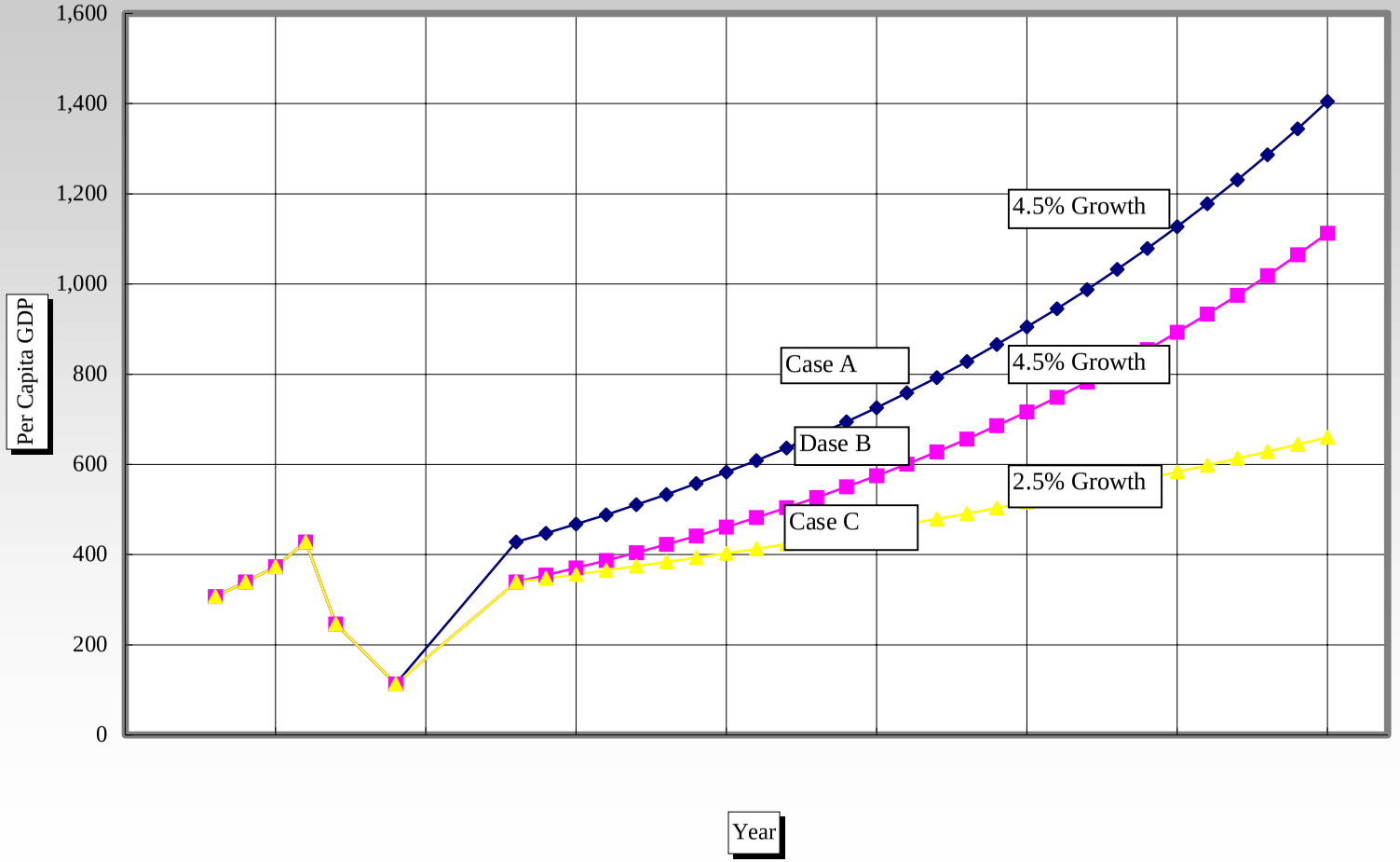


Table 8.3 The Summary of Project Cost and Annual O&M Cost (at 2000 Price)

(1000 USD)

Description	Dili	Other Districts	Total
Civil Work	4,079.4	2,258.4	6,337.8
Piping Work	5,246.6	3,520.3	8,766.9
Mechanical Work	152.0	797.1	949.2
Electrical Work	193.1	833.8	1,026.9
Public Taps	128.0	219.0	347.0
Service Connections	2,189.0	1,278.0	3,467.0
Miscellaneous	15.0	91.3	106.3
Sub-Total	12,003.2	8,997.8	21,001.0
Engineering Cost	1,200.3	899.8	2,100.1
Sub-Total	13,203.5	9,897.6	23,101.1
Contingency	1,980.5	1,484.6	3,465.2
Project Cost Total	15,184.0	11,382.2	26,566.2

(1000 USD)

Description	Dili	Other Districts	Total
Mechanical Operation	231.8	292.7	524.5
Personnel	26.9	204.1	231.1
Vehicle Running	12.0	75.0	87.0
Repair	120.0	90.0	210.0
Others	110.4	41.0	151.4
O&M Cost Total	501.2	702.8	1,204.0

Facility Life (Years)	
Civil	50.0
Mech.&Electric.	15.0
Average	40.9

(1000 USD)

Annual Depreciation	583.2

(41 Years Straight Line, 10% Salvage Value)

Table 8.4 Estimated O&M Cost from 2001 through 2025 (at 2000 Price)

(1000 USD)

Year	Description	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
O & M cost (4.5% Per Capita GDP Growth)	Mechanical Operation	524.5	524.5	524.5	536.3	548.4	560.7	573.3	586.2	599.4	612.9	626.7	640.8	655.2	669.9	685.0
	Personnel	231.1	231.1	231.1	241.5	252.3	263.7	275.6	288.0	300.9	314.4	328.6	343.4	358.8	375.0	383.4
	Vehicle running	87.0	87.0	87.0	89.0	91.0	93.0	95.1	97.2	99.4	101.7	104.0	106.3	108.7	111.1	113.6
	Repair	210.0	210.0	210.0	214.7	219.6	224.5	229.6	234.7	240.0	245.4	250.9	256.6	262.3	268.2	274.3
	Others	151.4	151.4	151.4	154.8	158.3	161.8	165.5	169.2	173.0	176.9	180.9	185.0	189.1	193.4	197.7
	O&M Cost Total	1,204.0	1,204.0	1,204.0	1,236.3	1,269.5	1,303.7	1,339.0	1,375.3	1,412.8	1,451.3	1,491.1	1,532.0	1,574.2	1,617.7	1,654.1

Year	Description	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
O & M cost (4.5% Per Capita GDP Growth)	Mechanical Operation	700.4	716.2	732.3	748.8	765.6	782.9	800.5	818.5	836.9	855.7	875.0	894.7	914.8	935.4	956.4
	Personnel	400.7	418.7	437.5	457.2	477.8	499.3	521.8	545.3	569.8	595.4	622.2	650.2	679.5	710.1	742.0
	Vehicle running	116.2	118.8	121.5	124.2	127.0	129.9	132.8	135.8	138.8	141.9	145.1	148.4	151.7	155.2	158.6
	Repair	280.5	286.8	293.2	299.8	306.6	313.5	320.5	327.7	335.1	342.6	350.3	358.2	366.3	374.5	383.0
	Others	202.2	206.7	211.4	216.1	221.0	226.0	231.1	236.3	241.6	247.0	252.6	258.2	264.1	270.0	276.1
	O&M Cost Total	1,699.9	1,747.2	1,795.9	1,846.2	1,898.0	1,951.5	2,006.6	2,063.5	2,122.2	2,182.8	2,245.3	2,309.8	2,376.4	2,445.1	2,516.1

(1000 USD)

Year	Description	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
O & M cost (2.5% Per Capita GDP Growth)	Mechanical Operation	524.5	524.5	524.5	531.1	537.7	544.4	551.2	558.1	565.1	572.1	579.3	586.5	593.9	601.3	608.8
	Personnel	231.1	231.1	231.1	236.8	242.8	248.8	255.1	261.4	268.0	274.7	281.5	288.6	295.8	303.2	310.8
	Vehicle running	87.0	87.0	87.0	88.1	89.2	90.3	91.4	92.6	93.7	94.9	96.1	97.3	98.5	99.7	101.0
	Repair	210.0	210.0	210.0	212.6	215.3	218.0	220.7	223.5	226.3	229.1	232.0	234.9	237.8	240.8	243.8
	Others	151.4	151.4	151.4	153.3	155.2	157.1	159.1	161.1	163.1	165.1	167.2	169.3	171.4	173.6	175.7
	O&M Cost Total	1,204.0	1,204.0	1,204.0	1,221.9	1,240.1	1,258.7	1,277.5	1,296.7	1,316.2	1,336.0	1,356.1	1,376.6	1,397.4	1,418.5	1,440.1

Year	Description	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
O & M cost (2.5% Per Capita GDP Growth)	Mechanical Operation	616.4	624.1	631.9	639.8	647.8	655.9	664.1	672.4	680.8	689.3	698.0	706.7	715.5	724.5	733.5
	Personnel	318.5	326.5	334.7	343.0	351.6	360.4	369.4	378.6	388.1	397.8	407.7	417.9	428.4	439.1	450.1
	Vehicle running	102.2	103.5	104.8	106.1	107.5	108.8	110.2	111.5	112.9	114.3	115.8	117.2	118.7	120.2	121.7
	Repair	246.8	249.9	253.0	256.2	259.4	262.6	265.9	269.2	272.6	276.0	279.5	283.0	286.5	290.1	293.7
	Others	177.9	180.2	182.4	184.7	187.0	189.3	191.7	194.1	196.5	199.0	201.5	204.0	206.5	209.1	211.7
	O&M Cost Total	1,461.9	1,484.2	1,506.8	1,529.9	1,553.3	1,577.1	1,601.3	1,625.9	1,651.0	1,676.5	1,702.4	1,728.8	1,755.6	1,782.9	1,810.7

Table 8.5 The Assumed Tariff Collection Rate by Districts (Case A)

(USD)

Year			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Per Capita GDP		Case A			428	447	467	488	510	533	557	582	609	636	665	695	726	758	793	828	866	905	945	988	1,032	1,079	1,127	1,178	1,231	1,286	1,344	1,405
		CaseB			339	354	370	387	404	422	441	461	482	504	526	550	575	601	628	656	686	716	749	782	818	854	893	933	975	1,019	1,065	1,113
		Case C			339	347	356	365	374	384	393	403	413	423	434	445	456	467	479	491	503	516	529	542	555	569	584	598	613	628	644	660
Average Monthly Water Bill per Connection		Case A			3.99	4.17	4.36	4.56	4.76	4.98	5.20	5.44	5.68	5.94	6.20	6.48	6.77	7.08	7.40	7.73	8.08	8.44	8.82	9.22	9.63	10.07	10.52	10.99	11.49	12.01	12.55	13.11
		CaseB			3.16	3.31	3.46	3.61	3.77	3.94	4.12	4.31	4.50	4.70	4.91	5.13	5.37	5.61	5.86	6.12	6.40	6.69	6.99	7.30	7.63	7.97	8.33	8.71	9.10	9.51	9.94	10.38
		Case C			3.16	3.24	3.32	3.41	3.49	3.58	3.67	3.76	3.86	3.95	4.05	4.15	4.26	4.36	4.47	4.58	4.70	4.81	4.93	5.06	5.18	5.31	5.45	5.58	5.72	5.87	6.01	6.16
District	Connections	Public Taps																														
Dili																																
Dili	17,680	56	30%	40%	50%	60%	70%	72%	73%	74%	75%	76%	77%	78%	79%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
High Income Districts																																
Ermera	1,010	17	20%	25%	30%	35%	40%	45%	50%	54%	58%	62%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Manafahi	863	6	20%	25%	30%	35%	40%	45%	50%	54%	58%	62%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Bobonaro	1,350	5	20%	25%	30%	35%	40%	45%	50%	54%	58%	62%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Liquicia	1,223	13	20%	25%	30%	35%	40%	45%	50%	54%	58%	62%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Lautem	1,057	8	20%	25%	30%	35%	40%	45%	50%	54%	58%	62%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Low Income Districts																																
Ainaro	750	25	10%	15%	20%	25%	30%	35%	40%	45%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	66%	66%	66%	66%	66%
Viqueque	967	10	10%	15%	20%	25%	30%	35%	40%	45%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	66%	66%	66%	66%	66%
Aileu	660	4	10%	15%	20%	25%	30%	35%	40%	45%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	66%	66%	66%	66%	66%
Manatuto	883	10	10%	15%	20%	25%	30%	35%	40%	45%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	66%	66%	66%	66%	66%
Baucau	933	15	10%	15%	20%	25%	30%	35%	40%	45%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	66%	66%	66%	66%	66%
Cova Lima	983	20	10%	15%	20%	25%	30%	35%	40%	45%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	66%	66%	66%	66%	66%

Table 8.6 The Assumed Tariff Collection Rate by Districts (Case B)

(USD)

Year			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Per Capita GDP		Case A			428	447	467	488	510	533	557	582	609	636	665	695	726	758	793	828	866	905	945	988	1,032	1,079	1,127	1,178	1,231	1,286	1,344	1,405
		CaseB			339	354	370	387	404	422	441	461	482	504	526	550	575	601	628	656	686	716	749	782	818	854	893	933	975	1,019	1,065	1,113
		Case C			339	347	356	365	374	384	393	403	413	423	434	445	456	467	479	491	503	516	529	542	555	569	584	598	613	628	644	660
Average Monthly Water Bill per Connection		Case A			3.99	4.17	4.36	4.56	4.76	4.98	5.20	5.44	5.68	5.94	6.20	6.48	6.77	7.08	7.40	7.73	8.08	8.44	8.82	9.22	9.63	10.07	10.52	10.99	11.49	12.01	12.55	13.11
		CaseB			3.16	3.31	3.46	3.61	3.77	3.94	4.12	4.31	4.50	4.70	4.91	5.13	5.37	5.61	5.86	6.12	6.40	6.69	6.99	7.30	7.63	7.97	8.33	8.71	9.10	9.51	9.94	10.38
		Case C			3.16	3.24	3.32	3.41	3.49	3.58	3.67	3.76	3.86	3.95	4.05	4.15	4.26	4.36	4.47	4.58	4.70	4.81	4.93	5.06	5.18	5.31	5.45	5.58	5.72	5.87	6.01	6.16
District	Connections	Public Taps																														
Dili																																
Dili	17,680	56	30%	40%	50%	53%	56%	59%	62%	65%	68%	71%	72%	73%	74%	75%	76%	77%	78%	79%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
High Income Districts																																
Ermera	1,010	17	20%	25%	30%	34%	38%	42%	46%	50%	54%	58%	60%	62%	64%	65%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%
Manafahi	863	6	20%	25%	30%	34%	38%	42%	46%	50%	54%	58%	60%	62%	64%	65%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%
Bobonaro	1,350	5	20%	25%	30%	34%	38%	42%	46%	50%	54%	58%	60%	62%	64%	65%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%
Liquicia	1,223	13	20%	25%	30%	34%	38%	42%	46%	50%	54%	58%	60%	62%	64%	65%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%
Lautem	1,057	8	20%	25%	30%	34%	38%	42%	46%	50%	54%	58%	60%	62%	64%	65%	66%	67%	68%	69%	70%	71%	72%	73%	74%	75%	75%	75%	75%	75%	75%	75%
Low Income Districts																																
Ainaro	750	25	10%	15%	20%	23%	26%	29%	32%	35%	38%	41%	44%	47%	50%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	65%	65%	65%	65%
Viqueque	967	10	10%	15%	20%	23%	26%	29%	32%	35%	38%	41%	44%	47%	50%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	65%	65%	65%	65%
Aileu	660	4	10%	15%	20%	23%	26%	29%	32%	35%	38%	41%	44%	47%	50%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	65%	65%	65%	65%
Manatuto	883	10	10%	15%	20%	23%	26%	29%	32%	35%	38%	41%	44%	47%	50%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	65%	65%	65%	65%
Baucau	933	15	10%	15%	20%	23%	26%	29%	32%	35%	38%	41%	44%	47%	50%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	65%	65%	65%	65%
Cova Lima	983	20	10%	15%	20%	23%	26%	29%	32%	35%	38%	41%	44%	47%	50%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	65%	65%	65%	65%
Total	28,359	189																														

Table 8.7 The Assumed Tariff Collection Rate by Districts (Case C)

(USD)

Year			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Per Capita GDP		Case A			428	447	467	488	510	533	557	582	609	636	665	695	726	758	793	828	866	905	945	988	1,032	1,079	1,127	1,178	1,231	1,286	1,344	1,405
		CaseB			339	354	370	387	404	422	441	461	482	504	526	550	575	601	628	656	686	716	749	782	818	854	893	933	975	1,019	1,065	1,113
		Case C			339	347	356	365	374	384	393	403	413	423	434	445	456	467	479	491	503	516	529	542	555	569	584	598	613	628	644	660
Average Monthly Water Bill per Connection		Case A			3.99	4.17	4.36	4.56	4.76	4.98	5.20	5.44	5.68	5.94	6.20	6.48	6.77	7.08	7.40	7.73	8.08	8.44	8.82	9.22	9.63	10.07	10.52	10.99	11.49	12.01	12.55	13.11
		CaseB			3.16	3.31	3.46	3.61	3.77	3.94	4.12	4.31	4.50	4.70	4.91	5.13	5.37	5.61	5.86	6.12	6.40	6.69	6.99	7.30	7.63	7.97	8.33	8.71	9.10	9.51	9.94	10.38
		Case C			3.16	3.24	3.32	3.41	3.49	3.58	3.67	3.76	3.86	3.95	4.05	4.15	4.26	4.36	4.47	4.58	4.70	4.81	4.93	5.06	5.18	5.31	5.45	5.58	5.72	5.87	6.01	6.16
District	Connections	Public Taps																														
Dili																																
Dili	17,680	56	30%	40%	50%	52%	54%	56%	58%	60%	62%	64%	66%	68%	70%	72%	74%	76%	78%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
High Income Districts																																
Ermera	1,010	17	20%	25%	28%	31%	34%	37%	40%	43%	46%	49%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	67%	68%	68%
Manafahi	863	6	20%	25%	28%	31%	34%	37%	40%	43%	46%	49%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	67%	68%	68%
Bobonaro	1,350	5	20%	25%	28%	31%	34%	37%	40%	43%	46%	49%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	67%	68%	68%
Liquicia	1,223	13	20%	25%	28%	31%	34%	37%	40%	43%	46%	49%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	67%	68%	68%
Lautem	1,057	8	20%	25%	28%	31%	34%	37%	40%	43%	46%	49%	50%	51%	52%	53%	54%	55%	56%	57%	58%	59%	60%	61%	62%	63%	64%	65%	66%	67%	68%	68%
Low Income Districts																																
Ainaro	750	25	10%	15%	17%	19%	21%	23%	25%	27%	29%	31%	33%	35%	37%	39%	40%	41%	42%	43%	44%	45%	46%	47%	48%	49%	50%	51%	52%	53%	54%	55%
Viqueque	967	10	10%	15%	17%	19%	21%	23%	25%	27%	29%	31%	33%	35%	37%	39%	40%	41%	42%	43%	44%	45%	46%	47%	48%	49%	50%	51%	52%	53%	54%	55%
Aileu	660	4	10%	15%	17%	19%	21%	23%	25%	27%	29%	31%	33%	35%	37%	39%	40%	41%	42%	43%	44%	45%	46%	47%	48%	49%	50%	51%	52%	53%	54%	55%
Manatuto	883	10	10%	15%	17%	19%	21%	23%	25%	27%	29%	31%	33%	35%	37%	39%	40%	41%	42%	43%	44%	45%	46%	47%	48%	49%	50%	51%	52%	53%	54%	55%
Baucau	933	15	10%	15%	17%	19%	21%	23%	25%	27%	29%	31%	33%	35%	37%	39%	40%	41%	42%	43%	44%	45%	46%	47%	48%	49%	50%	51%	52%	53%	54%	55%
Cova Lima	983	20	10%	15%	17%	19%	21%	23%	25%	27%	29%	31%	33%	35%	37%	39%	40%	41%	42%	43%	44%	45%	46%	47%	48%	49%	50%	51%	52%	53%	54%	55%
Total	28,359	189																														

Table 8.8 Expected Tariff Revenue by Districts (Case A)

(USD)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Per Capita GDP			428	447	467	488	510	533	557	582	609	636	665	695	726
Average Water Tariff			3.99	4.17	4.36	4.56	4.76	4.98	5.20	5.44	5.68	5.94	6.20	6.48	6.77
Dili															
Dili	254,253	339,003	423,754	531,388	647,850	696,347	747,896	802,674	860,868	922,674	964,194	1,007,583	1,052,924	1,100,305	1,149,819
High Income Districts															
Ermera	9,683	12,104	14,525	17,708	21,148	24,862	28,868	32,581	36,569	40,850	45,442	48,206	51,128	54,214	57,475
Manafahi	8,274	10,342	12,411	15,131	18,070	21,244	24,667	27,839	31,246	34,904	38,828	41,190	43,686	46,323	49,110
Bobonaro	12,943	16,178	19,414	23,669	28,268	33,232	38,586	43,548	48,879	54,601	60,739	64,434	68,339	72,464	76,823
Liquicia	11,725	14,656	17,588	21,442	25,608	30,106	34,956	39,451	44,281	49,465	55,025	58,373	61,910	65,647	69,596
Lautem	10,134	12,667	15,201	18,532	22,132	26,019	30,211	34,097	38,270	42,751	47,557	50,450	53,507	56,737	60,149
Low Income Districts															
Ainaro	3,595	5,393	7,190	9,392	11,778	14,360	17,149	20,161	23,409	24,952	26,586	28,317	30,149	32,090	34,143
Viqueque	4,635	6,953	9,271	12,110	15,186	18,514	22,111	25,995	30,183	32,172	34,279	36,510	38,873	41,374	44,022
Aileu	3,164	4,746	6,328	8,265	10,365	12,636	15,091	17,742	20,600	21,958	23,396	24,919	26,532	28,239	30,046
Manatuto	4,233	6,349	8,465	11,058	13,867	16,906	20,191	23,736	27,561	29,377	31,301	33,338	35,496	37,780	40,198
Baucau	4,472	6,709	8,945	11,684	14,652	17,863	21,334	25,081	29,121	31,040	33,073	35,226	37,506	39,920	42,474
Cova Lima	4,712	7,068	9,424	12,310	15,437	18,821	22,477	26,425	30,682	32,704	34,846	37,114	39,516	42,059	44,751
Total Tariff Revenue	331,823	442,169	552,515	692,690	844,362	930,910	1,023,537	1,119,329	1,221,669	1,317,447	1,395,266	1,465,660	1,539,565	1,617,153	1,698,606

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2030
Per Capita GDP	758	793	828	866	905	945	988	1,032	1,079	1,127	1,178	1,231	1,286	1,344	1,405	
Average Water Tariff	7.08	7.40	7.73	8.08	8.44	8.82	9.22	9.63	10.07	10.52	10.99	11.49	12.01	12.55	13.11	
Dili																
Dili	1,201,561	1,255,631	1,312,135	1,371,181	1,432,884	1,497,364	1,564,745	1,635,158	1,708,741	1,785,634	1,865,987	1,949,957	2,037,705	2,129,402	2,225,225	65.2%
High Income Districts																
Ermera	60,919	64,557	68,399	72,456	76,740	80,193	83,802	87,573	91,514	95,632	99,935	104,432	109,132	114,043	119,175	3.5%
Manafahi	52,053	55,161	58,444	61,911	65,571	68,522	71,605	74,827	78,194	81,713	85,390	89,233	93,248	97,445	101,830	3.0%
Bobonaro	81,426	86,289	91,425	96,847	102,573	107,189	112,012	117,053	122,320	127,825	133,577	139,588	145,869	152,433	159,293	4.7%
Liquicia	73,766	78,172	82,824	87,737	92,924	97,105	101,475	106,041	110,813	115,800	121,011	126,456	132,147	138,093	144,308	4.2%
Lautem	63,754	67,561	71,582	75,828	80,311	83,925	87,702	91,648	95,772	100,082	104,586	109,292	114,210	119,350	124,721	3.7%
Low Income Districts																
Ainaro	36,317	38,617	41,051	43,625	46,348	49,228	52,272	55,492	58,895	62,492	65,304	68,243	71,314	74,523	77,877	2.3%
Viqueque	46,825	49,790	52,928	56,247	59,758	63,471	67,397	71,547	75,935	80,573	84,199	87,988	91,947	96,085	100,409	2.9%
Aileu	31,959	33,983	36,125	38,390	40,786	43,320	46,000	48,833	51,828	54,993	57,468	60,054	62,756	65,580	68,531	2.0%
Manatuto	42,757	45,465	48,330	51,361	54,567	57,957	61,542	65,332	69,339	73,574	76,885	80,345	83,960	87,738	91,687	2.7%
Baucau	45,178	48,040	51,067	54,269	57,657	61,239	65,027	69,032	73,265	77,740	81,239	84,894	88,715	92,707	96,878	2.8%
Cova Lima	47,599	50,614	53,804	57,178	60,747	64,521	68,512	72,731	77,192	81,906	85,592	89,444	93,469	97,675	102,070	3.0%
Total Tariff Revenue	1,784,115	1,873,880	1,968,112	2,067,030	2,170,865	2,274,033	2,382,091	2,495,269	2,613,809	2,737,965	2,861,173	2,989,926	3,124,473	3,265,074	3,412,002	100.0%

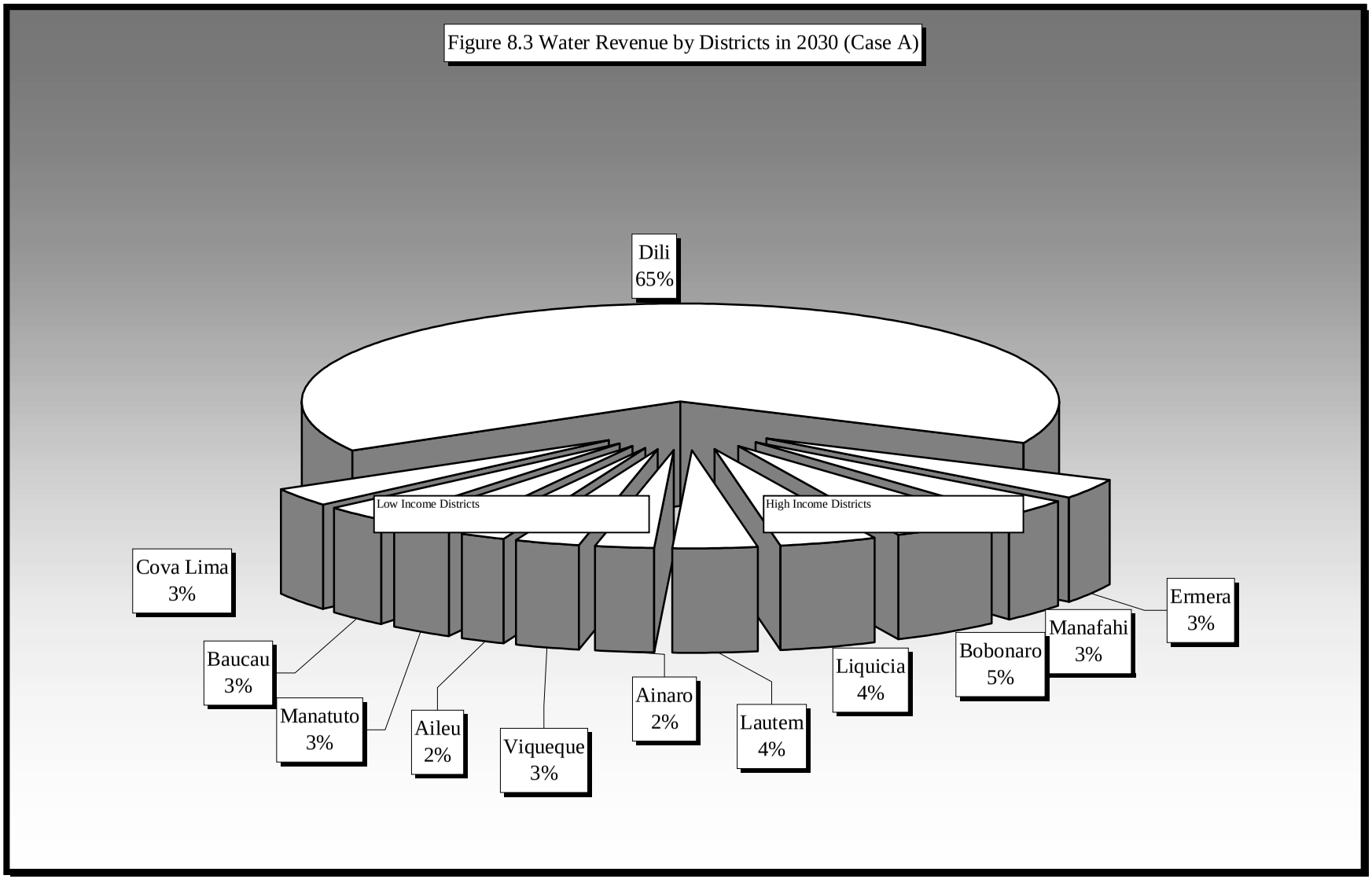


Figure 8.3 Water Revenue by Districts in 2030 (Case A)
Dili
65%
Low Income Districts
High Income Districts
Cova Lima
3%
Baucau
3%
Manatuto
3%
Aileu
2%
Viqueque
3%
Ainaro
2%
Lautem
4%
Liquicia
4%
Bobonaro
5%
Manafahi
3%
Ermera
3%

Table 8.9 Expected Tariff Revenue by Distsicts (Case B)

(USD)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Per Capita GDP			339	354	370	387	404	422	441	461	482	504	526	550	575
Average Water Tariff			3.16	3.31	3.46	3.61	3.77	3.94	4.12	4.31	4.50	4.70	4.91	5.13	5.37
Dili															
Dili	201,382	268,510	335,637	371,785	410,507	451,961	496,314	543,744	594,438	648,593	687,326	728,231	771,427	817,035	865,185
High Income Districts															
Ermera	7,670	9,587	11,504	13,625	15,913	18,380	21,036	23,894	26,967	30,268	32,721	35,333	38,114	40,451	42,922
Manafahi	6,553	8,192	9,830	11,642	13,597	15,705	17,974	20,416	23,042	25,863	27,958	30,190	32,567	34,564	36,675
Bobonaro	10,251	12,814	15,377	18,212	21,270	24,567	28,117	31,938	36,045	40,457	43,735	47,227	50,944	54,068	57,371
Liquicia	9,287	11,609	13,930	16,498	19,269	22,256	25,472	28,933	32,654	36,651	39,621	42,784	46,152	48,982	51,974
Lautem	8,026	10,033	12,040	14,259	16,654	19,235	22,015	25,006	28,222	31,676	34,243	36,977	39,887	42,334	44,919
Low Income Districts															
Ainaro	2,848	4,271	5,695	6,844	8,085	9,424	10,867	12,420	14,092	15,888	17,818	19,889	22,111	24,493	26,078
Viqueque	3,672	5,507	7,343	8,824	10,424	12,150	14,011	16,014	18,169	20,485	22,974	25,644	28,509	31,579	33,623
Aileu	2,506	3,759	5,012	6,023	7,115	8,293	9,563	10,930	12,401	13,982	15,680	17,503	19,458	21,553	22,948
Manatuto	3,353	5,029	6,705	8,058	9,519	11,095	12,794	14,623	16,591	18,706	20,978	23,417	26,032	28,836	30,702
Baucau	3,542	5,314	7,085	8,514	10,058	11,723	13,518	15,451	17,530	19,765	22,166	24,743	27,506	30,469	32,441
Cova Lima	3,732	5,598	7,465	8,970	10,597	12,351	14,243	16,279	18,469	20,824	23,354	26,068	28,980	32,102	34,179
Total Tariff Revenue	262,822	350,223	437,623	493,255	553,008	617,139	685,923	759,648	838,618	923,158	988,573	1,058,006	1,131,687	1,206,465	1,279,016

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2030
Per Capita GDP	601	628	656	686	716	749	782	818	854	893	933	975	1,019	1,065	1,113	1,163
Average Water Tariff	5.61	5.86	6.12	6.40	6.69	6.99	7.30	7.63	7.97	8.33	8.71	9.10	9.51	9.94	10.38	10.85
Dili																
Dili	916,015	969,667	1,026,293	1,086,052	1,134,924	1,185,996	1,239,366	1,295,137	1,353,418	1,414,322	1,477,967	1,544,475	1,613,977	1,686,606	1,762,503	65.4%
High Income Districts																
Ermera	45,533	48,292	51,207	54,287	57,541	60,977	64,606	68,438	72,484	76,756	79,154	82,716	86,439	90,328	94,393	3.5%
Manafahi	38,906	41,263	43,754	46,386	49,166	52,102	55,203	58,477	61,934	65,584	67,634	70,677	73,858	77,182	80,655	3.0%
Bobonaro	60,861	64,549	68,446	72,562	76,911	81,504	86,354	91,476	96,885	102,594	105,800	110,561	115,537	120,736	126,169	4.7%
Liquicia	55,135	58,476	62,007	65,736	69,675	73,836	78,231	82,871	87,770	92,943	95,847	100,160	104,668	109,378	114,300	4.2%
Lautem	47,652	50,539	53,590	56,813	60,218	63,814	67,612	71,623	75,857	80,328	82,838	86,566	90,461	94,532	98,786	3.7%
Low Income Districts																
Ainaro	27,756	29,532	31,412	33,402	35,507	37,733	40,088	42,579	45,213	47,997	50,941	53,233	55,629	58,132	60,748	2.3%
Viqueque	35,786	38,077	40,501	43,066	45,780	48,651	51,687	54,899	58,294	61,885	65,680	68,635	71,724	74,952	78,324	2.9%
Aileu	24,425	25,988	27,643	29,393	31,246	33,205	35,278	37,470	39,787	42,238	44,828	46,845	48,953	51,156	53,458	2.0%
Manatuto	32,678	34,769	36,983	39,325	41,803	44,425	47,197	50,130	53,231	56,509	59,974	62,673	65,494	68,441	71,521	2.7%
Baucau	34,528	36,738	39,077	41,552	44,170	46,940	49,870	52,968	56,245	59,709	63,371	66,222	69,202	72,316	75,571	2.8%
Cova Lima	36,379	38,707	41,171	43,778	46,537	49,456	52,542	55,807	59,259	62,909	66,767	69,771	72,911	76,192	79,620	3.0%
Total Tariff Revenue	1,355,654	1,436,599	1,522,083	1,612,353	1,693,477	1,778,638	1,868,035	1,961,875	2,060,378	2,163,773	2,260,801	2,362,537	2,468,851	2,579,950	2,696,047	100.0%

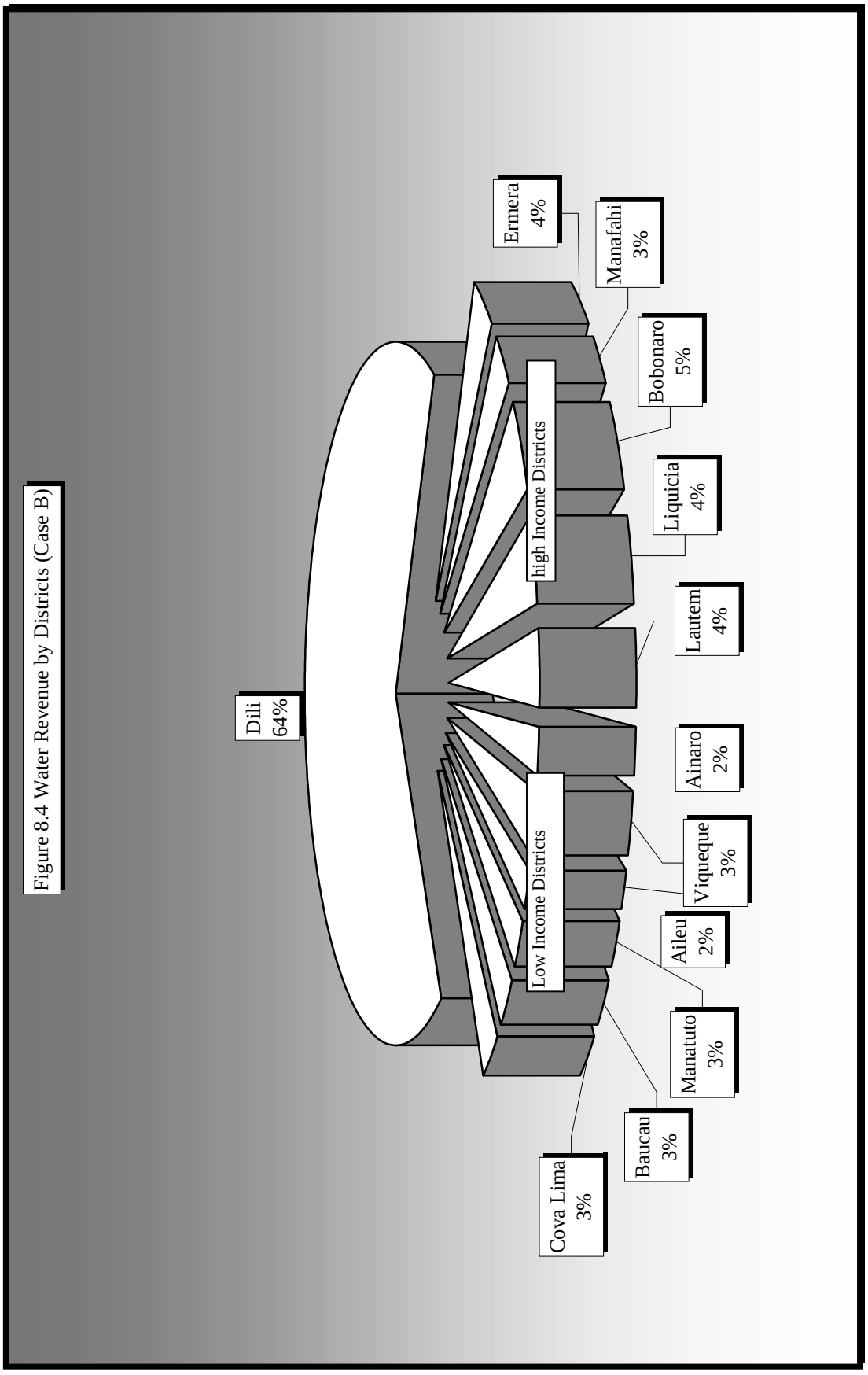


Figure 8.4 Water Revenue by Districts (Case B)

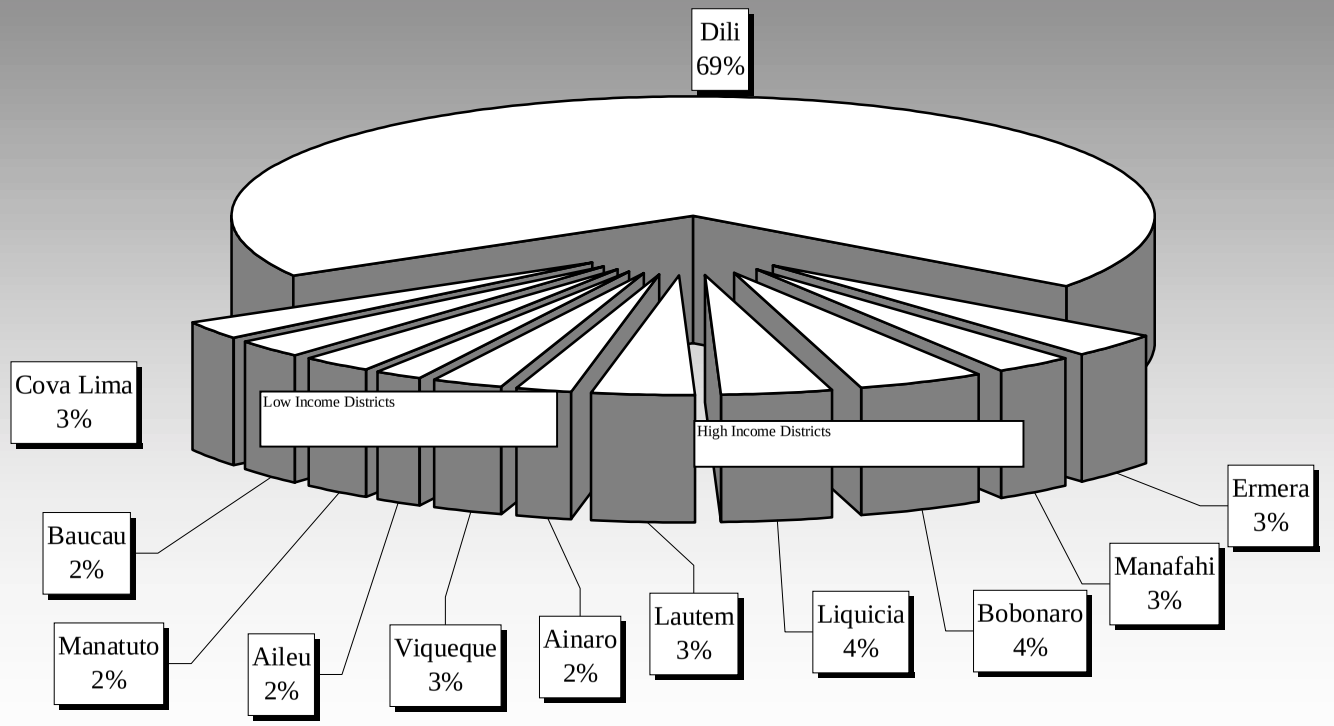
Table 8.10 Expected Tariff Revenue by Distsicts (Case C)

(USD)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Per Capita GDP			339	347	356	365	374	384	393	403	413	423	434	445	456
Average Water Tariff			3.16	3.24	3.32	3.41	3.49	3.58	3.67	3.76	3.86	3.95	4.05	4.15	4.26
Dili															
Dili	201,382	268,510	335,637	357,789	380,839	404,818	429,757	455,691	482,653	510,678	539,802	570,064	601,501	634,154	668,064
High Income Districts															
Ermera	7,670	9,587	10,737	12,185	13,698	15,280	16,931	18,656	20,457	22,336	23,361	24,424	25,526	26,667	27,850
Manafahi	6,553	8,192	9,175	10,412	11,705	13,056	14,467	15,941	17,480	19,085	19,961	20,870	21,811	22,786	23,796
Bobonaro	10,251	12,814	14,352	16,287	18,310	20,423	22,631	24,937	27,343	29,855	31,226	32,646	34,119	35,644	37,225
Liquicia	9,287	11,609	13,002	14,755	16,587	18,502	20,502	22,591	24,771	27,046	28,288	29,575	30,909	32,291	33,723
Lautem	8,026	10,033	11,237	12,752	14,336	15,991	17,719	19,525	21,409	23,375	24,449	25,561	26,714	27,908	29,146
Low Income Districts															
Ainaro	2,848	4,271	4,841	5,546	6,283	7,053	7,858	8,699	9,577	10,493	11,449	12,447	13,487	14,572	15,319
Viqueque	3,672	5,507	6,242	7,150	8,100	9,094	10,132	11,216	12,348	13,529	14,762	16,048	17,389	18,788	19,751
Aileu	2,506	3,759	4,260	4,880	5,529	6,207	6,915	7,655	8,428	9,234	10,075	10,953	11,869	12,823	13,481
Manatuto	3,353	5,029	5,699	6,529	7,397	8,304	9,252	10,241	11,275	12,354	13,480	14,654	15,879	17,156	18,035
Baucau	3,542	5,314	6,022	6,899	7,816	8,774	9,775	10,821	11,914	13,054	14,243	15,484	16,778	18,127	19,057
Cova Lima	3,732	5,598	6,345	7,269	8,235	9,244	10,299	11,401	12,552	13,753	15,006	16,314	17,677	19,098	20,078
Total Tariff revenue	262,822	350,223	427,549	462,452	498,833	536,745	576,240	617,374	660,205	704,792	746,104	789,041	833,659	880,014	925,523

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2030
Per Capita GDP	467	479	491	503	516	529	542	555	569	584	598	613	628	644	660	
Average Water Tariff	4.36	4.47	4.58	4.70	4.81	4.93	5.06	5.18	5.31	5.45	5.58	5.72	5.87	6.01	6.16	
Dili																
Dili	703,273	739,824	777,764	797,208	817,139	837,567	858,506	879,969	901,968	924,517	947,630	971,321	995,604	1,020,494	1,046,006	68.2%
High Income Districts																
Ermera	29,074	30,343	31,657	33,018	34,427	35,886	37,396	38,959	40,577	42,252	43,985	45,778	47,633	49,553	50,792	3.3%
Manafahi	24,843	25,927	27,050	28,212	29,416	30,663	31,953	33,289	34,671	36,102	37,583	39,115	40,701	42,341	43,399	2.8%
Bobonaro	38,862	40,558	42,314	44,133	46,016	47,966	49,984	52,074	54,237	56,475	58,791	61,188	63,668	66,234	67,890	4.4%
Liquicia	35,206	36,742	38,333	39,981	41,687	43,454	45,282	47,175	49,134	51,162	53,261	55,432	57,679	60,003	61,503	4.0%
Lautem	30,427	31,755	33,130	34,554	36,029	37,555	39,136	40,772	42,465	44,218	46,031	47,908	49,850	51,859	53,155	3.5%
Low Income Districts																
Ainaro	16,094	16,899	17,734	18,600	19,498	20,430	21,396	22,397	23,436	24,512	25,627	26,783	27,980	29,221	30,506	2.0%
Viqueque	20,751	21,789	22,865	23,982	25,140	26,341	27,586	28,878	30,216	31,604	33,042	34,532	36,076	37,675	39,332	2.6%
Aileu	14,163	14,871	15,606	16,368	17,159	17,978	18,828	19,710	20,623	21,570	22,552	23,569	24,623	25,714	26,845	1.8%
Manatuto	18,948	19,896	20,879	21,898	22,956	24,053	25,190	26,369	27,592	28,858	30,172	31,532	32,942	34,403	35,916	2.3%
Baucau	20,021	21,022	22,061	23,138	24,256	25,415	26,616	27,862	29,154	30,493	31,880	33,318	34,807	36,351	37,950	2.5%
Cova Lima	21,094	22,149	23,243	24,378	25,556	26,777	28,043	29,356	30,716	32,127	33,588	35,103	36,673	38,299	39,983	2.6%
Total Tariff revenue	972,758	1,021,776	1,072,637	1,105,472	1,139,278	1,174,084	1,209,918	1,246,810	1,284,790	1,323,890	1,364,142	1,405,579	1,448,236	1,492,146	1,533,278	100.0%

Figure 8.5 Water Revenue by Districts in 2000 (Case C)



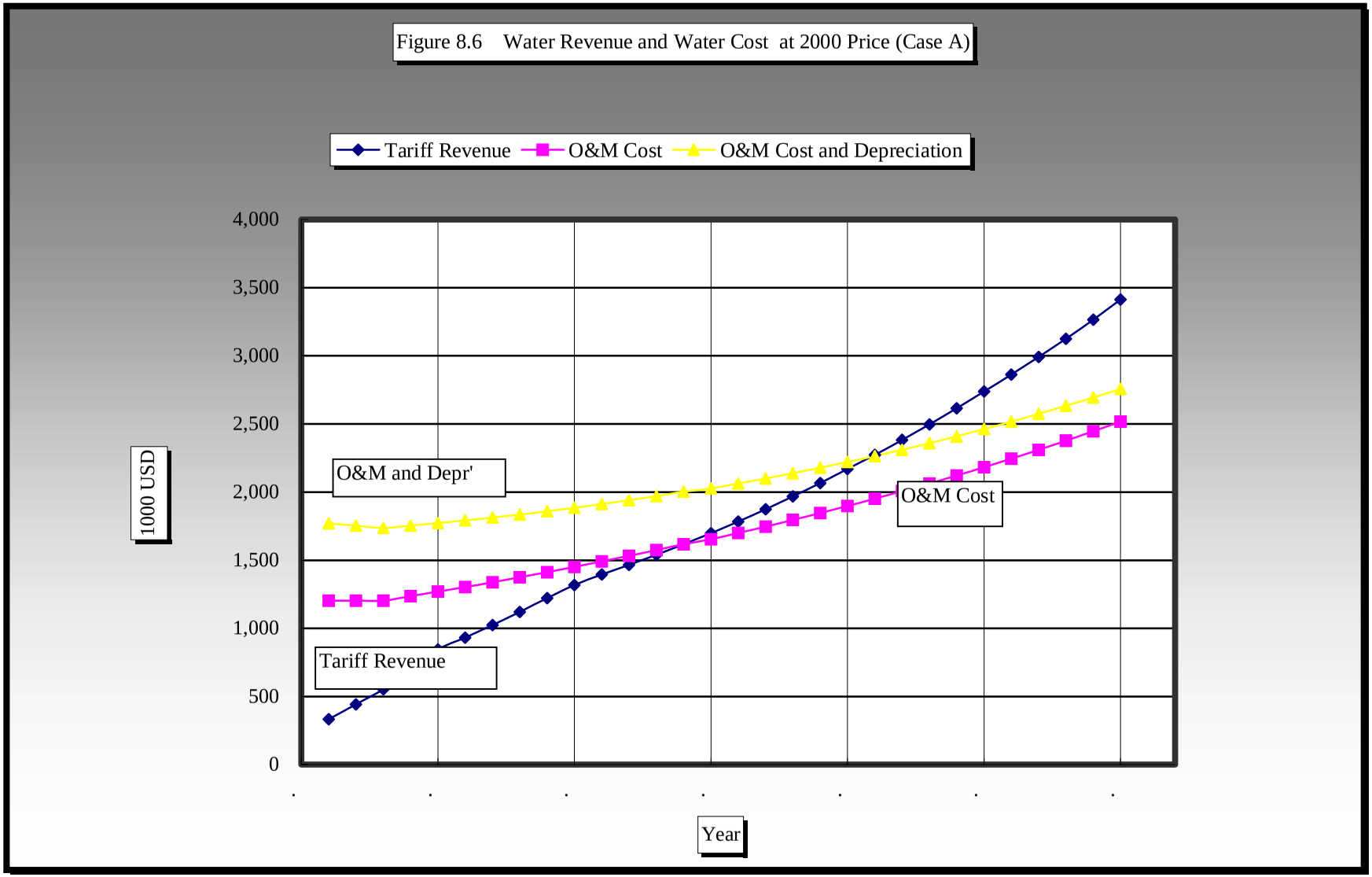


Figure 8.6 Water Revenue and Water Cost at 2000 Price (Case A)
Tariff Revenue
O&M Cost
O&M Cost and Depreciation
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1000 USD
O&M and Depr'
O&M Cost
Tariff Revenue
Year

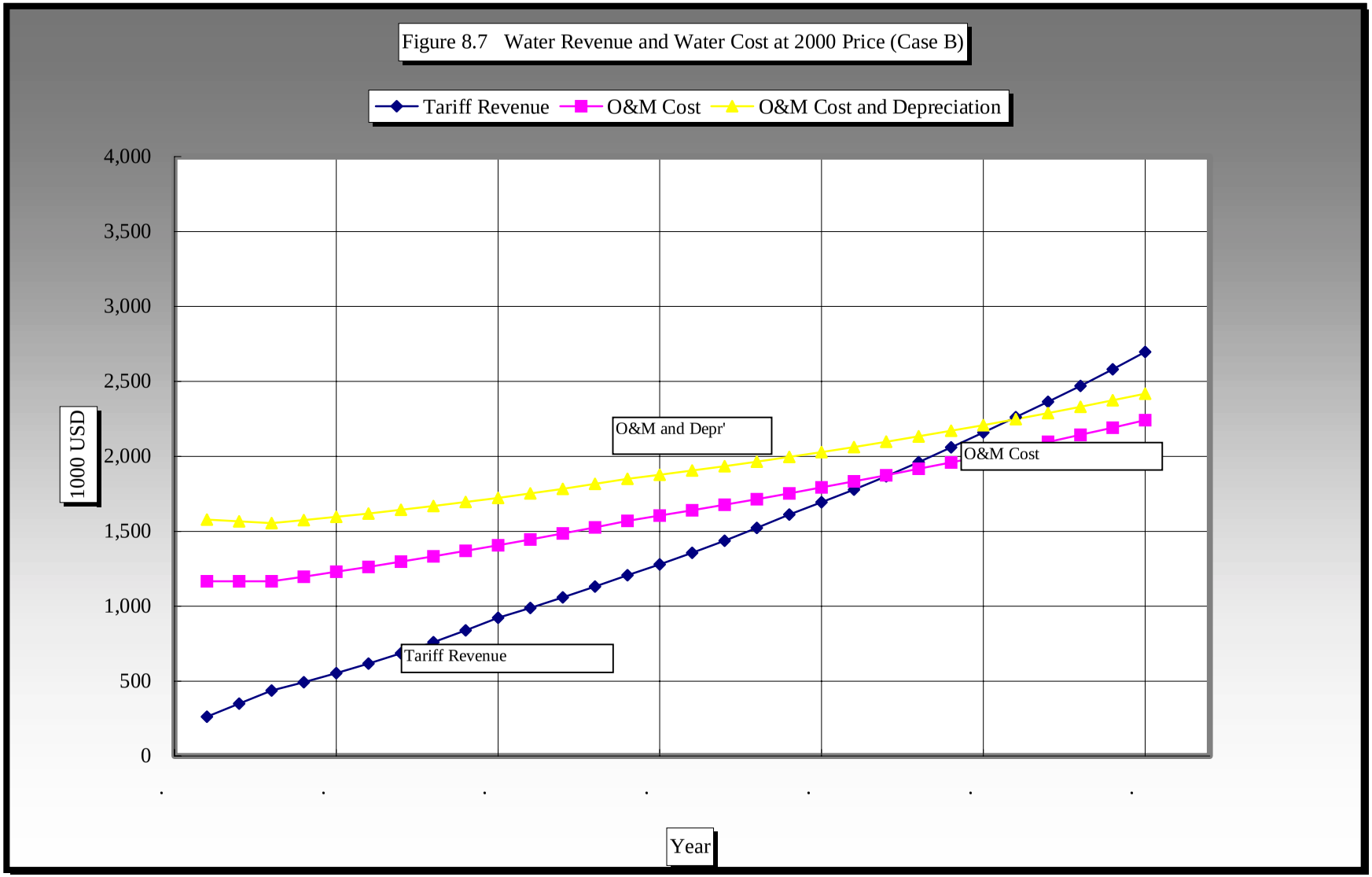


Figure 8.7 Water Revenue and Water Cost at 2000 Price (Case B)
Tariff Revenue
O&M Cost
O&M Cost and Depreciation
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1000 USD
O&M and Depr'
O&M Cost
Tariff Revenue
Year

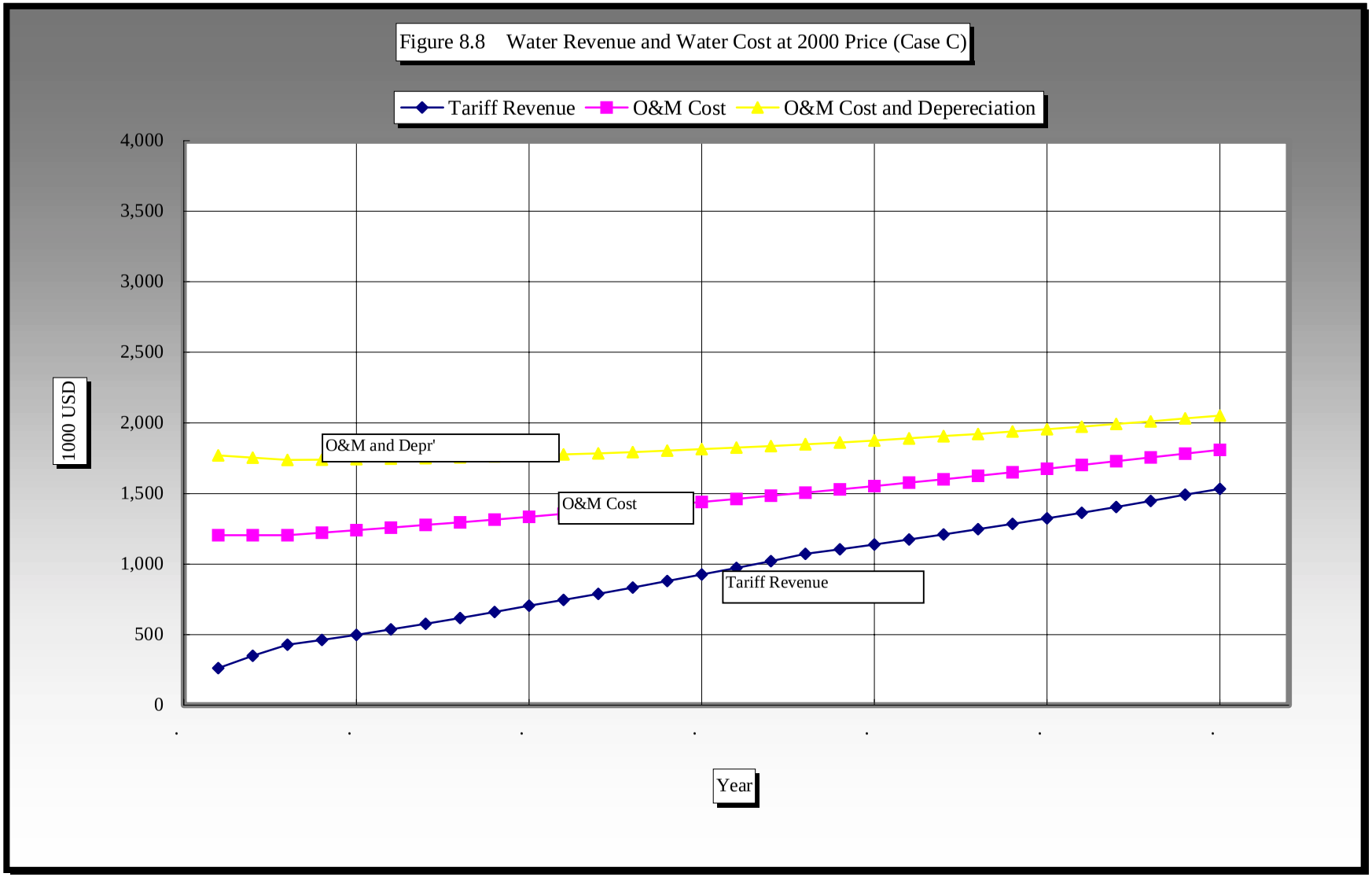


Figure 8.8 Water Revenue and Water Cost at 2000 Price (Case C)
Tariff Revenue
O&M Cost
O&M Cost and Depereciation
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1000 USD
O&M and Depr'
O&M Cost
Tariff Revenue
Year

CHAPTER 9 OVERALL EVALUATION AND RECOMMENDATIONS

9.1 OVERALL EVALUATION

To prepare for the national government of East Timor, UNTAET is developing the institutions for public administration and the public infrastructure including water supply. With substantial absence of natural resources and industry other than agriculture, political and economic independence of a country of small land and population is greatly challenging. In the Study, the rehabilitation plan was formulated on the water supply system in 15 towns, which were either damaged directly after a post-referendum violence or not adequately functional due to the low-standards of planning and construction. In the formulation of the rehabilitation plan, due consideration was taken to select water source by avoiding drawdown of groundwater aquifer, and also socioeconomic consideration was duly made by adopting the gravity flow that is energy-saving, and by reducing the cost of facility, which would be possible when the proposed leakage control is undertaken. Therefore, implementation of the rehabilitation plan will bring about the stable water supply, resulting in the following socio-economic and environmental effects:

9.1.1 SOCIOECONOMICS EVALUATION

The service areas of the 15 towns rehabilitation plan include the national capital and 11 district towns, which are major population centers of East Timor. A quarter of East Timorese population, i.e., approximately 200 thousand will be the direct beneficiaries. These service areas are centers of the regional socioeconomic activities. Populations from their hinterlands, who come to their marketplaces, are assumed indirect beneficiaries. Supply of clean and safe water does not only provide a basic human need, reduce the water-fetching labor and improve the sanitation, but also contribute to stabilize and promote regional economies by helping production and supply of the better food products, etc. It is thus expected to provide a basis for economic development of the entire land. Since rehabilitation of facility and operation thereof were designed on the basis of the lease cost, a large benefit/cost ratio is expected.

High unemployment rate in the towns where the industrial activity is poor will be positively reduced with increased employment opportunity generated by implementation of the rehabilitation programs. Populations who are thus participating in the program and its construction work will be exposed to the modern working standards, where the organized management is required. They may be provided with opportunities to learn such modern institutional behaviors. This may help establish the modern institutions, which are most needed in building the independent national government.

It is also proposed to let the people know that the water supply is provided for the price of costs, by means of the awareness raising activity or through the community participation. If this knowledge is propagated to everyone, decreased default of water bill and reduction of illegal connections are expected and the sound utility service will be brought about.

9.1.2 ENVIRONMENTAL EVALUATION

The water supply rehabilitation program as such is intended to improve the sanitation environment, and therefore improve environmental features of the region. During the implementation, however, some adverse impacts are temporarily possible. Environmental consideration on the following issues are desirably taken:

- Relocation of residents
  Facilities were located to the places where relocation was not necessary. Important impacts are not foreseen.

- Traffic hazards
  Distribution pipelines are often laid under the road. As traffic is not so dense in towns other than Dili, impacts will not be decisively significant. During construction, however, every caution should be taken.

- Water pollution
  Water pollution in drains and other waterways as well as groundwater aquifer is anticipated, since wastewater will increase as volume of water supply increase. Significant impact is less possible in towns, where volume of wastewater is not sizable. Regarding wastewater of the capital city, UNTAET is considering the needed measures on the basis of the sanitation master plan being undertaken by the Portuguese government. In the near future, wastewater treatment will be required in the larger urban centers.

- Residents participation
  Local communities in East Timor are solid and their members are closely linked. In implementing the plan, dialogue with residents is indispensable before and during construction works. It should be known by the residents that the water supply is installed for them and employment opportunities are provided to them.

9.2 RECOMMENSATIONS

The water supply sector, as well as other sectors of public infrastructure, has various problems as stated in the preceding chapters. To overcome these problems and to structure sustainable water supply system, recommendations suggested in the other chapters are hereby reiterated for integration.

9.2.1 ESTABLISHMENT OF ORGANIZATION

Regarding the institutional and operational setup of the water supply services of East Timor, the JICA Study Team has been discussing among itself, and with the Water and Sanitation Service (WSS) of UNTAET, with Project Management Unit of Asian Development Bank that is implementing the "Trust Fund for East Timor (TFET)," and with personnel of AusAID, who are helping mainly in capacity building.

As an overall consensus, water supply systems in district towns are to be operated by the government. Because of difficulty to operate small water supply systems in other local communities, it was confirmed that they would be entrusted to the self-help endeavor of the concerned residents. Because of difficulty to realize a sustainable water supply management system in each town, the management of water supply of Dili and

district towns was unified under one service authority. Under this conception, most of the local staffs, whose budget ceiling is 153 members, have already been employed by WSS under supervision of international staff and UN volunteers.

9.2.2 DEVELOPMENT OF HUMAN RESOURCES

All Indonesian engineers and officers who were at the management of the former water supply authority have left East Timor after the referendum. Most of the local staff remained and employed by WSS is junior operators, plumbers and laborers. There is no senior engineer and managerial staff who can manage institutional and organizational development. It is urgently required to train staff for the administrative and engineering posts.

To strengthen organization/management capacity and to develop human resources, the Project Management Unit (PMU) was established within the WSS. PMU will prepare a fiscal budget of 4.0 ~ 4.5 million US dollars in coming three years for restoration of essential facility, and procurement of equipment. Moreover, institutional/human resources development including several training programs, development of legal and financial arrangements is scheduled to be implemented in cooperation with Australian technical assistance.

If the rehabilitation projects of water supply facility in 15 towns are implemented, and house connections and public taps are popularized widely, population served is expected to go up to about 25% of the total population. In addition, other donors and NGOs will also be implementing different rehabilitation projects during next few years. After completion of the projects, activity of WSS will be expanded manifold. Therefore, it is necessary to urgently strengthen its organization in the short term. To achieve this, exercises are required not only by the classroom training but also by training in actual application.

9.2.3 DEVELOPMENT OF LAWS, REGULATIONS AND STANDARDS

Under the UNTAET administration, legislation is frozen. It is, however, required to develop laws and regulations that define the water supply services during the transition to establishment of the East Timorese national government. In that a water supply service provider operated under the modern technical standards and the efficient operational practices shall be targeted, and eventually financial self-sustainability shall be pursued. Here, the following three principles are emphasized:

- Quality and quantity of distributed water – operation control
- The least cost – cost control, primarily leakage control
- Financial autonomy – cost recovery through tariff collection

The water supply service provider should acquire most effective means to eliminate leakages, check unauthorized connections, collect tariff by volume-based billing and thereby minimize unaccounted-for water and wasteful water use. To achieve these exercises, the service provider needs to be regulated, technically upgraded, ethically esteemed and publicly monitored. It should be suggested that the financially autonomous service provider be eventually pursued as the modern public utility standards. It would be also essential that it should be monitored by and accountable to the public.

9.2.4 FINANCIAL PLANNING

Although, operation and maintenance costs of water supply business are borne by UNTAET, it will be shifted to a new government after independence. The national government is expected to make a start in a few years. The government's revenue will not be optimistic. It is necessary to make the water supply service be operated without depending the government's subsidy. It is, therefore, proposed to initiate the tariff collection in the early stage.

Under current economical situation of East Timor, tariff collection rate is expected extremely low in the beginning. To solve this issue, it is necessary to improve O&M ability and organizational structure. In adopting a tariff system that rises in proportion to the consumption, burdens on poorer segment of people would be reduced. An acceptable rate for poverty area would be set up by introducing a regional tariff system, and so on.

Execution of tariff collection throughout the country is important. Even in a small-scale water supply operated by local community, the costs for operation and maintenance and also for replacement of equipment should be collected. For example, water supply from a public tap should be charged, too. In short, it should be understood by everyone that piped water supply has price and someone has to pay it. For propagation of this principle, comprehensive publicity activity is required and should be started right now.

Also, to achieve the least cost, leakage control program should be carried out frequently and continuously to reduce cost by minimizing the unaccounted-for water.

9.2.5 SUSTAINABLE WATER SUPPLY FACILITY

It is thought that enthusiasm of water supply pervasion in the Indonesian era was substantial. Judging from the Japanese water supply standard, plenty of unsatisfactory structures were made. However, the Indonesian Government had provided water supply system not only to district town but also to smaller communities (over 60 places) throughout East Timor. Moreover, most structures were so designed as to minimize the operation costs. To obtain water without electric power and chemicals, water sources were located far beyond the mountain jungles and transmission pipes were laid up to the town struggling steep landforms.

At the stage when designed water supply capacity became unable to meet the demand that was increased by urban concentration of population, water treatment plant became necessary, but with sources from rivers that required minimum electric power. As and when the river water became insufficient in volume, then borehole well that required electric energy was installed. Rehabilitation plans of the present Study also followed these ideas wherever it was possible. Therefore, reconstruction and protection of transmission mains that tends to be damaged by flood or landslide were selected in the rehabilitation plan. In Urgent Grant Aid Project, the Study Team proposed rehabilitation of transmission mains in Dili. The Project will be completed in October 2002.

From the viewpoint of the sound water supply services, the existing systems do not have the proper control on water distribution. Everywhere in East Timor, there are

many leakage points and illegal connections. Due to lack of maintenance of distribution system, damage and clogging in the distribution mains occur and it is hard to supply water properly. Illegal connections with low-skilled job have been constructed at cheerful mains that preferred beforehand. As a result, new leakages are taking place and it is more and more hard to secure portable water. Consequently, considerable sum of money will be required for taking measures to leakage control/illegal connections. Water distribution control system must be adopted into the rehabilitation plan in terms of sound management of water supply services.

General concepts of rehabilitation plan are as follows:

- Reliable transmission pipelines
- Safe and acceptable water quality
- Efficient water distribution management
- Maximize service coverage

9.2.6 FLEXIBILITY OF PROJECT MANAGEMENT AND POSSIBILITY OF JAPAN'S COOPERATION

It is essential to ensure proper operation and maintenance of facilities in implementing the water supply rehabilitation projects for 15 towns. This implies that success of the rehabilitation projects depends on the success of the capacity building programs being planned and carried out by PMU. To follow up this, institutional, organizational and financial reviews shall be made during stages of rehabilitation project, and if it is found necessary, technical and financial experts will be inputted and additional organization strengthening measure will be suggested.

Among suggested proposals, the following will be the ones for that Japanese cooperation may be possible and such may bring positive effects:

(1) PREPARATION OF WATER SERVICE LEDGER IN DILI

In Dili, which is largest town, it is necessary to start tariff collection for stable management as soon as possible. Concretely, using water supply GIS system, house connection data are processed into the system as ledger data. After completing all data input, basic water service data, such as whether connected or not, issue a bill statement to the customer, payment condition are available. It is recommended that East Timor shall request the Japanese Government to dispatch concerned experts to assist the project.

(2) OPERATION OF TREATMENT PROCESS AND WATER QUALITY ANALYSIS

Presently, for larger towns, water sources are rivers. In the case of heavy rain, turbidity of river water increases and needs proper water treatment. But due to lack of O&M skills, the treatment is not done satisfactorily. By dispatching not only expert of O&M of Water Treatment Plant but also expert of water quality analysis, it is possible to supply stable and safe water. East Timor is advised to officially request the dispatch of such experts.

(3) LEAKAGE CONTROL

An unaccounted-for water in East Timor water supply system is high same as in other developing countries. To improve this, facility expansion and new installation should be postponed and at the same time capital cost is saved. If unaccounted-for water reduces 20 ~ 30 %, it is cost-effective for the moment. Leakage detection and repair was carried out within the Study. Intensifying and continuing leakage control program by dispatching an expert is essential. East Timor shall also request the Japanese Government to dispatch such an expert.

(4) AWARENESS UPLIFTING ACTIVITY

There are many residents who do not recognize costs of construction, operation and maintenance of water supply facility. Moreover, because of lack of understanding about water supply facility, many illegal connections and poor-constructions take place all over the country. Hygiene education was experimented in the Study tentatively but effectively. An extensive awareness-uplifting activity is required to let more people to understand water supply and its costs. Propagation of awareness to be undertaken by an expert or specialist is effective to raise rate of tariff collection and proper use of water supply facility. Therefore, East Timor is again advised to officially request dispatch of such expert.