BASIC DESIGN STUDY REPORT

ON
THE BASIC DESIGN STUDY
ON
THE PROJECT FOR THE IMPROVEMENT
OF
WATER SUPPLY IN DILI AND RURAL DISTRICTS
IN
THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

AUGUST 2003

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ENGINEERING CONSULTANTS CO., LTD.
IN ASSOCIATION WITH
PACIFIC CONSULTANTS INTERNATIONAL

PREFACE

In response to a request from the Government of Democratic Republic of Timor-Leste, the Government of Japan decided to conduct a basic design study on The Project for Improvement of Water Supply in DILI and Rural Districts in the Republic of Timor-Leste and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to East Timor a study team from 22 March to 5 May 2003 and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to East Timor from 26 July to 9 August 2003 in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Democratic Republic of Timor-Leste for their close cooperation extended to the teams.

August, 2003

Takao Kawakami
President
Japan International Cooperation Agency

August 2003

Mr. Takao Kawakami

President

Japan International Cooperation Agency

Letter of Transmittal

Dear sir,

We are pleased to submit to you the Basic Design Study Report on The Project for Improvement of Water Supply in DILI and Rural Districts in the Republic of Timor-Leste.

This study was conducted by Tokyo Engineering Consultants Co., Ltd. in association with Pacific Consultants International, under a contract to JICA, during the period from 13 March to 5 September 2003. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Timor-Leste and formulated the most appropriate basic design for the project under the Japanese Grand Aid Scheme.

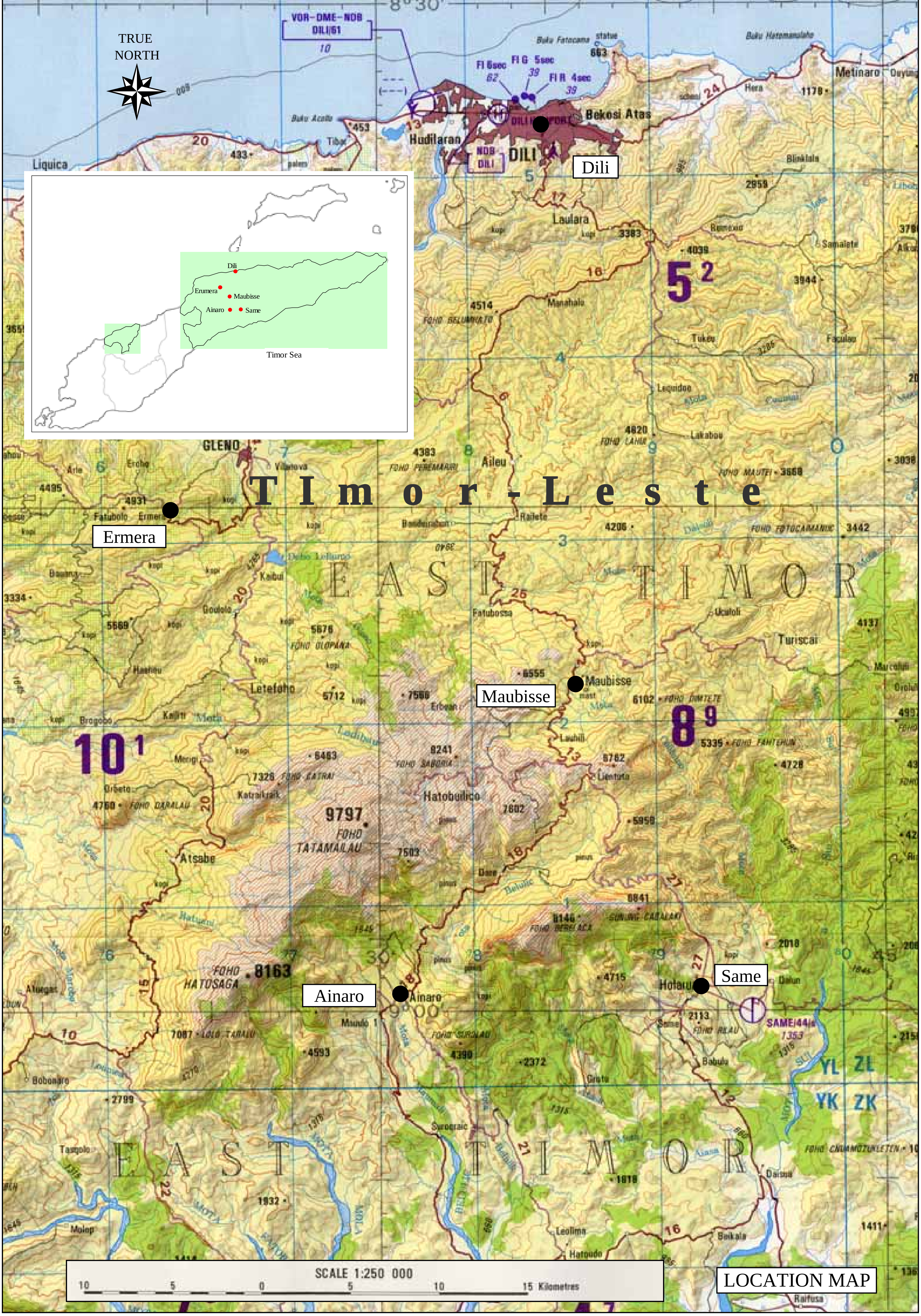
Finally, we hope that this report will contribute to further promotion of the Project.

Very truly yours,

Osamu Nakagome

Project manager,

Basic Design Study Team on The Project for Improvement of Water Supply in DILI and Rural Districts in the Republic of Timor-Leste


TRUE NORTH
Dili
Erumera
Maubisse
Ainaro
Same
Timor Sea
Timor-Leste
EAST TIMOR
Dili
Ermera
Maubisse
Ainaro
Same
SCALE 1:250 000
Kilometres
LOCATION MAP

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Abbreviations		
ADB	–	Asian Development Bank
AusAID	–	Australian Agency for International Development
CEP	–	Community Empowerment and Local Governance Project
CFA	–	Central Fiscal Authority
CWS&S	–	Community water supply & sanitation
CWSSP	–	(AusAID) Community Water Supply & Sanitation Project
DAO	–	District Administration Office
DURIDN	–	Dili Urgent Rehabilitation & Improvement of the Distribution Network
DWSSRP	–	Dili Water Supply & Sanitation Rehabilitation Project
ECHO	–	European Community Humanitarian Office
EDTL		Electricidade de Timor Leste
ETPA	–	East Timor Transitional Administration
FY	–	Fiscal Year
GOI	–	Government of Indonesia
GOJ	–	Government of Japan
GOP	–	Government of Portugal
GTZ	–	German Technical Cooperation
ICRC	–	International Committee of the Red Cross
IDA	–	International Development Association
JICA	–	Japan International Cooperation Agency
KfW	–	Kreditanstalt fur Wiederaufbau
MTCPW	–	Ministry of Transport, Communication and Public Works
MPF	–	Ministry of Planning and Finace
MIS	–	Management information system(s)
NGO	–	Non Government Organization
PKF	–	Peace Keeping Forces
PMU	–	Project Management Unit
SSF	–	Slow sand filter
TA	–	Technical assistance
TFET	–	Trust Fund for East Timor
UFW	–	Unaccounted for water
UN	–	United Nations
UNDP	–	United Nations Development Program
UNHCR	–	United Nations High Commissioner for Refugees
UNICEF	–	United Nations International Children's Fund
UNOPS	–	United Nations Office of Project Services
UNPKF	–	United Nations Peacekeeping Force

UNTAET	–	United Nations Transitional Administration in East Timor
UNV	–	United Nations Volunteer
USGET	–	United States Support Group for East Timor
WatSan	–	Water & sanitation
WB	–	World Bank
WHO	–	World Health Organization
WS&S	–	Water supply & sanitation
WSS	–	Water and Sanitation Service (Directorate of Water and Sanitation within the Ministry of Water & Public Works)
WSSRP	–	Water Supply & Sanitation Rehabilitation Project
WTP	–	Water treatment plant
WUG	–	Water User Group

Executive Summary

The Democratic Republic of Timor-Leste became the world's newest sovereign on 20 May, 2002 and become a member of the United Nations on 17 September, 2002. The total population is about 800 thousands. The country is situated at 124-127 degrees east longitude and 8-9 degrees south latitude with 14,000 km^2 land size. A core of rugged hills and mountains (2,000 m) divides the northern part of the country from southern region. The rainfall pattern is varied with the mountains receiving more rain than the coastal plains. The annual average rainfall is about 1,600 mm.

During the Indonesian time, the water supply systems were inadequate but 47 cities have the systems, which are mostly like community systems. For example in Dili, the estimated service ratio by piped supply is said about 40 % with 120,000 people and about 17,000 connections.

Physical damages to the main water supply facilities during the social unrest following the national election in 1999 were generally limited in the destruction of water supply offices and loss or stealing of equipment, tools, vehicles, records and data. The most of the facilities have been repaired through the emergency rehabilitation measures, however, there are some water supply systems, which still need intensive repair works. The aging facilities, improper maintenance & operation, and exodus of Indonesian staff cause the shortage of human resources in the fields of operation, maintenance and management of water works.

Most of the urban water supply systems were constructed during the Portuguese time in 1950 – 1974 or the Indonesian time in 1975-1995 and the facilities constructed during the Portuguese time are superannuated as a matter of fact.

Water and Sanitation Service (WSS) has been organized since the end of 1999 and established at the beginning of 2000 under the United Nations Transitional Administration in East Timor (UNTAET). Under the current Government of Timor-Leste, WSS falls under the jurisdiction of the Ministry of Transportation, Communication and Public Works (MTCPW). WSS has been entrusted with the agency responsible for the management of water supply systems of 13 district capitals with 168 staff members. The total population of these district capitals reach at 180,000 approximately and account for about 25% of the national population of 800,000. The estimated service ratio of the five (5) cities in the Study is as low as 20 – 60 %.

Meanwhile, the water charge system prevailed during the Indonesian time has been collapsed completely and water charge is not collected for the water supply systems operated and managed by WSS. At present, the draft of "Notification of Water Services Tariff" has been submitted to the Councillors of Ministers for approval and the collection of water charge system will begin in a short time in Dili.

The draft Water Services Decree submitted to the Councilors of Ministers for the third time in March 2003 prescribes the functions of the WSS, which are summarized as follows.

- Provide adequate, safe and sustainable water supply to Dili and districts towns' communities
- Full cost recovery in long term from users provided by WSS water supply system
- Ensure the communities access to adequate, safe and sustainable water through community owned and managed water facilities.

Generally, WSS has just stared to establish their organization and the water supply systems, just as East Timor has started to establish new Government by themselves.

The overall plan for improvement & expansion of existing water supply facilities is based on the National Development Plan (May, 2002). In the plan, WSS's function is described as follows,

"WSS is responsible for establishing the legal and institutional framework for water utilization and sanitation controls, managing the integrated activities of water and sanitation engineering, water quality control, relevant development and maintenance contracts, and establishing support activities."

The objectives in the sector is also described in the plan clearly,

Objective 1 : Provide adequate, safe and sustainable water supply

- 80 % of urban population with access to safe piped water
- 80 % of rural population with access to safe local water supply

Objective 2: Provision of adequate, safe and sustainable water supply and sanitation for village/rural communities through community owned and managed water and sanitation facilities

- 100 % of areas adjacent to urban center with appropriate access to water
- 80 % of village and enclaves with access to appropriate self-managed systems

Although the water supply systems in the country have been rehabilitated and reconstructed by the international assistance groups, WSS still have many problems to overcome. The common issues and problems among the head office of WSS and district waterworks are no basic data (logbooks, drawings and documents for management), aging facilities, and inadequate operation management capability. Obviously, in order to solve these issues, it is essential to formulate the necessary policies including the mid & long term measures in addition to the short-term measures.

Considering such situation, the Government of Japan conducted the Development Project Study titled "Study on Urgent Improvement for Water Supply System in East Timor (15 district towns)" in 2000. As a result of the Study, the grant aid project was implemented through UNDP. In addition, the preliminary study named "The Urgent Rehabilitation Support Program in East Timor" was conducted to search for the necessity of rehabilitation of water supply facilities.

The Government of Timor-Leste, for the Ministry of Transport, Communication and Public Works as the implementing agency, requested the bilateral assistance of the Japanese Government based on the results of a series of the studies and the water supply situation. The request of the water supply rehabilitation project was made on 27 November 2002.

The objective water supply systems in the request are five (5) district towns including Dili, Ermera, Same, Ainaro and Maubisse which are regarded to have a higher priority or urgent necessity for rehabilitation of the facilities. Also, these five(5) district towns are included in the JICA Development Project Study in 2000, however, except for Dili water supply, there are no donor countries extending the assistance to the four (4) district towns up to now.

Responding to the request, JICA undertook the Basic Design Study of the project and dispatched the Study Team to Timor-Leste in two phases from March 22 to May 5 and from July 26 to August 9,

in 2003 for the field surveys and for the explanation of the concepts of the basic design in addition to the continuous design work to be conducted in Japan during the study period.

The request made by the Government of Timor-Leste did not indicate concrete contents of the objective facilities. Accordingly, based on the results of field work, the Basic Design Study Team discussed several times with the Government of Timor-Leste over the rehabilitation plan of the objective district towns and agreed upon the objective facilities of each town. Basic design study was carried out in Japan based on the objective facilities and also cost estimation of the Project considering i) maximum utilization of existing limited water sources, ii) rehabilitation of the existing facilities, iii) consideration of easy operation and maintenance. Furthermore, there were no maps of water distribution network in the district towns. Therefore, the Study Team prepared the basic maps of the water distribution network through the hearing and field investigation in each district town. These maps were used for the water distribution planning.

Following table presents the list of objective facilities, water demand and capacity of the objective facilities included in the Basic Design Study.

Objective Facilities for Rehabilitation and Improvement in Each District Towns

District Town	Site	Existing Capacity (m^3/day)	Planned Capacity (m^3/day)	Water Intake	Raw Water Main	Water Treatment Plant	Service Reservoir	Water Distribution Network	Disinfection Equipment
Dili	Bemos WTP	1,700*1	2,000	-	-	○	-	-	○
	Lahane WTP	1,955	2,600	-	7.3km	○	-	-	○
	Benamauk WTP	350*1	600	-	-	○	-	-	○
	Dist. Network Zone1,5,6,7,8			-	-	-	-	19.6km	
Ermera	Motabura Sys.	86*2	86	-	○	-	○	-	○
	Ersoi Sys.	52*2	52	-	-	-	○	-	○
	Raitara Sys.	0(new)	300	○	2.5km	○	○	-	○
	Distribution Network			-	-	-	-	5.8km	
Same	Merbati Sys.	560*2	560	○	-	-	○	-	○
	Darelau Sys.	864*2	864	○	○	-	○	-	○
	Kotalala Sys.	130*2	130	-	○Total: 6.7km	-	○	-	○
	Distribution Network			-	-	-	-	15.5km	
Ainaro	Nugupo WTP	1,200*1	1,200	○	0.8km	○	○	-	○
	Distribution Network			-	-	-	-	8.3km	
Maubisse	Bukana Sys.	173*2	173	○	○	-	○	-	○
	Raikuak Ulun Sys.	69*2	69	○	○	-	○	-	○
	Erulu Sys.	43*2	43	○	○Total: 5.2km	-	○	-	○
	Distribution Network			-	-	-	-	1.5km	

*1 : Estimated capacity from filtration area. Not properly operated.
*2 :Existing capacity

In Dili, the target facilities are part of Dili water supply system, namely the existing three (3) water treatment plants (rehabilitation works) and rehabilitation & upgrading of distribution mains (zone 1,5,6,7,8 only, total zone number is 10). After the rehabilitation of the three treatment plants, the total capacity is 5,200 m^3/day, which corresponds to about 19 % of maximum supply capacity in Dili. Dili water treatment plant is just constructed with 6,000 m^3/day capacity. The other source of supply is ten (10) deep wells which are owned by WSS.

The project period is 80 months including detailed design. The estimated total cost is 3,136 million Yen (Japanese side :3,075 million Yen, Timor-Leste side :61 million Yen).

The effect of implementation of the Project, as a whole, is regarded as an upgrading of the water services to the residents. In Dili, the rehabilitation work is expected to improve the water service conditions in five (5) zones out of total 10 distribution zones. Meanwhile the rehabilitation works in the four(4) district towns is expected to contribute to the improvement of water service condition of the entire service area.

The direct effect of the Project is supposed to restore the function of the water intake facilities, raw water conveyance facilities, water treatment facilities and water distribution facilities through the rehabilitation, improvement and new construction works to provide the safe water and stable water supply facilities as a result of the development of the facilities.

The effect in terms of service ratio is as follows,

Since Dili's scope of work is part of the entire system, it is difficult to give service ratio for entire city like other four cities, however, UFW (Unaccounted for Water) for the study area is expected to be 28 % from 40 %. The service ratio in the other cities is estimated as follows,

Item	Unit	Existing				After the Project			
		Ermera	Same	Ainaro	Maubisse	Ermera	Same	Ainaro	Maubisse
1. Administration- Pop	person	4,300	11,800	4,900	2,700	4,300	11,800	4,900	2,700
2. Served Population	person	730	3,208	3,265	864	1,505	5,546	3,577	1,269
3. Service Ratio	%	17	27	66	32	35	47	73	47

The indirect effects of the Project in Dili and the four (4) district towns is expected to bring about the service of sufficient amount of water through the direct house connection and/or the public taps that are available all the time at convenient distance. As a result, the project will contribute to decrease the working time of drawing water for female and/or children and materialize the sanitary and convenient living environment of the residents as the beneficiaries. The supply and use of safe water will control the outbreak of water-born diseases drastically and improve the public health in the region simultaneously. On the other hand, for the side of WSS, it is expected that the collection of water charges due to the upgrading of water service will enable more income which can be spent on the operation and maintenance costs, thereby contributing to the healthy financial management of WSS.

However, it shall be noted herein that several issues need to overcome prior to and in connection with the implementation of the Project as summarized in the followings.

- Budgeting of the allotted works to the Timor-Leste Government under the fragile national financial conditions.

- Collection of water charge for the sustainable management of the waterworks
- Securing of operation and maintenance staff sand their capacity building

In addition to the issues above, there is an issue to be emphasized that the installation of service pipes, connection works and setting of the water meter should be carried out in order to have a good linkage with the improved facilities/systems by the Project. The works after the service piping is to be shouldered by the Government of Timor-Leste. The proper planning and implementation of those works supplied by some equipment is very important for the entire project. Also overcoming the issue to forward the execution of water charge system will result in the sustainable operation and maintenance of the objective facilities and establishment of the healthy management of waterworks.

Water supply function in the objective district towns will be restored through implementation of the proposed Project. The normal operation and maintenance of the water supply facilities will bring sanitary and convenient living condition to resident beneficiaries. Additionally, the installation of distribution pipes and public tap stations will reduce the water loss ratio and increase the water service coverage ratio.

As in above, the Project will respond widely to the BHN for the residents with the restoration of water supply functions. As the result, improved sanitary condition and convenient life will be brought to the people with safe and stable water supply. Accordingly, it is ensured herewith the appropriateness to implement the rehabilitation work of the objective facilities under the Japanese Grant Aid Scheme.

BASIC DESIGN STUDY REPORT

THE BASIC DESIGN STUDY ON HE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN DILI AND RURAL DISTRICTS

IN

THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

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Chapter 1

Background of the Project

Chapter 1 Background of the Project

1-1 Historical Background of the Project

The Government of Japan conducted the Development Project Study titled "Study on Urgent Improvement for Water Supply System in East Timor (15 district towns)" in 2000. As a result of the Study, the grant aid project was implemented through UNDP. In addition, the preliminary study named "The Urgent Rehabilitation Support Program in East Timor" was conducted to search for the necessity of rehabilitation of water supply facilities.

The Government of Timor-Leste on behalf of the Ministry of Transport, Communication and Public Works as the implementing agency, requested the bilateral assistance of the Japanese Government based on the results of a series of the studies and the existing water supply situation. The request of the water supply project was made together with the projects for "Rehabilitation for Road and Bridge" and "Rehabilitation for Comoro Power Station" in November 2002.

The objective water supply systems in the request are five (5) district towns including Dili, Ermera, Same, Ainaro and Maubisse which are regarded to have higher priority or urgent necessity for rehabilitation of the facilities. Also, these five(5) district towns are included in the JICA Development Project Study in 2000, however, except for Dili water supply, at present there are no donor countries extending assistance to the four (4) district towns.

Responding to the request, JICA undertook the Basic Design Study of the project and dispatched the Study Team to Timor-Leste in two phases from March 22 to May 5 and from July 26 to August 9, 2003 for the field surveys and for the explanation of the concepts of the basic design in addition to the continuous design work conducted in Japan during the study period.

1-2 Objective Facilities for the Study

The request aimed at rehabilitation of water supply facilities of the objective district towns although the detail contents were not indicated. Accordingly, based on the results of field work, the Basic Design Study Team discussed several times with the Government of Timor-Leste over the rehabilitation plan of the objective district towns and agreed about the objective facilities of each town. Target facilities of the Study are indicated in the following subsection.

1-2-1 Target Facilities of the Study

(1) Dili

- Rehabilitation of three existing Water Treatment Plants

  Bemos, Lahane and Benamauk WTPs
- Rehabilitation and improvement of existing Distribution Network (Zone 1, 5, 6, 7 and 8)

  Main target will be Portuguese period pipes and existing Water Treatment Plants

(2) Ermera

- New Intake

  Haturegas Raitara Stream
- New Raw Water Main

  From New Intake to the Proposed Water Treatment Plant site
- New Water Treatment Plant

Near the Haturegas Raitara

- New Service Reservoir

  Near the Haturegas Raitara (at the Proposed Water Treatment Plant site)

- Rehabilitation of existing Service Reservoir

  Mota Bura and Poetete

- Rehabilitation of existing Distribution Network

(3) Same

- Rehabilitation of existing Intakes

  Merbati and Darelau

- New Raw Water Mains

  Darelau Intake to Hularua Service Reservoir
  Kotalala Intake to Posto Elevated Tank

- Rehabilitation of existing Service Reservoirs

  Merbati, Hularua and Kotarala

- Rehabilitation and Improvement of Existing Distribution Network

(4) Ainaro

- Rehabilitation of existing Intakes

  Sarai

- Rehabilitation of Raw Water Main

  From Sarai Intake to Nugupo Water Treatment Plant

- Rehbilitation and Improvement of existing Water Treatment Plant

  Nugupo WTP

- Rehabilitation of existing Service Reservoir

  Kamilaran No. 1

- New Transmission Line from Nugupo WTP to Kamilaran No.1 Service Reservoir

- Rehabilitation and Improvement of existing Distribution Network

(5) Maubisse

- Rehabilitation of existing Intakes

  Bucana, Raikuak Ulun and Eruru

- New Raw Water Mains

  From Bucana Intake to Pousada Service Reservoir
  From Raikuak Ulun Intake to Leputo Service Reservoir
  From Eruru Intake to Erulu Service Reservoir

- Rehabilitation of existing Service Reservoir

  Pousada, Leputo and Erulu

- Rehabilitation of existing Distribution Network, if the necessity is confirmed.

Chapter 2

Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

The first National Development Plan, since independent of Timor-Leste in May 2002 ranks higher priority to the Project concerned with water supply and sanitation. Under the National Development Plan, water supply is clearly stated in the target (the higher rank target) and is to be given higher priority.

- Higher Rank Target : Supply of safe water to 80 % of urban population through pipeline

The Objectives district towns of the Project, five(5) district towns(Dili, Ermera, Same, Ainaro and Maubisse), have a population scale (administration population) of about 180,000. The total population of Timor-Leste is estimated at 800 thousand and the urban population constitute 25% of total as described in the National Development Plan, the objective population of the Project covers 90% of the urban population. Accordingly, it can be emphasized that the Project is important for the development and prosperity of Timor-Leste.

The objective facilities of each district town is tabulated as follows in Table-2-1-1.

Table-2-1-1 Summary of Objective Facilities for Rehabilitation in Each District Town

District Town	Site	Planned Capacity (m^3/day)	Water Intake	Raw Water Main	Water Treatment Plant	Service Reservoir	Water Distribution Network	Disinfection Equipment
Dili	Bemos WTP	2,000	-	-	○	-	-	○
	Lahane WTP	2,600	-	7.3km	○	-	-	○
	Benamauk WTP	600	-	-	○	-	-	○
	Dist. Network Zone1,5,6,7,8		-	-	-	-	19.6km	
Ermera	Motabura Sys.	86	-	○	-	○	-	○
	Ersoi Sys.	52	-	-	-	○	-	○
	Raitara Sys.	300	○	2.5km	○	○	-	○
	Distribution Network		-	-	-	-	5.8km	
Same	Merbati Sys.	560	○	-	-	○	-	○
	Darelau Sys.	864	○	○	-	○	-	○
	Kotalala Sys.	130	-	○Total: 6.7km	-	○	-	○
	Distribution Network		-	-	-	-	15.5km	
Ainaro	Nugupo WTP	1,200	○	0.8km	○	○	-	○
	Distribution Network		-	-	-	-	8.3km	
Maubisse	Bukana Sys.	173	○	○	-	○	-	○
	Raikuak Ulun Sys.	69	○	○	-	○	-	○
	Erulu Sys.	43	○	○Total: 5.2km	-	○	-	○
	Distribution Network		-	-	-	-	1.5km	

*1 : Estimated capacity from filtration area. Not properly operated.

*2 :Existing capacity

As it will be described later, the objective facilities and the scope of work for the basic designing were determined with the purpose to rehabilitate the major existing facilities in order to facilitate the effective use of water sources and easy operation and maintenance of the systems.

Since the Basic Design Study covers five cities of water supply systems (part of Dili, Same, Ainaro, Maubisse, and Ermera), it includes many design components as can be seen in the Table 2-1-1. The detailed components are explained in the following Section 2-2 in Chapter 2.

After the execution of the Project for all the five(5) waser supply systems, the following effect of the Project in terms of improved service ratios is expected to be achieved.

Table-2-1-2 Improvement of Service Ratio

Towns	Service Ratio (%)			Population
	Current	After the Project	Ratio of Increase	
Ermera	17	35	206	4,300
Same	27	47	174	11,800
Ainaro	66	73	110	4,900
Maubisse	32	47	147	2,700

Note: The service ratio of Dili is not estimated since the projects covers only a part of Dili,

In line with the formation of a new country on May 20,2002, development of all the infrastructures in the country has been just started in Timor-Leste. In the field of water supply, the organization is still young and insufficient in human resources and hence there are many issues to cope with the superannuated facilities and strengthening of operation and maintenance. On the base ground of these facts, introduction of an assistance program of soft component is required in technical assistance activities in addition to the rehabilitation and improvement work of the existing facilities.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

Most of the water supply facilities in Timor-Leste were founded by the Portuguese Government in the 1960s. Thereafter, the water supply facilities were expanded, operated and maintained by the Indonesian Government.

The water supply facilities in the cities and towns were damaged and malfunctioned during the social unrest following the national election in 1999. Further more, the exodus of Indonesian managerial staff caused the loss of water supply related drawings and document related to management of waterworks as well as the shortage of skilled staff . All these factors have brought in the difficulties for normal operation and maintenance of the water supply facilities.

A part of the water supply facilities damaged during the disturbance of the society has been rehabilitated by the international assistance groups and the NGOs, however, the present situation shows that all the facilities and the functions are still not restored.

The Study deals with the basic design for rehabilitation and improvement of Dili waterworks where the facilities and the functions are not wholly restored and the water supply facilities in Ermera, Ainaro, Same and Maubisse where the rehabilitation through the assistance programs are not yet implemented. The following basic policies are concerned,

- Rehabilitation of existing facilities and maximum utilization of existing limited water sources
- Establishment of basic monitoring system mainly at Water Treatment Plant(including Basic water quality analysis)
- Consideration of easy Operation and Maintenance
- Improvement of distribution mains in order to increase service ratio

(1) Dili

In Dili water supply system, there are three existing water treatment plants(WTP), namely; Bemos WTP, Lahane WTP and Benamauk WTP and the water distribution area is divided into 10 water service zones. An emergency rehabilitation was made for each WTP. However, the facilities and equipment are not yet sufficient to satisfy the normal operation of the treatment facilities. With regard to the water distribution system, rehabilitation work of pipes for the zones 2, 3 4, 9 and 10 are either underway or completed in several zones.

In view of the present status described above, the basic design for Dili include the restoration of the malfunctioning water treatment plants of Bemos Lahane and Bemos, and the rehabilitation of water service zones, 1, 5, 6, 7 and 8 where the rehabilitation work of water distribution networks have not been started yet.

1) Water Demand

Water demand of Dili is presented in Table-2-2-1-1 as follows.

Table-2-2-1-1 Water Demand in Dili (Year 2003)

Item	Unit	Quantity
1. Admin. Population	Person	159,100
2. Served population	Person	114,100
3. Service coverage ratio	%	70
4. Max. DWD per capita	lit/c/d	249
5. Daily AWD per capita	lit/c/d	208
6. Max. daily water demand	m^3/day	27,785
7. Daily average water demand	m^3/day	23,154
8. Water loss amount	m^3/day	9,262
9. Ratio of water loss amount	%	40.0

Abbreviations: DWD : Daily Water Demand, AWD : Average Water Demand

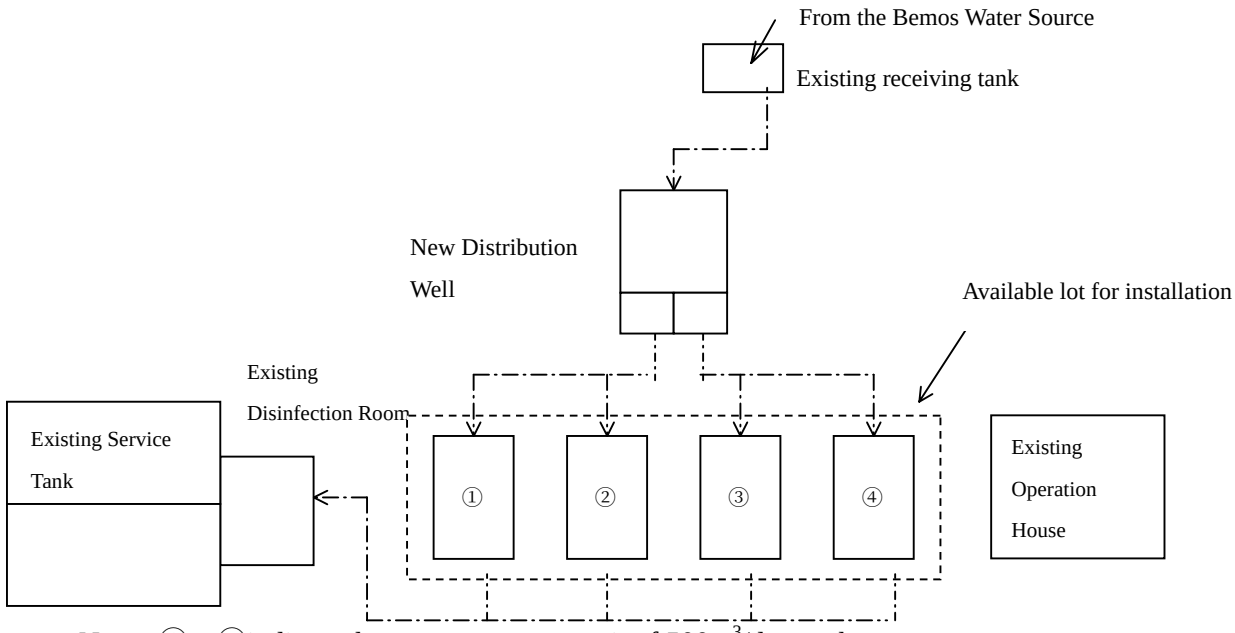
Data Source:
JICA Development Project Study " Study on Urgent Improvement for Water Supply System in East Timor (15 district towns) in 2001"

2) Water Treatment Plant Capacity

Water treatment capacity of WTPs is unknown due to the loss of the relevant document. Therefore, the capacity of each WTP has been estimated based on the following procedures and the capacity is shown in Table-2-2-1-2.

(a) Bemos Water Treatment Plant

The plant capacity of Bemos WTP is determined based on the maximum use of the lot area of the existing water treatment plant. As indicated in the schematic in Figure-2-2-1-1, the total plant capacity of 2,000 m^3/day, 4 series of water treatment plant units of 500 m^3/day each, is proposed.



Note: ①～④indicate the water treatment unit of 500m^3/day each.

Figure-2-2-1-1 Layout of New Water Treatment Units (Bemos WTP)

(b) Lahane Water Treatment Plant

The plant capacity of Lahane WTP is determined based on the capacity of the existing suspended solid contact clarifier and/or the capacity of existing rapid sand filters. In accordance with the Japanese standards for the Design Criteria of Water Supply Facility, the plant capacity is determined at 2,600 m^3/day as follows.

Estimated Capacity of Suspended Solid Contact Clarifier

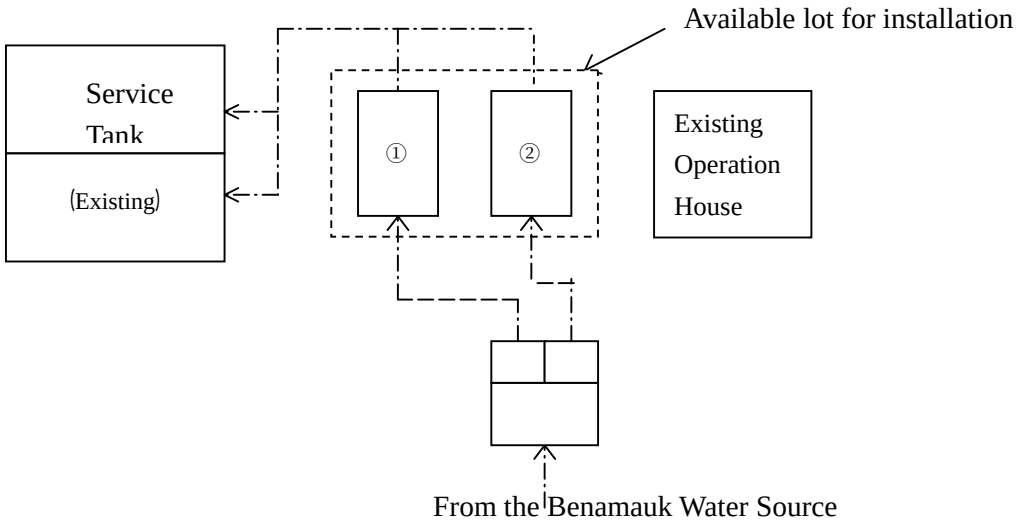
- Surface loading V＝50mm/min (40～60mm/min, from the Design Criteria)
- Sedimentation Area A＝ (7.5^2-3.0^2) x π ÷4＝37.1m^2
- Water Treatment Capacity Q=V x A＝0.05m/min x 37.1m^2 x 1,440min＝ 2,671m3/day

Estimated Capacity of Rapid Sand Filters

- Filtration Rate V＝120m/day (120～150m/day, from the Design Criteria)
- Filtration Area A＝4.85×2.5＝12.1m^2/filter
- Nos. of Filters No.=2 filters (3 filters including 1 stand-by unit)
- Water Treatment Capacity Q＝V x A x N＝120m/day x 12.1m^2/filter ×2filters＝ 2,904m^3/day

(c) Benamauk Water Treatment Plant

The plant capacity of Benamauk WTP is determined based on maximum utilization of the lot area where the existing water treatment units are installed. As a result, the total plant capacity of 600m^3/day, 2 series of water treatment plant units of 300m^3/day each, is proposed as shown in Figure-2-2-1-2.



Note: ①～②indicate the water treatment unit of 300m^3/day each.。

Figure-2-2-1-2 Layout of New Water Treatment Units (Benamauk WTP)

The following Table shows each WTP design capacity.

Table-2-2-1-2 Plant Capacity of Each WTP (Dili)

WTP	Water Source	Water Source Capacity	Plant Capacity
1. Bemos WTP	Bemos stream	17,020m^3/day (197.0lit/s)	2,000m^3/day
2. Lahane WTP	Bemos stream	1,728m^3/day (20.0lit/s)	2,600m^3/day
	Benamauk stream	2,765m^3/day (32.0lit./s)	
3. Benamauk WTP	Benamauk stream	2,765m^3/day (32.0lit/s)	600m^3/day
Total		21,513m^3/day (249.0lit/s)	5,200m^3/day

(d) Water Distribution Network

The network drawing for Dili is inaccurate. In the Study, network information for Zone 1, 5, 6, 7, 8 is gathered through interviews and test diggings. The information is up-dated and input into GIS system. The distribution pipes plan was made based on the GIS system.

(2) Ermera

There are two water sources in Ermera, namely, Motabura and Ersoi springs, and water is distributed to the town from these two (2) systems. The basic design for Ermera includes the rehabilitation of these two systems and water distribution network since any practical rehabilitation work has not yet begun and the town is facing water shortage problem. In addition, the basic design includes the new water source development at the Haturegas Raitara stream to construct a new water supply system for the town to cope with the water shortage problem in dry season.

1) Water Demand

Water demand in Ermera is presented in Table-2-2-1-3 as follows.

Table-2-2-1-3 Water Demand in Ermera (Year 2003)

Item	Unit	Quantity
1. Admin. Population	Person	4,300
2. Served population	Person	2,200
3. Service coverage ratio	%	50
4. Max. DWD per capita	lit/c/d	195
5. Daily AWD per capita	lit/c/d	162
6. Max. daily water demand	m^3/day	428
7. Daily average water demand	m^3/day	356
8. Water loss amount	m^3/day	178
9. Ratio of water loss amount	%	50.0

Abbreviations: DWD : Daily Water Demand, AWD : Average Water Demand

Data Source:
JICA Development Project Study " Study on Urgent Improvement for Water Supply System in East Timor (15 district towns) in 2001"

2) Water Supply Capacity of Each System

The water supply capacity of Ermera is determined based on the capacity of the water sources and the maximum daily water demand as shown in the Table-2-2-1-4. Since the capacity of existing water sources is not adequate to fulfill the maximum daily water demand at

428 m^3/day, a new water source development plan at the Haturegas Raitra stream has been proposed.

Table-2-2-1-4 Capacity of Each Water Supply System (Ermera)

Water Supply System	Water Source	Water Source Capacity	System/Plant Capacity	**Remarks**
1. Haturegas Raitara System	Haturegas Raitara stream	397m^3/day (4.6lit/s)	300m^3/day	New
2. Motabura System	Motabura spring	86m^3/day (1.0lit/s)	86m^3/day	
3. Ersoi System	Ersoi spring	52m^3/day (0.6lit/s)	52m^3/day	
Total		535m^3/day (6.2lit/s)	438m^3/day	

The water supply capacity of the Haturegas Raitara is determined as described below.

- Water Supply Capacity of Haturegas Raitara：q_1
- Maximum Daily Water Demand ：$Q = 438 m^3$/day
- Water Supply Capacity of Motabura System ：$q_2 = 86 m^3$/day
- Water Supply Capacity of Ersoi System：$q_3 = 52 m^3$/day
- Ratio of Miscellaneous Water Use in the Plant：$q_a = 3\%$
- $q1 = (Q - q_2 - q_3) \times (1 + qa) = (438-86-52) \times (1+0.03)$ 300m^3/day

3) Water Distribution Network

Since there is no network drawing, the Study team carried out interviews and prepared rough network drawing. The network drawing need to be up-dated at Detailed Design stage. The distribution pipes are planned based on the Study results.

(3) Same

There are three water sources in Same, namely, Merbati, Dalerau and Kotalala springs, and water is distributed to the town from these three (3) systems. The basic design for Same include the rehabilitation of these three systems and water distribution network since any practical rehabilitation work has not yet begun and the town is facing the water shortage.

1) Water Demand

Water demand in Same is presented in Table-2-2-1-5 as given below.

Table-2-2-1-5 Water Demand in Same (Year 2003)

Item	Unit	Quantity
1. Admin. Population	Person	11,800
2. Served population	Person	5,900
3. Service coverage ratio	%	50
4. Max. DWD per capita	lit/c/d	263
5. Daily AWD per capita	lit/c/d	219
6. Max. daily water demand	m^3/day	1,554
7. Daily average water demand	m^3/day	1,295
8. Water loss amount	m^3/day	648
9. Ratio of water loss amount	%	50.0

Abbreviations: DWD : Daily Water Demand, AWD : Average Water Demand

Data Source:

JICA Development Project Study " Study on Urgent Improvement for Water Supply System in East Timor (15 district towns) in 2001"

2) Water Supply Capacity of Each System

The water supply capacity of Same is determined based on the capacity of the water sources and the maximum daily water demand as shown in the Table-2-2-1-6.

Table-2-2-1-6 Capacity of Each Water Supply System (Same)

Water Supply System	Water Source	Water Source Capacity	System/Plant Capacity
1. Merbati System	Merbtati spring and stream	24,192m^3/day (280lit/s)	560m^3/day
2. Dalerau System	Dalerau spring & stream	864m^3/day (10lit/s)	864m^3/day
3. Kotalala System	Kotalala spring	130m^3/day (1.5lit/s)	130m^3/day
Total		25,186m^3/day (291.5lit/s)	1, 554m^3/day

The water supply capacities of the Darelau and Kotalala systems are determined based on the capacity of respective water sources.

The water supply capacity of the Merbati system is determined based on the followings.

- Maximum Daily Water Demand in Same : $Q = 1{,}554 m^3$/day
- Water Supply Capacity of Darelau System : $q_2 = 864 m^3$/day
- Water Supply Capacity of Kotalala System : $q_3 = 130 m^3$/day
- Water Supply Capacity of Merbati System : q_1
- $q_1 = Q - q_2 - q_3 = 1{,}554 - 864 - 130 = 560 m^3$/day

3) Water Distribution Network

No network drawing is available for the region, therefore, the Study team carried out interviews and prepared rough network drawing. The network drawing need to be up-dated at Detailed Design stage.

The distribution pipes are planned based on the Study results.

(4) Ainaro

There is only one water source in Ainaro, namely the Nugupo stream. The Nugupo WTP system supplies water to the town. The basic design for Ainaro include the rehabilitation of Nugupo WTP system and water distribution network since any practical rehabilitation work has not yet been undertaken.

1) Water Demand

Water demand in Ainaro is presented in Table-2-2-1-7 as given below.

Table-2-2-1-7 Water Demand in Ainaro (Year 2003)

Item	Unit	Quantity
1. Admin. Population	Person	4,900
2. Served population	Person	4,400
3. Service coverage ratio	%	90
4. Max. DWD per capita	lit/c/d	233
5. Daily AWD per capita	lit/c/d	194
6. Max. daily water demand	m^3/day	1,025
7. Daily average water demand	m^3/day	854
8. Water loss amount	m^3/day	427
9. Ratio of water loss amount	%	50.0

Abbreviations: DWD : Daily Water Demand, AWD : Average Water Demand

Data Source:
JICA Development Project Study " Study on Urgent Improvement for Water Supply System in East Timor (15 district towns) in 2001"

2) Water Supply Capacity of the System

The water supply capacity of Ainaro is unknown due to loss of relevant water supply documents. Because of the said status, the treatment capacity of slow sand filters is determined in accordance with the Japanese standards for the Design Criteria of Water Supply Facility as well as the procedures applied for the Lahane WTP. The plant capacity is determined at 1,200 m^3/day as shown below.

Estimated Capacity of Slow Sand Filters

- Filtration Rate V＝5m/day (4～5m/day, from the Design Criteria)
- Filtration Area A＝6.1m×20.0＝122.0m^2
- Nos. of Filters N＝2filters
- Water Treatment Capacity Q＝V x A x N＝5.0 x 122.0 x 2 1,200m^3/day

3) Water Distribution Network

In the absence of any network drawing, the Study team again carried out interviews and prepared rough network drawing. The network drawing need to be up-dated at Detailed Design stage. The distribution pipes are planned based on the Study results.

(5) Maubisse

There are three water sources in Maubisse, namely Bucana, Raikuak Ulun and Erulu springs and

water is distributed to the town from these three(3) systems. The basic design for Maubisse include the rehabilitation of these three systems and water distribution network since any practical rehabilitation work has not yet begun and the town is facing the water shortage.

1) Water Demand

Water demand in Maubisse is presented in Table-2-2-1-8 as follows.

Table-2-2-1-8 Water Demand in Maubisse (Year 2003)

Item	Unit	Quantity
1. Admin. Population	Person	2,700
2. Served population	Person	1,900
3. Service coverage ratio	%	70
4. Max. DWD per capita	lit/c/d	187
5. Daily AWD per capita	lit/c/d	156
6. Max. daily water demand	m^3/day	356
7. Daily average water demand	m^3/day	297
8. Water loss amount	m^3/day	149
9. Ratio of water loss amount	%	50.0

Abbreviations: DWD : Daily Water Demand, AWD : Average Water Demand

Data Source:
JICA Development Project Study " Study on Urgent Improvement for Water Supply System in East Timor (15 district towns) in 2001"

2) Water Supply Capacity of Each System

The water supply capacity of Maubisse is determined based on the capacity of the water sources and the maximum daily water demand as shown in the Table-2-2-1-9.

Table-2-2-1-9 Capacity of Each Water Supply System (Maubisse)

Water Supply System	Water Source	Water Source Capacity	System/Plant Capacity
1. Bucana System	Bucana spring	173m^3/day (2.0lit/s)	173m^3/day
2. Raikuak Ulun System	Raikuak Ulun spring	69m^3/day (0.8lit/s)	69m^3/day
3. Erulu System	Erulu spring	43m^3/day (0.5lit/s)	43m^3/day
Total		285m^3/day (3.3lit/s)	285m^3/day

The maximum daily water demand in Maubisse is estimated at 356m^3/day. Meanwhile, the total water supply capacity is 285m^3/day and hence the amount of 71m^3/day will deficit to the required maximum daily water demand. However, the water supply ratio 80% (285m^3/day÷ 356m^3/day x 100 80%) is sufficient for the daily average water demand and the water shortage under the condition will not be a significant problem in the area. Accordingly, the Maubisse water supply shall be rehabilitated at 285m^3/day for the time being. However, the development of new sources of water is recommended in future.

3) Water Distribution Network

The Study team carried out interviews and prepared rough network drawing, as no network drawing is available. The network drawing need to be up-dated at Detailed Design stage.

The distribution pipes are planned based on the Study results.

2-2-1-2 Considerations of Natural Conditions for Design

(1) Air Temperature

Timor-Leste, situated in the equatorial region, experiences two seasons in terms of rainfall and temperature determined by the monsoon regime. Monthly average air temperature ranges from 24 ～27℃ during 7 months of the dry season from April to October, and about 27℃ during the rainy season from November to March. In order to prevent evaporation caused by high temperature and drying, frequent watering is required for curing concrete in dry season.

(2) Rainfall

Precipitation increases in the rainy season from November to March. The maximum monthly average precipitation occurs at 236mm while the monthly average precipitation is about 141mm. Number of annual rainy days exceed 160 and 60% of these days concentrate during the five months' rainy season.

In such conditions, concrete work shall be basically avoided during rainy seasons. In the rainy season, the work for installation of raw water mains in the mountain area shall also not be implemented due to the danger of frequent collapse of slopes and land slides.

⑶ Earthquake

The seismic activity is low in Timor-Leste and the earthquake-grade due to consider the seismic load for the design of water supply facilities is not occur. Accordingly, the earthquake-resistant design is not considered in the basic design.

⑷ Geography and Geology

1) Dili

Dili lies along the coastal area and the geological conditions in the area is characterized by an alluvium consisting of a mixture of deposits such as clay and large gravel to form a firm ground. Bemos WTP, Lahane WTP and Benamauk WTP are located on hillside where the ground is strong enough for the direct footing. For installation of pipes, open cut will be practical for the trenching work.

2) District Towns (Ermera, Same, Ainaro & Maubisse)

The district towns are located in the steep mountain areas. The inter-district roads are mostly paved but there are many sections having sharp curves and steep slopes. Both road sides consist of steep slopes and traffic is interrupted from time to time in rainy season due to landslides caused by stormwater washout.

As a whole, the stratum in the objective district towns formed of Paleozoic, Mesozoic and Quaternary strata of Cenozoic era, which are consisted of metamorphic rocks, limestone, sandstone, and fine sedimentary rocks. Boring tests conducted in Ainaro and Ermera revealed the existence of 2-5 m deep soft soil layer at the WTP sites. In basic design study, this soft soil layer will be replaced by crushed gravel for the construction of foundation of the structures.

With regard to the installation of raw water mains, there are many sections without roads along the route of the raw water mains. Exposed piping will be adopted at the sections where

the pipeline routes are selected along the streams and slopes. For underground piping, the ground is stiff enough for open cut trenching.

2-2-1-3 Considerations on Social and Economic Conditions

Timor-Leste has just become an independent state and has recently started working towards development of the country. Number of experienced engineers are running short at present. These engineers will be able to have a basic technical transfer through the implementation of the project.

Power supply in the district towns is limited from 18:00 to 24:00 hours. Therefore, procurement of diesel generator(s) is required at the project office(s) and staff quarter(s) during the construction period.

Water supply condition in the district towns become worse in the dry season due to drop in stream water level and decrease of spring water. Accordingly, procurement of water tank truck(s) is required.

2-2-1-4 Considerations on the Conditions for Construction, Procurement, Special & Conventional Practices in the Construction

Ministry of Development and Environment drafted and submitted the Pollution Control Decree and Environmental Assessment Decree to the Councilors of Ministers for approval. The draft Environmental Assessment Decree does not stipulate the necessity of implementation of environmental assessment for water supply facilities.

In Timor-Leste, Design Guideline was prepared by the MTCPW especially for the building and civil structures although the design standards and/or criteria have not yet been formulated up to now. Accordingly, the basic design has been carried out in compliance with the Japanese design standards “Design Criteria of Water Supply Facility-1998”.

There are about 80 local construction companies and some foreign construction companies of Australia, Philippines, and Singapore. Most of the local construction companies are small in business scale and these companies generally do not possess construction equipment and labors but procure only after they get a construction contract . The foreign construction companies generally possess several construction machines and skilled labors but there is no foreign construction companies expanding the business on a large scale, if anything, the scale of business is rather reducing.

With regard to the local construction material, concrete blocks, concrete pipes, etc. are produced in Timor-Leste. Sand and gravel are available from the nearby riverbed such as the down stream section of the Kasa River in Ainaro, and the Commoro River in Dili, and other rivers in each construction site. Other construction materials are imported from the neighboring countries such as Indonesia and Australia.

In Timor-Leste, there is no lease company for construction machines although it is possible to procure the general construction machines from the local construction company(ies).

It is possible to procure steel benders and plasterers in Dili. But, it might be required to procure the skilled labors such as plumbers, carpenters for form work, mechanics, electrician, etc. from the third country(s) such as the Philippines.

2-2-1-5 Considerations to Use Local Construction Company and Consultant

As mentioned earlier under the existing status of construction work, there are two groups of construction companies, namely the local construction companies and the foreign construction companies.

Local construction companies have problems in the performance of work and keeping a construction schedule. Only few companies can fulfill guarantee of the work, others may terminate the contract as the work becomes unprofitable and the deeds become a social problem.

As for the foreign construction companies, because of a shrinking of construction work market, only a limited numbers of engineers and skilled labors are stationed in Timor-Leste and they implement the construction work through deployment of the staff and procure/import the construction machines from their home country as the construction work is awarded to them.

Under such conditions, the opportunities to make use of the subcontractor(s) will be quite limited.

There is no consulting firms in the field of water supply engineering in Timor-Leste.

2-2-1-6 Considerations on the Capacity of Management & Maintenance of the Implementation Agency

The implementing agency, WSS, does not have district WSS office in Ermera and Maubisse and the water supply of Ermera is controlled by the Ermera District WSS in Gleno while the water supply of Maubisse is controlled by the Ainaro District WSS.

Therefore, it is proposed to establish a WSS subdistrict branch office in Ermera and Maubisse respectively in connection with the implementation of this project.

The budget of WSS has been funded by TFET controlled by ADB and CFET. The funding from TFET will end by the middle of 2003. About 75% of the budget of CFET is funded by the assistance agency(ies).

WSS is scheduled to collect water charge from June 2003 and the income from the water charge will be used for allocating to a part of the WSS budget.

Operation and maintenance staffs of WSS are very few. However, the sufficient number of operation and maintenance staffs will be deployed and trained in connection with the implementation of the project.

With regard to the education background of the staffs of WSS, the staffs having senior high school graduate and less education background account for about 73%. Therefore, the human resource of higher technical level is running short. Accordingly, it is required to improve the capacity of the staff through a series of training programs.

2-2-1-7 Considerations to Determine the Grade of Facilities and Equipment

Most of the existing facilities/system in each town is manually controlled. Because of no monitoring facilities installed, operation and maintenance work of the facilities is often obstructed and delayed.

The grade of the facilities and the equipment proposed under the basic design is determined to have the similar level with the existing facilities and the equipment to meet with the appropriate technology in the country. However, the required equipment for monitoring such as water level

meters and flow meters are installed for upgrading the operation and maintenance of the facilities and systems procured under the project.

2-2-1-8 Considerations on the Construction Methods & Procurement and Implementation Time Schedule

(1) Method of Construction and Procurement

Construction work of water supply facilities under the project will be implemented based on the following courses.

With regard to the method of construction, the construction work shall use general construction material and machines since the facilities of the project is procured with general water supply facilities to be constructed on a ground of good geological conditions. Therefore, there is no special construction method to be applied and the procurement is also planned to be made with a general practices. Followings are the common facilities procured under the project.

- Intake Facilities
- Raw Water Mains including aqueduct
- Distribution Well, Receiving Tank, Elevated Tank
- Office House, Staff Quarter
- Water Service Tank
- Water Distribution Pipes

(2) Implementation Time Schedule

There are five objective district cities and towns for rehabilitation of the water supply systems under the project. The project gives priorities to the cities and towns where the WSS District office is operated. The first phase of the project shall implement the rehabilitation work for Dili. The projects for Same and Ainaro are proposed in the second phase and finally the rehabilitation works of two sites, Ermera and Maubisse, are also proposed in the third phase. The first and second phases shall be implemented in multiple fiscal years and the third phase shall be implemented in a single fiscal year.

2-2-2 Basic Plan (Facility Plan & Equipment Plan)

2-2-2-1 Overall Plan

(1) Dili

1) Bemos WTP

Bemos WTP shall have the capacity at 2,000 m3/day through the replacement of water treatment unit (steel made), rehabilitation of office house, mechanical and electrical equipment, and other facilities and equipment. The contents of the rehabilitation and improvement works are presented in Table-2-2-2-1.

Table-2-2-2-1 Proposed Facilities ad Equipment of Bemos WTP

Category of Work	Facilities & Equipment	Remarks
1. Civil Work	Distribution well -1 unit Mixing Flume -2 units Wash-water Tank -1 tank	New New New
2. Building Work	Office House (Rehabilitation)-1 house Generator House (Rehabilitation)-1 house	Rehabilitation Rehabilitation
3. Mechanical Work	Water Treatment Unit -4 units Chemical Dosing Equipment. -1 system Disinfecting Equipment -1 system	Replacement Replacement Replacement
4. Electrical Work	Power Distribution System –1 system Monitoring Equipment -1 system Standby Generator Unit -1 unit	Replacement New Replacement

2) Lahane WTP

Lahane WTP shall have the capacity at 2,600 m^3/day through the replacement of raw water mains, new construction of receiving tank, rehabilitation of office house, mechanical and electrical equipment, and other facilities and equipment. The contents of the rehabilitation and improvement works are presented in Table-2-2-2-2.

Table-2-2-2-2 Proposed Facilities and Equipment of Lahane WTP

Category of Work	Facilities & Equipment	Remarks
1. Civil Work	Raw Water Mains -2 pipeline Receiving Tank-1 tank	New Line Replacement
2. Building Work	Office House –1 house	Rehabilitation
3. Mechanical Work	Suspended Solid Contacting Clarifier-1 tank Rapid Sand Filters -3 filters Chemical Dosing Equipment. -1 system Disinfection Equipment. -1 system	Rehabilitation Rehabilitation Replacement Replacement
4. Electrical Work	Incoming Power Receiving Sys.–1 system Power Distribution System –1 system Monitoring Equipment -1 system Standby Generator -1 unit	Replacement Replacement New Replacement

3) Benamauk WTP

Benamauk WTP shall have the capacity at 600 m3/day through the replacement of water treatment unit, rehabilitation of office house, mechanical equipment, and new installation of electrical equipment. The contents of the rehabilitation and improvement works are presented in Table-2-2-2-3.

Table-2-2-2-3 Proposed Facilities and Equipment of Benamauk WTP

Category of Work	Facilities & Equipment	Remarks
1. Civil Work	Distribution Well –1 unit Wash-water Elevated Water Tank -1 tank	New New
2. Building Work	Office House-1 house Staff House -1house	Rehabilitation New
3. Mechanical Work	Water Treatment Unit -2 units Chemical Dosing Equipment -1 system Disinfection Equipment-1 system	Replacement Replacement Replacement
4. Electrical Work	Incoming Power Receiving Sys. -1 system Power Distribution System –1 system Monitoring Equipment -1 system Standby Generator Unit -1 unit	Replacement Replacement New Replacement

4) Water Distribution Network

Rehabilitation work of water distribution network shall be carried out for the pipes having more water leaks and the non-served areas in the zones, 1,5,6,7, and 8 and the pipe laying distance are listed in the following Table-2-2-2-4.

Table-2-2-2-4 Proposed Length of Pipe Laying in Dili

Size (mm)	Length (m)
φ80	2,618
φ100	6,841
φ150	8,415
φ200	1,729
Total	19,603

(2) Ermera

1) Haturegas Raitara System

The maximum daily water demand amounts to around 438m^3/day in Ermera. However, the existing water supply capacity is estimated at only 138m^3/day and the supplied water amount falls short of demand by 300m^3/day. Therefore, the new water source, Haturegas Raitara system, shall be developed with the capacity of 300m^3/day. The contents of the rehabilitation and improvement work of the Haturegas Raitara system are summarized in Table-2-2-2-5.

Table-2-2-2-5 Proposed Facilities and Equipment of Haturegas Raitara System

Category of Work	Facilities and Equipment	Remarks
1. Civil Work	Intake Facilities-1 unit Raw Water Mains-1 pipeline Receiving Tank-1 tank Water Service Tank-1 tank with 2 chambers	New System
2. Building Work	Office House-1 house Staff House-1house	New System
3. Mechanical Work	Water Treatment Unit-1 units Chemical Dosing Equipment-1 system Disinfecting Equipment. -1 system	New System
4. Electrical Work	Incoming Power Receiving Sys. -1 system Power Distribution Sys. -1 system	New System

	Monitoring Equipment -1 system Standby Generator Unit -1 unit	

2) Motabura System

Water supply capacity of the Motabura System is 86m^3/day. There are water leaks at more than 20 places on the raw water mains of Motabura System, which will be repaired. Motabura System is not equipped with a flow meter and the water distribution amount is not measured. Installation of flow meter is required accordingly. From the result of the water quality test, Ecoli. Bacteria count exceeds the drinking water standard. Therefore, disinfection is necessary. All the rehabilitation and improvement work of Motabura System is summarized in Table-2-2-2-6.

Table-2-2-2-6 Proposed Facilities and Equipment of Motabura System

Category of Facilities	Facilities and Equipment	Remarks
1. Raw Water Mains	φ50～φ100 –1 lot	Repair of leaks
2. Water Service Station	Flow Meter -1 unit Disinfecting Equipment-1 system	New Replacement

3) Ersoi System

Water supply capacity of the Ersoi System is 52m^3/day. Poetete service tank is not equipped with flow meter and the water distribution amount is not measured. Installation of flow meter is required accordingly. As the result of the water quality test show Ecoli. Bacteria count exceeding the drinking water standard, disinfection of water before supply is necessary. All the rehabilitation and improvement work of Ersoi System is summarized in Table-2-2-2-7.

Table-2-2-2-7 Proposed Facilities and Equipment of Ersoi System

Category of Facilities	Facilities and Equipment	Remarks
Water Service Station	Flow Meter –2 unit Disinfection Equipment-1 system	New Rehabilitation

4) Water Distribution Network

Rehabilitation work of water distribution network in Ermera is planned to be carried out for the replacement of the pipes having higher degree of water leaks and installation of pipes in the non-served areas with the pipe laying distance shown in the following Table-2-2-2-8.

Table-2-2-2-8 Proposed Length of Pipe Laying in Ermera

Size(mm)	Length (m)
φ80	5,298
φ100	470
Total	5,768

5) Public Tap

Rehabilitation: 6 places

Newly constructed public tap stations : 17 places

(3) Same

1) Merbati System

Water supply capacity of the Merbati System is 560m^3/day. The Merbati spring intake water decreases in dry season and withdraws surface water from the adjacent stream through temporary intake facilities. It is required to improve the temporary intake facilities for the permanent facilities.

The total water retention time of the service tanks in Same is only 2 hours and expansion is necessary to increase the storage volume. The total storage volume shall be equivalent to the water demand of 8 hours in accordance with the former Japanese design standards of "Design Criteria for Water Supply Facility". Flow meter is not installed at the Merbati water service tank and water distribution amount is not measured. Installation of flow meter is required accordingly. As the result of the water quality test show Ecoli. Bacteria count exceeding the drinking water standard, disinfection is necessary before water supply is made. All the rehabilitation and improvement work of Merbati System is summarized in Table-2-2-2-9.

Table-2-2-2-9 Proposed Facilities and Equipment of Ersoi System

Category of Facilities	Facilities and Equipment	Remarks
1. Water Intake Facilities	Infiltration pipe gallery -1 unit	New
2. Water Service Station	Water Service Reservoir -1 tank with 2 chambers Flow Meter - 1 unit Disinfection Equipment - 1 system	Expansion New New

2) Darelau System

Water supply capacity of the Darelau System is 864m^3/day. In the Darelau water intake system, spring water decrease in dry season and, further, water permeate through the bottom of the intake weir, consequently leading to ireduced water level and insufficient withdrawal of water intake. Accordingly, it is required to construct underground weir for improvement of the facilities.

Water leaks at several sections of the raw water mains due to aging and the illegal and improper connections, which have been made by the resident people. Therefore enough water is not stored at the Holarua water service tank due to the said water loss. Installation of new raw water mains is necessary in order to convey the rated amount of water to the water service tank. In addition, the total storage amount in the service tank is not sufficient for the standard retention time of water service tank and expansion of storage capacity is required. Flow meter is not installed at the Holarua water service tank and water distribution amount is not measured. Installation of flow meter is required accordingly. The result of the water quality test of Darelau water source shows Ecoli. Bacteria count exceeding the drinking water standard, hence disinfection is necessary. All the rehabilitation and improvement work of Dalerau System is summarized in Table-2-2-2-10 as follows.

Table-2-2-2-10 Proposed Facilities and Equipment of Darelau System

Category of Facilities	Facilities and Equipment	Remarks
1. Water Intake	Underground weir -1 unit	Rehabilitation
2. Raw Water Mains	Raw Water Mains -1 pipeline	New
3. Water Distribution Station	Water Service Reservoir - 1 tank with	Expansion

	2 chambers Flow Meter -1 unit Disinfecting Equipment -1 system	 New New

3) Kotalala System

Water supply capacity of the Kotalala System is 130m^3/day. Water leaks at several sections of the raw water mains due to aging and in addition illegal and improper connections, which have been made by the resident people. Hence, enough water is not conveyed to the Posto elevated tank due to the said water loss. Installation of new raw water mains is necessary to overcome this problem.

Flow meter is not installed at the Posto elevated tank and the water distribution amount is not measured. Installation of flow meter is required accordingly. As the result of the water quality test of raw water of Kotalala water source show Ecoli. Bacteria count exceeding the drinking water standard, disinfection is necessary. All the rehabilitation and improvement work of Kotalala System is summarized in Table-2-2-2-11.

Table-2-2-2-11 Proposed Facilities and Equipment of Kotalala System

Category of Facilities	Facilities and Equipment	Remarks
1. Water Intake	Disinfection Equipment -1 unit	New
2. Raw Water Mains	Raw Water Mains -1pipeline	New
3. Water Service Station	Flow Meter -2 units	New

4) Water Distribution Network

Rehabilitation work of water distribution network in Same is essential to be carried out for the replacement of the pipes having much water leaks and installation of pipes in the non-served areas with the pipe laying distance shown in the following Table-2-2-2-12.

Table-2-2-2-12 Proposed Length of Pipe Laying in Same

Size (mm)	Length (m)
φ80	3,380
φ100	12,135
Total	15,515

5) Public Tap

Rehabilitation: 15 places

Newly constructed public tap stations: 32 places

(4) Ainaro

1) Nugupo Water Treatment Plant

The designed capacity of Nugupo WTP is determined to be 1,200m^3/day. Raw water conveyance rectangular channel from the Sarai water source to the Nugupo WTP is installed with concrete cover, however the cover is damaged and lost at many sections. Water pollutants such as excrement and urine of wild animals and pastured domestic animals in addition to the soil and sand from storm water runoff enter into the conduit during rainfall. To prevent this, pipes as a closed conduit is required for the raw water mains.

Existing slow sand filters of Nugupo WTP is not capable to meet the requirements for higher turbid water during and after rain, it is required to construct sedimentation facilities to reduce loading of turbidity to the filters.

Total storage volume of the existing water service tanks is insufficient, only 4.4 hours in terms of retention time, and require expansion of water service tank. The total storage volume shall have 8 hours in terms of the retention times as well as the storage capacity proposed for Ainaro. Flow meter is not installed in Ainaro water supply system and the water distribution amount is not being measured. Installation of flow meter is required to facilitate flow monitoring.

Construction of office house and staff quarter are necessary to have continuous 24 hours' operation and maintenance for the Nugupo WTP. All the rehabilitation and improvement work of Nugupo System is summarized in Table-2-2-2-13.

Table-2-2-2-13 Proposed Facilities and Equipment of Nugupo System

Category of Facilities	Facilities and Equipment	Remarks
1. Water Intake	Intake Weir -1 lot Intake Facilities - 1 nit	Repair
2. Raw Water Mains	Raw Water Mains- 1 pipeline	Replacement
3. Water Treatment Plant	Sedimentation Tank(Renovation of existing slow sand filters)-2 tanks	Renovation
	Slow Sand Filters -4 filters	New
	Water Service Reservoir -1tank with 2 chambers	Expansion
	Office House - 1 house	New
	Staff House -1 house	New
	Disinfection Equipment - 1 system	New
	Incoming Power Receiving Sys. -1 lot	New
	Power Distribution Equipment - 1 lot	New
	Monitoring Equipment – 1 lot	New
	Standby Generator Unit –1 unit	New

2) Water Distribution Network

Rehabilitation work of water distribution network in Ainaro is needed to be carried out for the replacement of the pipes having more water leaks and installation of pipes in the non-served areas with the pipe laying distance is shown in the following Table-2-2-2-14.

Table-2-2-2-14 Proposed Length of Pipe Laying in Ainaro

Size (mm)	Length (m)
φ100	6,095
φ150	2,245
Total	8,340

3) Public Tap

Rehabilitation: 18 Places

Newly constructed public tap : 2 Places

(5) Maubisse

1) Bucana System

Water supply capacity of the Bucana System is 173m^3/day. The water in Bucana spring

decreases in the dry season and, further, water permeate through the bottom of the intake structure, thereby it reduces water level and causes insufficient withdrawal of water intake. As a remedy, it is required to construct underground weir for improvement of the facilities.

Water leaks at several sections of the raw water mains due to aging and the illegal and improper connections made by the resident people are also observed. Water is not stored in sufficient amount at the Pousada water service tank due to the said water loss. Installation of new raw water mains is necessary to convey the rated amount of water to the water service tank.

Flow meter is not installed at the Pousada water service tank and water distribution amount is not being measured. Installation of flow meter is required to monitor waterflow. The result of the water quality test of raw water of Bucana water source shows Ecoli. Bacteria count exceeding the drinking water standard and disinfection is necessary to supply the water in portable form. All the rehabilitation and improvement work of Bucana System is summarized in Table-2-2-2-15.

Table-2-2-2-15 Proposed Facilities and Equipment of Bucana System

Category of Facilities	Facilities and Equipment	Remarks
1. Water Intake	Underground weir -1 lot	Rehabilitation
2. Raw Water Mains	Raw Water Mains -1 pipeline	New
3. Water Service Station	Flow Meter – 1 unit Disinfection Equipment - 1 system	New New

2) Raikuak Ulun System

Water supply capacity of the Raikuak Ulun System is 69m^3/day. The intake facility is constructed with structurally poor weir embanked by earth and stones and the facility do not have sufficient function of water intake. Accordingly, overall rehabilitation is required for the water intake facilities.

Water leaks at several sections of the raw water mains due to aging and the illegal and improper connections made by the resident people are also observed at many locations. Therefore, enough water is not stored in the Leputo water service tank. Installation of new raw water mains is necessary in order to convey the designed amount of water to the water service tank.

Total storage volume of the existing water service tanks in Maubisse is insufficient, only 4.5 hours in terms of retention time, and requires expansion of water service tank. The total storage volume shall have 8 hours in terms of the retention times as well as the storage capacity proposed for the Merbati System in Same. Presently, flow meter is not installed and the water distribution amount is not being measured. Installation of flow meter is required for proper flow monitoring.

As the result of the water quality test of raw water of Raikuak Ulun water source shows Ecoli. Bacteria count exceeding the drinking water standard, therefore disinfection is necessary. All the rehabilitation and improvement work of Raikuak Ulun System is summarized in Table-2-2-2-16.

Table-2-2-2-16 Proposed Facilities and Equipment of Raikual Ulun System

Category of Facilities	Facilities and Equipment	Remarks
1. Water Intake	Water Intake Weir -1 lot	New
2. Raw Water Mains	Raw Water Mains-1 pipeline	New
3. Water Service Station	Water Service Reservoir -1 tank Flow Meter -1 unit Disinfection Equipment –1 system	Expansion New New

3) Erulu System

Water supply capacity of the Erulu System is 43m^3/day. The Erulu spring water yields less water in dry season and further, water permeation through the bottom of the intake chamber reduces water level and causes insufficient amount of water withdrawal at the intake. Accordingly, it is required to construct underground weir for improvement of the facilities.

One line of the raw water mains is disconnected on the way and water dose not reach the water service tank. The other one has a leakage and illegal and improper connections made by the resident people. Therefore enough water is not stored in the Erulu water service tank. Installation of new raw water mains is necessary in order to convey the rated amount of water to the water service tank.

Flow meter is not installed at the Erulu water service tank and the water distribution amount is not measured. Installation of flow meter is essential to monitor water flow.

As for result of the water quality test of raw water of Erulu water source, Ecoli. Bacteria count exceed the drinking water standard and so disinfection is necessary. All the rehabilitation and improvement work of Erulu System is summarized in Table-2-2-2-17.

Table-2-2-2-17 Proposed Facilities and Equipment of Erulu System

Category of Facilities	Facilities and Equipment	Remarks
1. Water Intake	Underground Weir -1 lot	Rehabilitation
2. Raw Water Mains	Raw Water Mains-1 pipeline	New
3. Water Service Station	Flow Meter -1 unit Disinfecting Equipment –1 system	New New

4) Water Distribution Network

Rehabilitation works of water distribution network in Maubisse are the replacement of the pipes having much water leaks and installation of pipes in the non-served areas. The pipe laying distance is shown in the following Table-2-2-2-18.

Table-2-2-2-18 Proposed Length of Pipe Laying in Maubisse

Size (mm)	Length (m)
φ80	1,503
Total	1,503

5) Public Tap

Rehabilitation: 3 Places

Newly constructed public tap stations: 1 place

2-2-2-2 Facility Plan

(1) Dili

1) Bemos WTP

(a) Facility

Four(4) series of factory made steel made water treatment unit with the capacity of 500 m3/day each will be installed. For the purpose to distribute raw water equally to each unit, a distribution well will be constructed.

A tank is installed to store water for back wash, chemical dosing, and for water use within the plant.

Rehabilitation work is required for the entrance road since the pavement is damaged severely and the slope is very steep for heavy trucks.

(b) Building Work

- Office House （existing rehabilitation）

  The rehabilitation work will be carried out to add a office room and a storage room for chemicals.

- Generator House （existing rehabilitation）

  Rehabilitation work is required to house a new generator unit.

(c) Mechanical Equipment

- Water Treatment Unit

  Design capacity : 2,000m^3/day As mentioned earlier, the Japanese design criteria is applied for designing of the water treatment unit.

- Chemical Dosing Equipment

  The equipment is designed based on the following assumption.

Design	Turbidity	Dosing Rate
Max.	200	60 ppm
Mean.	20	20 ppm
Min.	5	15 ppm

- Chlorination

  Chlorination equipment is designed based on the following dosing rate.

Design	Pre-chlorination	Post-chlorination
Max.	5 ppm	2 ppm
Min.	2 ppm	1 ppm

(a) Electrical Equipment

To cope with the new mechanical equipment, distribution power panels and water level monitoring equipment will be installed. A generator unit is also installed.

(b) Equipment Supply

Since there is no water analysis equipment at Bemos WTP, a basic standard water analysis set is to be supplied. The following items shall be tested at the WTP periodically.

- PH, - Color, - Turbidity, - Temperature, - Total Iron, - Manganese, - NH_3-N,
- E.Coli., - Residual Chlorine

Table-2-2-2-19 Specifications and Quantity of Bemos WTP Proposed Facilities

Facility	Item	Specifications/Quantity
WTP	Distribution Well	RC structures, W=2.15m, L=3.00m, Hw=1.50m, C=10.0m^3, No.=1
	Mixing Flume	RC structures, Cascade Type, W=1.00m, L=0.30m, No.=2 series
	Tank	RC structures, W=3.50m, L=3.50m, Hw=1.60m, C=20.0m^3 N=1
Building Facility	Office house (Existing)	Rehabilitation, W=9.60m, L=15.36m, A=147.0m^2, No.=1 (single story)
	Generator (existing)	Rehabilitation, W=6.00m, L=6.00m, A=36.0m^2, No.=1 (single story)
Mechanical Equipment	Coagulation	Steel made, W=2.10m, L=2.10m, Hw=2.27 m, C=10.0m^3, No.=4 units
	Sedimentation	Steel Made, Inclined plate, W=2.30m, L=5.50m, Hw=2.30m, C=29.0m^3, No.=4 units
	Rapid sand filter	Steel made, W=1.50m L=1.60mA=2.4m^2 N=8 Units (1unit standby) Gravel T=150mm, Sand T=600mm
	Flocculation	Vertical type, P=0.75kW No.=4
	Sludge Collector	P=0.2kW No.=2×4 series =8
	Pump	0.40m^3/min. H=15.00m P=2.20kW No.=2 (1 standby)
	Flow Meter	Impeller type Inlet φ200 No.=1 Outlet φ250 No.=1
Chemical Dosing Equipment	Tank for Aluminum Sulfate	PCB (Polychlorobiphenyl) made, W=1.09m L=1.09m H=1.30m C=1.0m^3 N=2 Tanks
	Mixer for Aluminum Sulfate	Propeller size = 250mm single, Shaft Length=1,000mm P=0.20kW No. =2
	Pump for high turbidity	Diaphragm pump C=400mL/min H=20m P=0.043kW No.=2 (1 standby)
	Pump for low turbidity	Diaphragm pump C=400mL/min H=20m P=0.043kW No.=2 (1 standby)
Chlorination	Tank for Hypochlorite	PCB made, W=1.09m L=1.09m H=1.30m C=1.0m^3 No.=2 tanks
	Mixer for hypochlorite	Propeller size=250mm single, Shaft Length=1,000mm P=0.20kW No. =2
	Pump for pre-chlorination	Diaphragm pump C=150mL/min. H=100.00m P=0.02kW No.=3 (1 standby)
	Pump for post-chlorination	Diaphragm pump C=100mL/min. H=40m P=0.02kW N=3 (1 standby)
Electrical Equipment	Power Control Panel	1 unit (3 panels)
	Distribution Panel	For office house, generator house, staff house, 3 panels
	Water Level Meter	At Distribution well 1 unit At reservoir (existing) 2 units
	Generator Unit	Diesel Engine, Package Type, 3 phase 3 wire, 220V, 50Hz, 50KVA, No.=1

2) Lahane WTP

(a) Facility

The existing raw water mains have two lines; Bemori line (φ150) and Benamouk line (φ150), and the two lines are combined into single line (φ200). After the couple of trials for flow measurement and survey, it was revealed that the water loss of the two lines is high due to water leakage and many branching pipes and the lines have lost an appropriate function to convey raw water to the WTP. Accordingly, installation of two pipelines are required to ensure conveying the designed raw water flow to the plant. The diameters of the new pipelines are the same with that of the existing pipes.

The existing receiving well was constructed in 1993 to feed coagulants, however the existing facility is not designed properly and the size of receiving well is too small for performing a good coagulation effect. Therefore, RC structures new receiving well shall be constructed with proper design.

(b) Building Work

- Office House (existing rehabilitation)

  The rehabilitation work will be carried out to add a office room and a generator house.

(c) Mechanical Equipment

- Water Treatment Plant (Suspended Solid Contact Clarifier: Existing Facility)

  The drive unit of the clarifier has oil leakage and the cooling fan is broken and the driving unit shall be replaced. The steel made equipment in the clarifier has not been painted for long time, therefore anti-corrosion painting is required.

  The underdrain nozzles of rapid sand filters are damaged and all the nozzles shall be replaced.

  The depth of filter sand layer has reduced. The sand layer will be removed at the time of replacement of the underdrain nozzles. Due to the difficulties to reuse the filter sand, the sand layer shall be replaced by new filter sand.

  Flow control equipment is out of order and new system will be installed.

  The roots blower for air wash has oil leakage and the specification is unknown, therefore, the equipment including one(1) standby unit shall be replaced.

- Chemical Dosing Equipment

  The existing equipment does not match with the design capacity, therefore, new equipment will be installed with the following design conditions as well as the equipment to be installed at Bemos WTP.

Design	Turbidity	Rate
Max.	200	60 ppm
Mean.	20	20 ppm
Min.	5	15 ppm

■ Chlorination

Chlorination equipment is designed based on the following same conditions applied for the equipment to be installed at Bemos WTP.

Design	Pre-chlorination	Post-chlorination
Max.	5 ppm	2 ppm
Min.	2 ppm	1 ppm

(d) Electrical Equipment

High voltage receiving panels, distribution panel, water level equipment, and generator unit are installed under the category of electrical work.

(e) Equipment Supply

There is no water analysis equipment at Lahane WTP, a basic standard water analysis set is provided as well as the Bemos WTP.

Table-2-2-2-20 Specifications and Quantity of Lahane WTP Proposed Facilities

Facility	Item	Specifications/Quantity
Raw Water Main	Raw Water Main	DIP φ150 L=6,795m φ200 L= 484m Total 7,279m
Building Facilities	Office House	Rehabilitation, W=7.26m, L=13.16m, A=95.5m^2 (Single Story)
Water Treatment	Receiving Well	RC structures, W=2.50m, L=3.95m, Hw=1.50m, C=15.0m^3, No.=1
Mechanical Equipment	Suspended Solid Contact Clarifier (existing)	Drive Unit P=1.5 kW N=1 Anti-corrosion painting for inner side of the tank : 1 unit
	Rapid Sand Filter (existing)	Nozzles : φ13 mm, for 3 filter basins Gravel : use the existing gravel layer Filter sand : Depth=600 mm, for 3 filter basins Flow Control Unit : for 3 filter basins Compressor Unit : Non-oil Type, Air Tank=30 lit., C=45 lit./m, P=0.4kW, No.=2 units (1 unit standby) Blower for Air wash : C=11m^3/min., H=4m, P=15 kW, No.=2 (1 standby) Back Wash Pump : Volute type, C=8.3m^3/min., H=15m, P=30 kW, No.=2 (1 standby)
	Pump for Internal use	Volute type: C=0.1m^3/min., H=15m, P=0.4 kW, No.=2 (1 standby)
	Flow Meter	Impeller Type For Lahane WTP Inlet φ200 No.=1, Outlet φ150 No.=1 For Lahane Reservoir Outlet φ250 No.=1, Outlet φ150 No.=1
Chemical Dosing Equipment	Tank for Aluminum Sulfate	Use Existing One W=1.00m L=1.40m H=1.68m C=2.0m^3 No.=2
	Mixer for Aluminum Sulfate	Propeller size, 250 mm, single, Shaft Length=1,000 mm, P=0.20kW, No.=2
	Pump for high turbidity	Diaphragm pump: C=733m. lit./min., H=100m, P=0.2 kW, No.=2 (1 standby)
	Pump for low turbidity	Diaphragm pump: C=400m. lit./min, H=20m, P=0.043 kW, No.=2 (1 standby)

Chlorination	Tank for Hypochlorite	Use the existing tank, W=1.00m, L=1.40m, H=1.00m, C=1.0m^3, No.=2
	Mixer for Hypochlorite	Propeller size :250 mm, single, Shaft Length=1,000 mm, P=0.2 kW, No.=2
	Pump for pre-chlorination	Diaphragm pump: C=400m. lit./min, H=20m, P=0.043 kW, No.=1
	Pump for post-chlorination	Diaphragm pump: C=110m. lit./min, H=100m, P=0.043 kW, No.=2 (1 standby)
Electrical Equipment	Receiving Panel	1 panel
	Transformer	3 phase dry system, 150kVA, 20KV/440V, 50Hz, No.=1
	Power Control Unit	N=1 unit (4 panels)
	Distribution panel	For administrative Building, Staff House, No.=2 panels
	Generator Unit	Diesel Engine, Package Type, 3 phase 3 wire, 440V, 50Hz, 150KVA, No.=1
	Water Level Meter	AT Receiving Well No.=1 unit Clear Water Reservoir (existing) No.=1unit For Lahane Reservoir (existing) No.=2 unit

3) Benamouk WTP

(a) Facility

The existing site area is fit only for two (2) series of the treatment units with the capacity of 600 m^3/day in total. Distribution well is needed to split raw water flow equally into the two units.

An elevated tank is required to store back wash water, water for mixing chemicals and water use in the WTP site.

(b) Building Work

- Office House
- Staff House

Staff house is required for the operation & maintenance staff. The area is designed at 50m^2 (w=5.0m, L=10.0m) in consideration of the following conditions.

- Existing staff house at Lahane is about 50 m^2.
- The average number of people in a house is 5 people in Dili.

The structure of the house is RC structures with concrete block wall and steel made roof.

- Generator Building (existing)

  This house is renovated to have the office, laboratory, and machine rooms.

- Generator Room (New)

  A new generator room is planned.

(a) Mechanical Equipment

- Water Treatment Plant

  The design capacity is 600 m^3/day with 2 series. The design condition of the mechanical equipment is same as the Bemos WTP.

■ Chemical Dosing Equipment (same as Bemos WTP method).

The existing equipment does not match with the design capacity, therefore, new equipment will be installed with the following design conditions as well as the equipment to be installed at Bemos WTP.

Design	Turbidity	Dosing Rate
Max.	200	60 ppm
Mean.	20	20 ppm
Min.	5	15 ppm

■ Chlorination

Chlorination equipment is designed based on the following same conditions applied for the equipment of Bemos WTP.

Design	Pre-chlorination	Post-chlorination
Max.	5 ppm	2 ppm
Min.	2 ppm	1 ppm

(c) Electrical Equipment

High voltage receiving panels, distribution panel, water level equipment, and generator unit installed under the electrical work..

(d) Equipment Supply

The basic water quality analysis set and jar-tester will be provided.

Table-2-2-2-21 Specifications and Quantity of Benamuk WTP Proposed Facilities

Facility	Item	Specifications/Quantity
WTP	Distribution Well	RC W=2.30m L=2.00m Hw=1.00m C=5.0m^3 No.=1
	Elevated Tank	RC W=2.50m L=2.50m Hw=1.60m C=10.0m^3 No.=1
Building Facility	Office House (existing)	Rehabilitation W=5.00m L=12.00m A=60.0m^2 No.=1 (single story)
	Staff House	Concrete Block W=3.00m L=4.70m A=14.1m^2 No.=1 (Single Story)
	Pumping Room	Concrete Block W=2.00m L=2.50m A=5.0m^2 No.=1 (Single Story)
	Generator House	Concrete Block W=2.00m L=2.50m A=5.0.m^2 No.=1 (Single Story)
Mechanical Equipment	Mixing Well	Steel Made W=0.50m L=0.50m H=1.75m C=0.4m^3 No.=2
	Coagulation	Steel Made W＝1.80m L=1.80m Hw=1.75m C=5.0m^3 No.=2
	Sedimentation	Steel Made, Inclined Plate W=1.80m L=3.80m Hw=1.75m C=11.0m^3 No.=2 units
	Rapid Sand Filter	Steel Made W=0.60m L=1.66m A=1.0m^2 No.=6 unit (1 unit standby) Gravel Depth=150 mm, Filter Sand Depth=600 mm
	Rapid Mixing	Propeller P=0.1 kW No.=2
	Flocculator	P=0.20 kW No.=2
	Sludge Collector	P=0.2 kW No.=2×2 series =4
	Pump	0.20m^3 H=15m P=1.50 kW No.=2 (1 standby)
	Flow Meter	Impeller type Inlet φ100 No.=2 Outlet φ150 No.=1 Outlet φ100 No.=1
Chemical Dosing Equipment	Tank for Aluminum Sulfate	PCB (Polychlorobiphenyl) made W=0.90m L=0.90m H=1.20m C=1.0m^3 No.=2
	Mixer for Aluminum Sulfate	Propeller size = 200 mm, Single, Shaft Length=800 mm, P=0.10 kW, No.=2

	Pump for high turbidity	Diaphragm pump, C=150 m.lit./min., H=70m, P=0.043 kW, No.=2 (1 standby)
	Pump for low turbidity	Diaphragm pump C=100m. lit./min. H=40m P=0.02 kW No.=2 (1 standby)
Chlorination	Tank for Hypochlorite	PCB made W=0.85m L=0.85m H=1.15m C=0.8m^3 No.=2
	Mixer for Hypochlorite	Propeller size=200 mm single, Shaft Length=800 mm P=0.10 kW No.=2
	Pump for Pre-chlorination	Diaphragm pump, C=40m. lit/min., H=40.0m, P=0.02 kW, No.=1
	Pump for Post-chlorination	Diaphragm pump, C=28 m. lit./min., H=100m, P=0.02 kW, No.=3 (1 standby)
Electrical Equipment	Receiving Panel	No.=1 panel
	Transformer	3 phase dry system, 30 kVA, 20 kv/220v, 50 Hz, No.=1
	Power Control Panel	No.=1 unit (3 panels)
	Distribution Panel	Office Room, Staff House, No.=2 panels
	Water level Meter	At distribution Well No.=1 unit At existing reservoir No.= 2 units
	Generator Unit	Diesel Engine, Package Type, 3 phase 3 wire, 220V, 50Hz, 37.5 kVA, No.=1

4) Dili Distribution Pipes (Zone 1,5,6,7,8)

The old distribution pipes in the Portuguese time and the pipelines having much water leakages shall be replaced. Also, new distribution pipes will be installed in the non-served areas.

For the material of pipes, Ductile Cast Iron (T type) shall be used for main routes and PVC be used for the branch lies. Instead of concrete thrust block, anchor joint is proposed against the thrust force at the bending sections for the purpose to avoid the influence of rainfall and faster installation work compared with the concrete thrust blocks.

Table-2-2-2-22 Specifications and Quantity of Distribution Pipes (Zone 1,5,6,7,8)

Facility	Item	Specifications/Quantity
Distribution	Distribution Pipes	PVC φ80 L=2,618m φ100 L= 6,841m DIP φ150 L=8,415m φ200 L=1,729m Total= 19,603m

5) Equipment Supply

Table-2-2-2-23 summarize equipment supply list for Dili.

Table-2-2-2-23 Specifications and Quantity of Dili Equipment Supply

Item	Specifications/Quantity	Remarks
Basic Water Quality Analysis Set	No.=3 sets	・Bemos WTP ・Lahane WTP ・Benamaouk WTP
Jar – Tester	No.=1	・Benamaouk WTP
Saddle	For PVCφ80×φ13,25,50, No.=381 sets	For zones 1, 5, 6, 7, 8

Saddle	For PVC φ100 × φ13,25,50, No.=927 sets	For zones 1, 5, 6, 7, 8
Saddle	For DIP φ150 × φ13,25,50, No.=522 sets	For zones 1, 5, 6, 7, 8
Saddle	For DIP φ200 × φ13,50, No.=168 sets	For zones 1, 5, 6, 7, 8
Drill	Manual Operation For φ13～φ25 No.=8 sets	For zones 1, 5, 6, 7, 8
Drill	Motor Drive φ45～φ70 用 No.=2 sets	For zones 1, 5, 6, 7, 8
Spare Bits	φ13 N=50 pieces φ25 N=2 pieces φ25 N=2 pieces	For zones 1, 5, 6, 7, 8

(2) ERMERA

1) Haturegas Raitara System

(a) Facility

The design capacity is determined at 300m^3/day. Intake structure is RC structures designed to facilitate easy operation and maintenance.

The length of raw water main is about 2.5km with 26m difference in elevation. The diameter is φ100mm. Since the raw water main route is hilly up-down area, steel pipe is planned to meet these conditions.

The capacity of the service reservoir constructed at the site of new treatment plant is designed at 100m^3, which is equivalent to 8 hours of the plant capacity (300m^3/day). The reservoir is RC structures with two chambers for easy maintenance.

(b) Building Work

- Office House

  Office house has a room for office & monitoring, chemical dosing room, storage, laboratory, and generator room. The structures and the designing criteria are the same conditions with that of Benamouk WTP (RC, Concrete block wall, Steel made corrugated sheet roofing).

- Staff House

  Same as the design of Benamouk WTP (A=50m^2).

(c) Mechanical Equipment

New water treatment plants is a unit type (capacity : 300m^3/day) designed by the same conditions with the unit of Benamouk WTP type in Dili (Steel made unit plant).

(d) Electrical Equipment

Distribution panel, water level meter, and generator will be installed. Low voltage receiving panel is also planned.

Table-2-2-2-24 Specifications and Quantity of Haturegas Raitara System Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Intake Weir	RC W=4.00m L=7.20m No.=1
	Sludge Drain	RC W=1.00m L=1.85m H=1.00m No.=1

Raw Water main	Pipe	SP φ100 L=2,524m
WTP	Receiving Well	RC W=1.00m L=2.70m Hw=1.00m C=3.0m^3 No.=1
	Reservoir	RC W=8.00m L=5.00m Hw=3.00m C=100.0m^3 No.=1 (separate wall)
Building Facility	Office House	Concrete Block W=5.00m L=10.00m A=50.0m^2 No.=1 (Single Story)
	Staff House	Concrete Block W=5.00m L=10.00m A=50.0m^2 No.=1 (Single Story)
Mechanical Equipment	Mixing Well	Steel Made W=0.50m L=0.50m H=1.75m C=0.4m^3 No.=1
	Coagulation	Steel Made W=1.80m L=1.80m Hw=1.75m C=5.0m^3 No.=1
	Sedimentation	Steel Made, Inclined Plate W=1.80m L=3.80m Hw=1.75m C=11.0m^3 No.=1 unit
	Rapid Sand Filter	Steel Made W=0.60m L=1.66m A=1.0m^2 No.=3 units (1 unit standby) Gravel T=150 mm, Filter Sand T=600 mm
	Water Tank	Steel Made W=1.80m L=4.20m H=0.70m C=5.0m^3 No.=1
	Back Wash Pump	C=0.75m^3/min. H=10.0m P=2.2 kW No.=3
	Flow Meter	Impeller Type Inlet φ100 No.=1, Outlet φ100 No.=1
	Rapid Mixing	P=0.1 kW N=1
	Flocculator	Vertical type, P=0.20 kW No.=2
	Sludge Collector	P=0.2 kW No.=2×1 series=2
	Pump	C=0.1m^3/min. H=15m P=0.40 kW No.=2
Chemical Dosing Equipment	Tank for Aluminum Sulfate	PCB Made, W=0.70m L=0.70m H=0.85m C=0.4m^3 No.=2
	Mixer for Aluminum Sulfate	P=0.10 kW No.=2
	Pump for high turbidity	Diaphragm pump, C=100 m. lit./min., H=40m, P=0.043 kW, No.=2 (1 standby)
	Pump for low turbidity	Diaphragm pump, C=40 m.lit./min., H=70m, P=0.02 kW, No.=2 (1 standby)
Chlorination	Tank for Hypochlorite	PCB (Polychlorobiphenyl) made W=0.70m L=0.70m H=0.85m C=0.4m^3 No.=2
	Mixer for Hypochlorite	P=0.10 kW No.=2
	Pump for Pre-chlorination	Diaphragm pump C=40 m.lit./min. H=70.0m P=0.02 kW No.=1
	Pump for Post-chlorination	Diaphragm pump C=28 m. lit./min. H=70m P=0.015 kW No.=2 (1 standby)
Electrical Equipment	Power Control Panel	No.=1 unit (3 panels)
	Distribution Panel	For Office House & Staff House, Closed indoor wall mount type, No.=2 panels
	Water Level Meter	At receiving well No.=1 unit For existing reservoirs No.=2 units
	Generator	Diesel Engine 3 phase 3 wire system 220v 50Hz 50kVA No.=1

2) Motabura System

(a) Facility

The existing raw water mains have many visual leakages and the leakages shall be repaired.

Table-2-2-2-25 Specifications and Quantity of Motabura System Proposed Facilities

Facility	Item	Specifications/Quantity
Raw Water Main	Pipe	Leakage Repair(22 points), φ50 SP No.=19 points, φ80 SP No.=1 point φ100 SP No.=2 point
Motabura Reservoir	Chlorination Cover	Wooden made W=2.00m L=2.00m A=4.0m^2 No.=1 unit
	Mechanical Equipment	Flow Meter : Impeller Type, φ100 No.=1 Sluice Valve Inlet φ100 No.=1 Outlet φ100 No.=1
	Chlorination	Mixing Tank for Hypochlorite 200 lit No.=1 unit Dosing Tank : PCB made 100 lit. , No.=1 unit

3) Ersoi System

Table-2-2-2-26 Specifications and Quantity of Ersoi System Proposed Work

Facility	Item	Specifications/Quantity
Poetete Reservoir	Chlorinator Cover	Wooden made, W=2.00m, L=2.00m, A=4.0m^{2,} No.=1
	Mechanical Equipment	Flow Meter : Impeller Type, φ80, No.=2 Sluice Valve: Inlet φ50, No.=3, Outlet φ80, No.=2
	Chlorination	Mixing Tank for Hypochlorite : PCB (Polychlorobiphenyl) made, 200 lit., No.=1 Dosing Tank and Equipment : PCB (Polychlorobiphenyl) made, 100 lit., No.=1 unit

4) Ermera Distribution Pipes

Distribution pipes laid in Portuguese Time and having leakage will be replaced. Also, new distribution pipes are planned accordingly.

For the material of pipes, Ductile Cast Iron (T type) shall be used for main routes and PVC be used for the branch lines. Instead of concrete thrust block, anchor joint is proposed against the thrust force at the bending sections for the purpose to avoid the influence of rainfall and faster installation work compared with the concrete thrust blocks.

Broken public taps shall be repaired and the public taps shall be installed newly at the poor water service area(s).

Table-2-2-2-27 Specifications and Quantity of Ermera Proposed Distribution

Facility	Item	Specifications/Quantity
Distribution main	Pipe	PVC φ80 L= 314m DIP φ80 L= 4,984m φ100 L= 470m, Total=5,768m
Service Tap	Public Tap	RC structures W=1.70m, H=1.60m No.=17-new, 6-rehabilitation

5) Ermera Equipment Supply

① Basic Water Quality Analysis Set, same type as that of the Benamauk WTP, Dili
② Jar –Tester

Table-2-2-2-28 Specifications and Quantity of Ermera Equipment Supply

Item	Quantity	Remarks
Basic Water Quality Analysis Set	No.=1	At new WTP
Jar –Tester	No.=1	ditto

(3) Same

1) Merbati System

(a) Facility

Merbati intake water amount decrease in dry season. A temporary small intake was constructed to withdraw water from the stream nearby, however, an adequate water amount is not withdrawn from the temporary intake. Therefore, a new intake for the stream shall be constructed based on the appropriate engineering design. The structure shall be RC structures and an infiltration gallery made of perforated pipes shall be installed in the riverbed to withdraw enough amount of low turbidity water.

Total detention time of the water service reservoirs in Same is only two (2) hours and so a new RC structures service reservoir with 300m^3 storage volume is planned at the adjacent area of the existing Merbati service reservoir.

Table-2-2-2-29 Specifications and Quantity of Merbati System Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Intake Pipe Channel	Perforated Concrete Pipe: φ500 No.=1 line Sand Pit: RC, W=1.20m, L=1.20m, H=1.40m, No.=1
Reservoir	Reservoir	RC structures, W=8.00m, L=13.00m, Hw=3.00m, C=300m^3, No.=1 (with two chambers)
	Chlorination Cover	Concrete Block, W=2.00m, L=2.00m, A=4.0m^2, No.=1
	Mechanical Equipment	Flow Meter: φ150, No.=1
	Chlorination	Mixing Tank for Hypochlorite: PCB (Polychlorobiphenyl) made 200lit., No.=1 Dosing Tank and Equipment: PCB (Polychlorobiphenyl) made 100lit., No.=1 unit

2) Darelau System

(a) Facility

Intake water amount decrease in dry season. Underground RC weir is planned to enclose the existing intake chamber to secure sufficient water intake amount in dry season.

Water leaks at several sections of raw water mains due to aging and illegal and improper connections made by the resident people. Therefore, new raw water main is necessary to convey the designed water amount.

The total storage capacity of the service reservoirs in Same is lacking as mentioned earlier. Accordingly, considering the available site area, a new service reservoir of the capacity at 90 m3 shall be constructed at the site of Hularua service reservoir. The same structural design concept is applied for the service reservoir of the Mebati System.

Table-2-2-2-30 Specifications and Quantity of Darelau System Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Intake Weir (existing)	Underground Weir RC H=2.35m L=16.00m No.=1
Raw Water Main	Pipe	SP φ100 L=2,720m No.=1
Reservoir	Reservoir	RC W=8.00m L=4.0m Hw=3.00m C=90.0m^3 No.=1 (separation Wall installed for maintenance purpose)
	Chlorination Cover	Concrete Block W=2.00m L=2.00m A=4.0m^2 No.=1
	Mechanical Equipment	Flow Meter: φ100, No.=1
	Chlorination	Mixing Tank for Hypochlorite : PCB (Polychlorobiphenyl) made, 200 lit. No.=1 Dosing Tank PCB (Polychlorobiphenyl) made, 100 lit. , No.=1

3)Kotalala System

(a) Facility

Due to the similar situation with the Darelau System, the raw water mains are installed with the diameter of φ80 mm SP.

Table-2-2-2-31 Specifications and Quantity of Kotalala System Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Chlorination Cover	Wooden made, W=2.00m, L=2.00m, A=4.0m^2, No.=1
	Chlorination	Mixing Tank for Hypochlorite : PCB (Polychlorobiphenyl) made, 200 lit., No.=1 Dosing Tank : PCB (Polychlorobiphenyl) made 100 lit. , No.=1 unit
Raw Water Main	Pipe	SP, φ80, L=4,042m, No.=1 line
Posto Elevated Tank	Mechanical Equipment	Flow Meter φ80 No.=1 Sluice Valve Inlet φ80 No.=1, Outlet φ80 No.=1

4) Same Distribution Pipes

Table-2-2-2-32 Specifications and Quantity of Same Distribution Pipees

Facility	Item	Specifications/Quantity	Remarks
Distribution	Pipe	SP φ80 L= 103m DIP φ80 L= 3,277m φ100 L= 12,135m, Total＝15,515m	Steep area
Service Tap	Public Tap	RC structures, W=1.70m, H=1.60m No.=32-new, 15-rehabilitation	

5) Same Equipment Supply

① Basic Water Quality Analysis Set, same type as that of the Benamauk WTP, Dili

② Procurement of saddles and a drill set

Table-2-2-2-33 Specifications and Quantity of Same Equipment Supply

Item	Specifications/Quantity	Remarks
Basic Water Quality Analysis Set	No.=1 set	WSS Same Office
Saddle	For DIP φ100×φ13 No.=190	
Drill	Manual Operation For φ13～φ25 No.=2 Spare Bits No.=7	

(4) Ainaro

1) Nugupo WTP

(a) Facility

The design capacity of Nugupo WTP is determined as 1,200m^3/day. Raw water conveyance rectangular channel from the Sarai water source to the Nugupo WTP is installed with concrete cover, however the cover is damaged and lost at many sections. Water pollutants such as excrements of wild animals and pastured animals in addition to soil and sand caused by storm water runoff enter into the conduit during rainfall. Accordingly, pipeline, as a closed conduit, is required for the raw water mains.

Existing slow sand filters of Nugupo WTP is not capable to meet the requirements of higher turbid water during and after rain and it is required to construct sedimentation facilities to reduce loading of turbidity to the filters.

The total storage volume shall have 8 hours in terms of the retention times as well as the storage capacity, thus, 300m^3 reservoir is planned at WTP site, consequently, the Ainaro water supply system will have an adequate storage amount of the service reservoir.

Flow meter is not installed in Ainaro water supply system and the water distribution amount is not measured. Installation of flow meter is required accordingly.

Construction of office house and staff house are necessary to have continuous 24 hours' operation and maintenance for the Nugupo WTP.

(b) Building Work

- Office House

  Office house is planned with the same design concept with that of the Ermera WTP.

- Staff House

  Staff house is planned with the same design concept with that of the Benamouk WTP（A-50m^2）.

(c) Mechanical Equipment

Chlorination system is designed same as Bemos WTP in Dili.

(d) Electrical Equipment

Distribution panel, water level meter, and a generator unit will be installed. High voltage receiving panel is also planned.

Table-2-2-2-34 Specifications and Quantity of Nugupo WTP Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Intake Weir (existing)	Rehabilitation of a part of the crest concrete wall : 1 unit
	Intake Mouth	RC structures, W=1.00m, L=2.10m, H=1.00m, No.=1
Raw Water Main	Pipe	SP φ150, L=778m
WTP	Sedimentation	Renovation of the existing Slow Sand Filter, W=6.10m, L=20.00m, H=3.06m No.=2 series
	Slow Sand Filters	RC structures, W=7.00m, L=11.50m, H=2.90m, No.= 4 (1 standby)
	Clear Water Reservoir	RC structures, W=8.00m, L=13.00m, Hw=3.00m, C=300m^3, No.=1 (with two chambers)
Building Facility	Office House	Concrete Block W=3.00m L=11.00m A=33.0m^2 No.=1 (Single Story)
	Staff House	Concrete Block W=5.00m L=10.00m A=50.0m^2 No.=1 (Single Story)
Mechanical Equipment	Pump	Volute Type C=0.1m^3/min. H.=15.0m P=0.4kW No.=1
	Flow Meter	Outlet φ150 No.=1
Chlorination	Tank for Hypochlorite	PCB (Polychlorobiphenyl) made W=0.85m L=0.85m H=1.15m C=0.8m^3 No.=2
	Mixer for Hypochlorite	Propeller size = 200mm single Shaft Length = 800mm No.=2
	Pump for chlorination	Diaphragm pump C=100mL/min. H=40.0m P=0.02kW No.=2 (1 standby)
Electrical Equipment	Receiving Panel	No.=1 panel
	Transformer	3 phase dry system, 50KVA, 20kV/220V, 50Hz, No.=1
	Power Control Panel	No.=1 unit (2 panels)
	Distribution Panel	For Office House & Staff House, No.=2 panels
	Water Level Meter	No.=2 units
	Generator	Diesel Engine, Package Type, 3 phase 3 wire, 220V, 50Hz, 50kVA, No.=1

2) Ainaro Distribution Pipes

Table-2-2-2-35 Specifications and Quantity of Ainaro Distribution Pipes

Facility	item	Specifications/Quantity
Distribution	Pipe	DIP φ100 L=6,095m φ150 L=2,245m Total = 8,340m
Service Pipe	Public Tap	RC structures, W=1.70m H=1.60m No.=2-new, 18 –rehabilitation

3) Ainaro Equipment Supply

① Basic Water Quality Analysis Set, same type as that of the Benamauk WTP, Dili

② Procurement of saddles and a drill set

Table-2-2-2-36 Specifications and Quantity of Ainaro Equipment Supply

Item	Specifications/Quantity	Remarks
Basic Water Quality Analysis Set	No.=1 set	Nugupo WTP
Saddle	DIP φ100×φ13 No.=138 DIP φ100×φ25 No.=2 DIP φ150×φ13 No.=50	
Drill	Manual Operation φ13～φ25 No.=2 Spare Bits φ13 No.=7 Spare Bits φ25 No.=1	

(5) Maubisse

1) Bucana System

(a) Facility

Similar to the intake chamber of Darelau in Same, the intake chamber of Bucana System shall be rehabilitated with the underground weir of the similar type of structures.

The raw water main will be installed newly using SP and the size of φ80 mm determined with the intake flow at 173m^3/day. All the rehabilitation and improvement work of Bucana system is summarized in Table-2-2-2-37.

Table-2-2-2-37 Specifications and Quantity of Bucana System Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Intake Chamber (existing)	Underground weir RC H=2.00m L=24.5m No.=1
Raw Water Main	Pipe	SP φ100 L=1,700m No.=1 line
Pousada Reservoir	Chlorination Cover	Wooden made W=2.00m L=2.0m A=4.0m^2 No.=1 unit
	Mechanical Equipment	Flow Meter φ100 No.=1 Sluice Valve Inlet φ100 No.=1 Outlet φ100 No.=1
	Chlorination	Mixing Tank for Hypochlorite PCB (Polychlorobiphenyl) made, 200 lit. No.=1 Dosing Tank for Hyprochlorite PCB (Polychlorobiphenyl) made 100 lit., No.=1 unit

2) Raikuak Ulun System

(a) Facility

Water supply capacity of the Raikuak Ulun System is designed 69m^3/day. The intake facility is constructed with structurally poor weir embanked by earth and stones and the facility do not have sufficient function of water intake. Accordingly, overall rehabilitation is required for the water intake facilities.

Water leaks at several sections of the raw water mains due to aging and the illegal and improper connections made by the resident people. Water is not stored enough at the Leputo water service tank due to the said water loss. Installation of new raw water mains is necessary accordingly to convey the design amount of water to the water service tank.

Total storage volume of the existing water service tanks in Maubisse is insufficient, only 4.5 hours in terms of retention time, and requires expansion of water service tank.

Presently, flow meter is not installed and the water distribution amount is not measured. Installation of flow meter is required accordingly.

As the result of water quality test at Raikuak Ulun source, raw water show Ecoli. Bacteria count exceeding the drinking water standard and disinfection is necessary accordingly. All the rehabilitation and improvement work of Raikuak Ulun System is summarized in the following Table-2-2-2-38.

Table-2-2-2-38 Specifications and Quantity of Raikuak Ulun System Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Weir	RC structures, D=1,500 mm No.=1
	Underground Weir	RC structures, H=1.65m L=26.5m No.=1
Raw Water Main	Pipe	SP φ80 L=3,331 m No.=1line
Leputo Reserivoir	Reservoir	RC structures, W=3.00m, L=3.50m, Hw=3.00m, C=30.0m^3, No.=1 (with two chambers)
	Chlorination Cover	Concrete Block, W=2.00m, L=2.0m, A=4.0m^2, No.=1 unit
	Mechanical Equipment	Flow Meter : φ80, No.=1
	Chlorination	Mixing Tank for Hypochlorite: PCB (Polychlorobiphenyl) made 200 lit., No.=1 Dosing Tank PCB (Polychlorobiphenyl) made 100 lit., No.=1 unit

3) Erulu System

(a) Facility

Water supply capacity of the Erulu System is designed at 43m^3/day. The Erulu spring water yields less water in dry season. Furthermore, water permeation through the bottom of the intake chamber reduce water level and cause insufficient withdrawal of raw water amount at the intake. Accordingly, it is required to construct a underground weir for improvement of the facilities.

Raw Water main has leakages and illegal and improper connections made by the resident people. Installation of new raw water mains is necessary accordingly to convey the designed flow to the water service reservoir.

Flow meter is not installed at the Erulu water service reservoir and the water distribution amount is not measured. Installation of flow meter is required accordingly.

The result of water quality test at Erulu raw water shows Ecoli. Bacteria count exceeding the drinking water standard. Therefore, installation of disinfection equipment is necessary. All the rehabilitation and improvement work of Erulu System is summarized in the following Table.

Table-2-2-2-39 Specifications and Quantity of Erulu System Proposed Facilities

Facility	Item	Specifications/Quantity
Intake	Intake (existing)	Underground weir RC structures, H=2.00m L=17.0m No.=1
Raw Water Main	Pipe	SP φ100 L=151m No.=1 line
Reservoir	Chlorination Cover	Wooden made W=2.00m L=2.0m A=4.0m^2 No.=1 棟
	Mechanical Equipment	Flow Meter φ100 No.=1 Sluice Valve Inlet φ100 No.=1 Outlet φ50 No.=1, φ100 No.=1
	Chlorination	Mixing Tank for Hypochlorite PCB (Polychlorobiphenyl) 200 lit. No.=1 Dosing Tank PCB (Polychlorobiphenyl) made 100 lit. No.=1 unit

4) Maubisse Distribution Pipes

The Table below summarizes the plan of distribution facilities for Maubisse.

Table-2-2-2-40 Specifications and Quantity of Maubisse Distribution Pipes

Facility	Item	Specifications/Quantity	Remarks
Distribution	Pipe	PVC φ80 L=654m SP φ80 L=181m DIP φ80 L=668m Total 1,503m	Steep area
Service	Public Tap	RC structures, W=1.70m, H=1.60m, No.=1-new, 3-rehabilitation	

5) Maubisse Equipment Supply

① Basic water Quality Analysis Set same as Dili
② Saddle and drill for pipes

Table-2-2-2-41 Specifications and Quantity of Maubisse Equipment Supply

Item	Specifications/Quantity	Remarks
Basic water Quality Analysis Set s	No.=1 set	Maubisse Sub-district Office
Saddle	For DIP φ80×φ13 No.=9 For DIP φ80×φ25 No.=1 For DIP φ100×φ13 No.=61	
Drill	Manual Operation φ13～φ25 No.=2 Spare Bits φ13 No.=3 Spare Bits φ25 No.=1	

2-2-3 Basic Design Drawings

Followings are the list of drawings prepared in the course of the the Basic Design for the objective five(5) district towns.

(1) Dili

1) Dili

DWG-No.1. Dili general plan

2) Bemos WTP

DWG-No.2. Water treatment plant general plan/Bemos WTP
DWG-No.3. Water treatment plant flow sheet/Bemos WTP
DWG-No.4. Water purification unit/Bemos WTP
DWG-No.5. Single line diagram/Bemos WTP

3) Lahane WTP

DWG-No.6. Raw water main plan and profile
DWG-No.7. Water treatment plant general plan/Lahane WTP
DWG-No.8. Water treatment plant flow sheet/Lahane WTP
DWG-No.9. Single line diagram/Lahane WTP

4) Benamauk WTP

DWG-No.10. Water treatment plant general plan/Benamauk WTP
DWG-No.11. Water treatment plant flow sheet/Benamauk WTP
DWG-No.12. Water purification unit/Benamauk WTP
DWG-No.13. Single line diagram/Benamauk WTP

5) Dili distribution pipeline plan

DWG-No.14. Distribution pipeline/Zone 1
DWG-No.15. Distribution pipeline/Zone 5,6,7and 8

(2) Ermera

1) Ermera

DWG-No.16. Ermera general plan

2) Hatulegas Raitara

DWG-No.17. Intake station general plan/Hatulegastara
DWG-No.18. Raw water main plan and profile
DWG-No.19. Water treatment plant general plan/Hatulegas Raitara
DWG-No.20. Water treatment plant flow sheet/New WTP
DWG-No.21. Water purification unit/New WTP
DWG-No.22. Single line diagram/New WTP

3) Ermera Distribution Pipeline

DWG-No.23. Distribution pipeline plan

(3) Same

1) Same

DWG-No.24. Same general plan

2) Merbati

DWG-No.25. Intake station general plan/Merbati
DWG-No.26. Distribution station general plan/Merbati

3) Darelau

DWG-No.27. Intake station general plan/Darelau
DWG-No.28. Raw water main plan and profile
DWG-No.29. Distribution station general plan/Holalua

4) Kotalala

DWG-No.30. Raw water main plan and profile

5) Same Distribution Pipeline

DWG-No.31. Distribution pipeline plan

(4) Ainaro

1) Ainaro

DWG-No.32. Ainaro general plan
DWG-No.33. Intake station general plan/Sarai
DWG-No.34. Raw water main plan and profile
DWG-No.35. Water treatment plant general plan/Nugupo WTP
DWG-No.36. Water treatment plant flow sheet/Nugupo WTP
DWG-No.37. Single line diagram/Nugupo WTP

2) Ainaro Distribution Pipeline

DWG-No.38. Distribution pipeline plan/Ainaro

(5) Maubisse

1) Maubisse

DWG-No.39. Maubisse general plan

2) Bucana

DWG-No.40. Intake station general plan/Bucana
DWG-No.41. Raw water main plan and profile

3) Raikuak Ulun

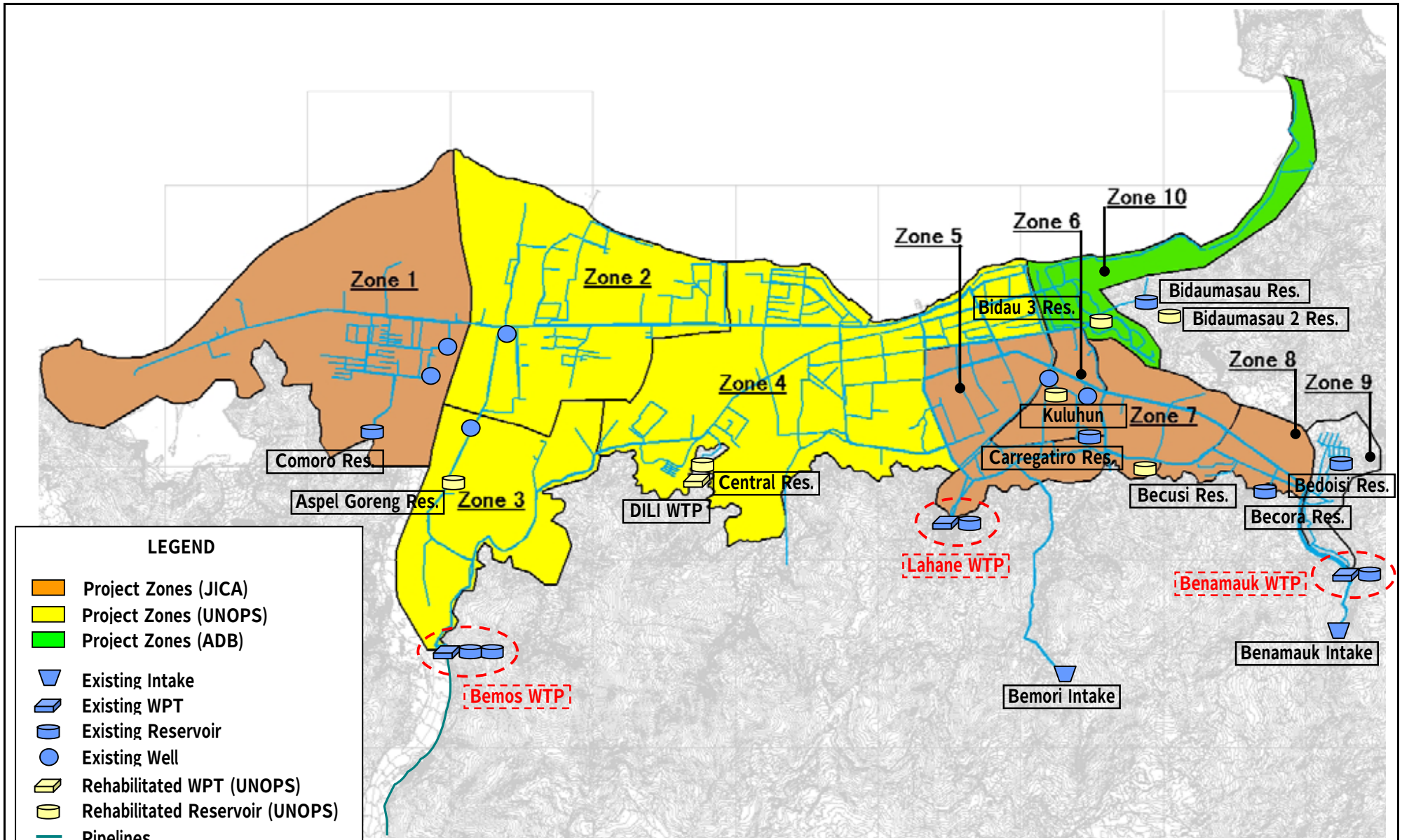
DWG-No.42. Intake station general plan/ Raikuak Ulun
DWG-No.43. Raw water main plan and profile
DWG-No.44. Distribution station general plan/Leputo

4) Erulu

DWG-No.45. Intake station general plan/Erulu
DWG-No.46. Raw water main plan and profile

5) Maubisse

DWG-No.47. Distribution pipeline plan

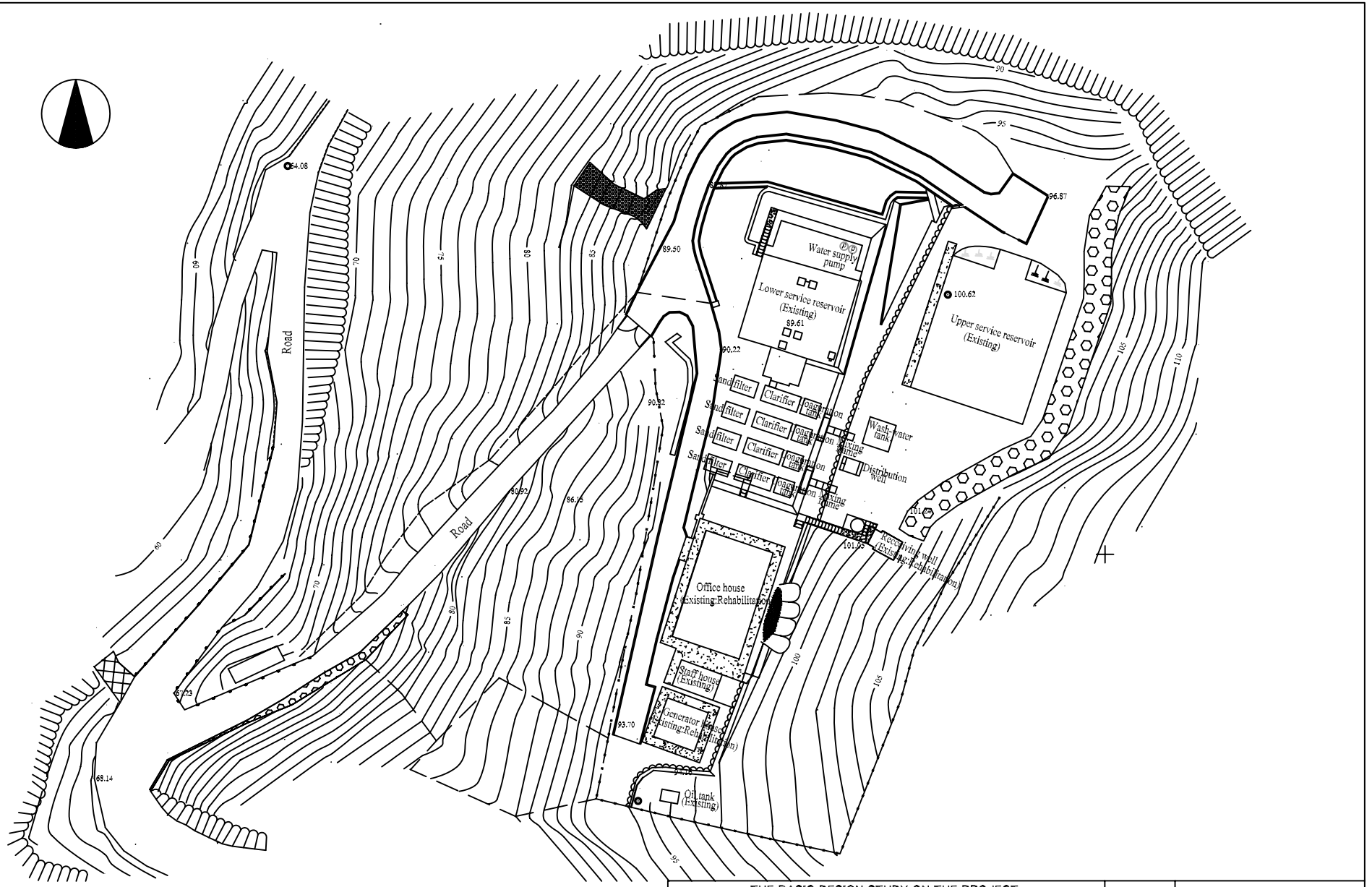


JICA

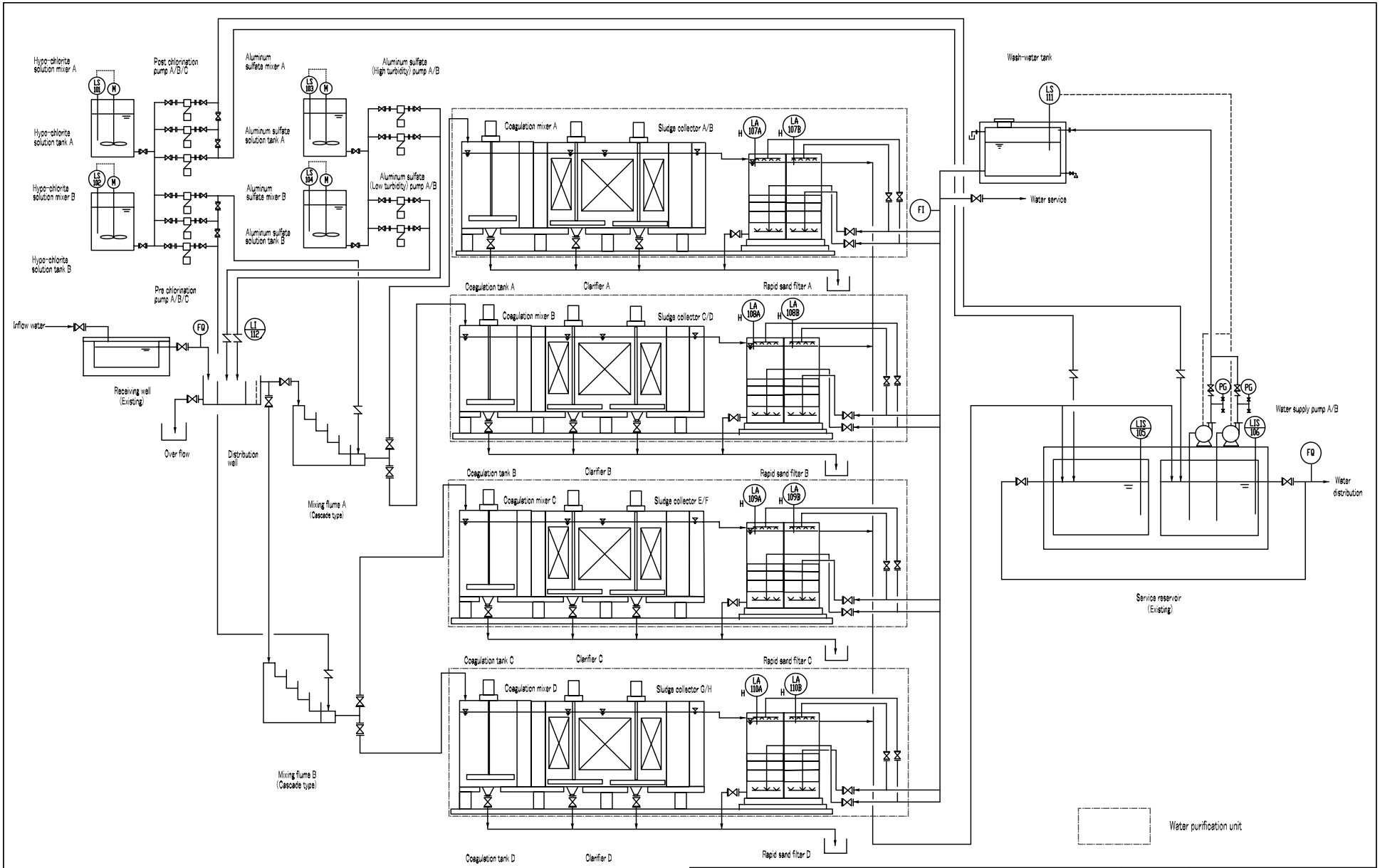
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN DILI AND DISTRICTS IN THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

Dili general plan

DWG No.1

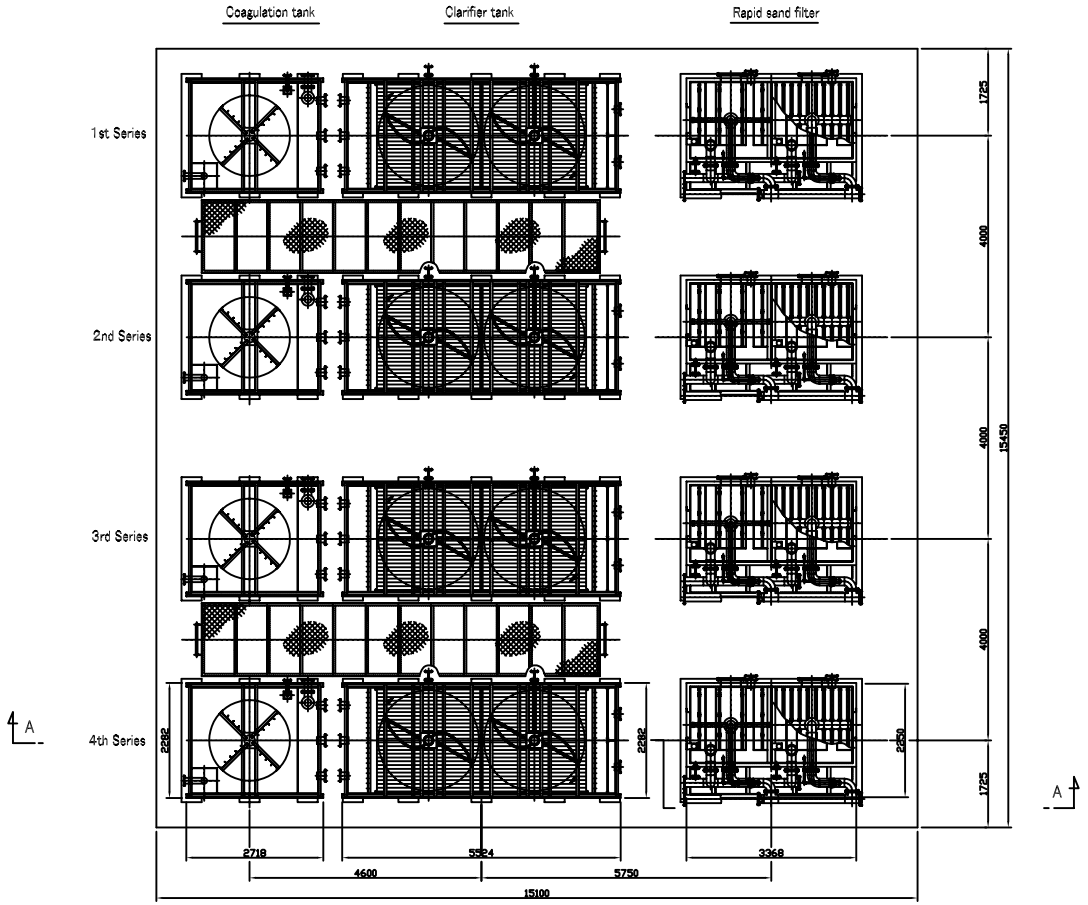


THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN DILI AND DISTRICTS IN THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE	DWG No.	Water treatment plant general plan / Bemos WTP / Dili
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	2	

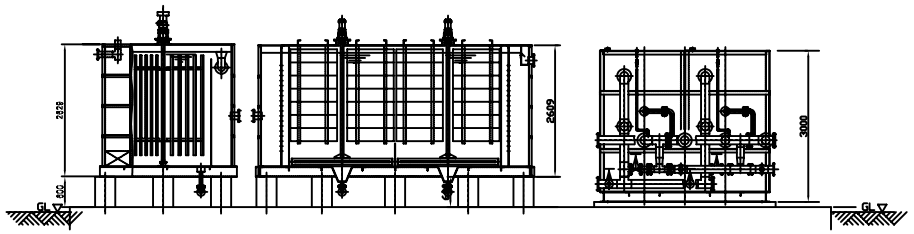


THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN DILI AND DISTRICTS IN THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE	DWG No.	Water treatment plant flow sheet / Bemos WTP / Dili
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	3	

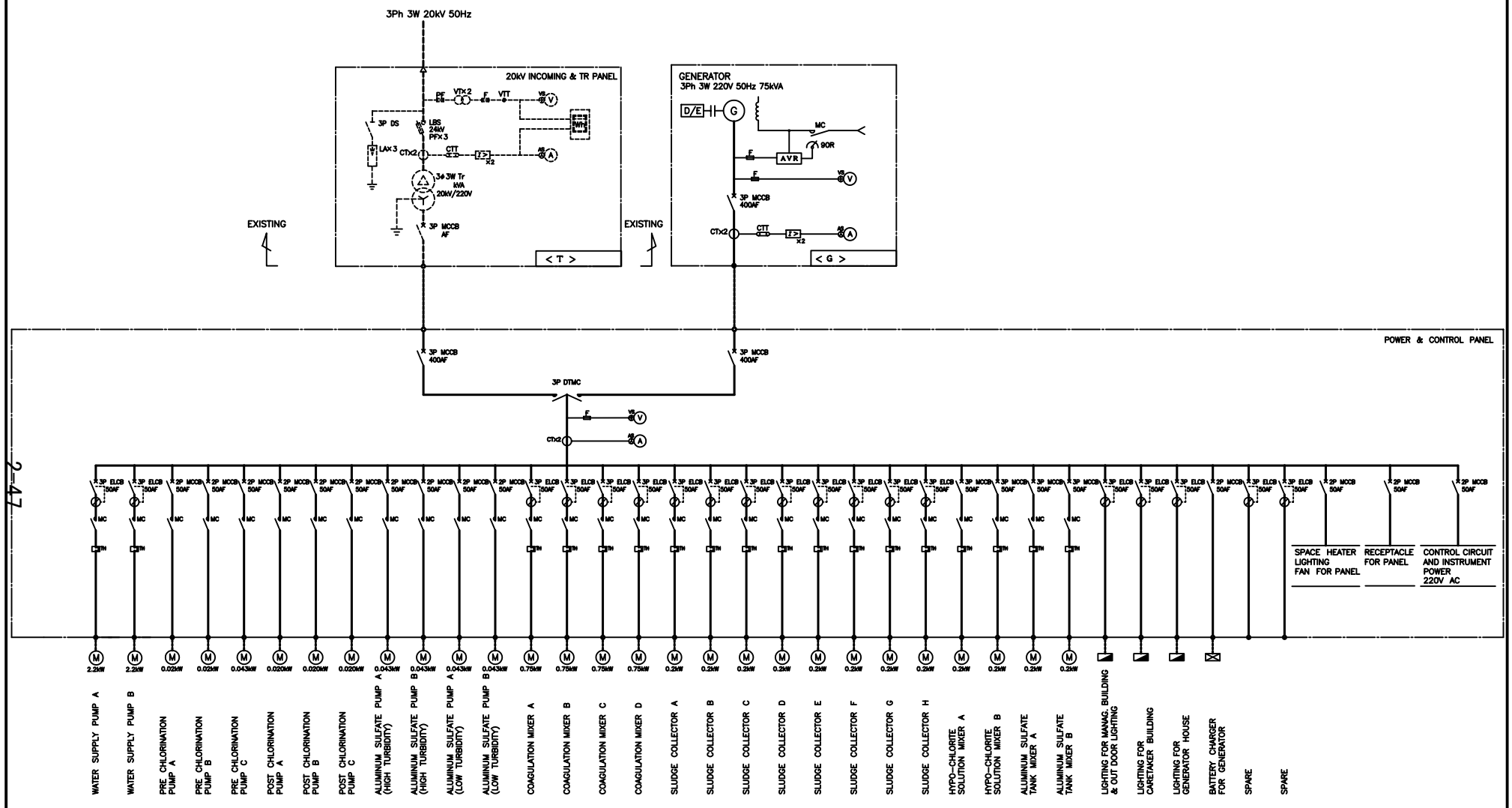
PLAN



SECTION A-A



THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN DILI AND DISTRICTS IN THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE	DWG No.	Water purification unit / Bemos WTP / Dili
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	4	



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THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN DILI AND DISTRICTS IN THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE	DWG No.	Single line diagram / Bemos WTP / Dili
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	5	