GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

STATE OF ERITREA
MINISTRY OF LAND, WATER AND ENVIRONMENT

STUDY ON GROUNDWATER DEVELOPMENT AND WATER SUPPLY FOR SEVEN TOWNS IN SOUTHERN REGION OF ERITREA

FINAL REPORT

MENDEFERA

VOLUME I MAIN REPORT

JANUARY 1999

SANYU CONSULTANTS INC.

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PREFACE

In response to the request from the Government of the State of Eritrea, the Government of Japan decided to conduct the Study on the Groundwater Development and Water Supply for Seven Towns in Southern Region of Eritrea and entrusted the study to Japan International Cooperation Agency (JICA).

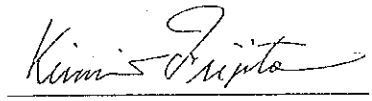
JICA sent to Eritrea a study team headed by Mr. Takao KUME, SANYU CONSULTANTS INC., from August 1997 to March 1998.

The team held discussions with the officials concerned of the Government of Eritrea, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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 the State of Eritrea for their close cooperation extended to the team.

January, 1999



Kimio Fujita
President
Japan International Cooperation Agency

January 12, 1999

Mr. Kimio Fujita
President
Japan International Cooperation Agency (JICA)
Tokyo

Letter of Transmittal

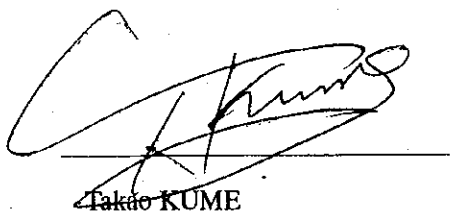
Dear Sir,

We are pleased to submit to you our Final Report on the Study on Groundwater Development and Water Supply for Seven Towns in Southern Region of Eritrea. This Report incorporates the findings and the development plans formulated, as well as advice and suggestions of the authorities concerned of your Agency and the Government of Japan.

The objectives of the Study are evaluation of water resources potential in focusing groundwater, formulation of development plans for water supply and sanitation, feasibility study for the water supply project, and technology transfer. Based on the Study, groundwater can meet the water demand of all target towns up to the Year 2005. Most towns will be sufficiently supplied with water from the test well(s) under the Study, or together with the existing wells. Facilities such as boreholes, well pumps, transmission/distribution pipelines, reservoir, booster pumps, pumping pits, control houses, service facilities, public latrines will be required for the Project. Although there are some conditions, the project is feasible and to promote the project was recommended.

We wish to take this opportunity to express our sincere gratitude to your Agency and the Ministry of Foreign Affairs of the Government of Japan. We also wish to express our deep gratitude to the Ministry of Land, Water and Environment and the Ministry of Local Government of the Government of Eritrea for the close cooperation and assistance extended to us during our studies.

Very truly yours,



Takao KUME
Leader of the Study Team

List of Reports

This volume is part of the following reports:

Executive Summary

Debarwa	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Mendefera	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Adiquala	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Dekemhare	Volume I	Main Report
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	Volume III	Drawings
Segeneiti	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Adi Keyih	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings
Senafe	Volume I	Main Report
	Volume II	Appendix
	Volume III	Drawings

Operation and Maintenance Manual for Water Supply Facility

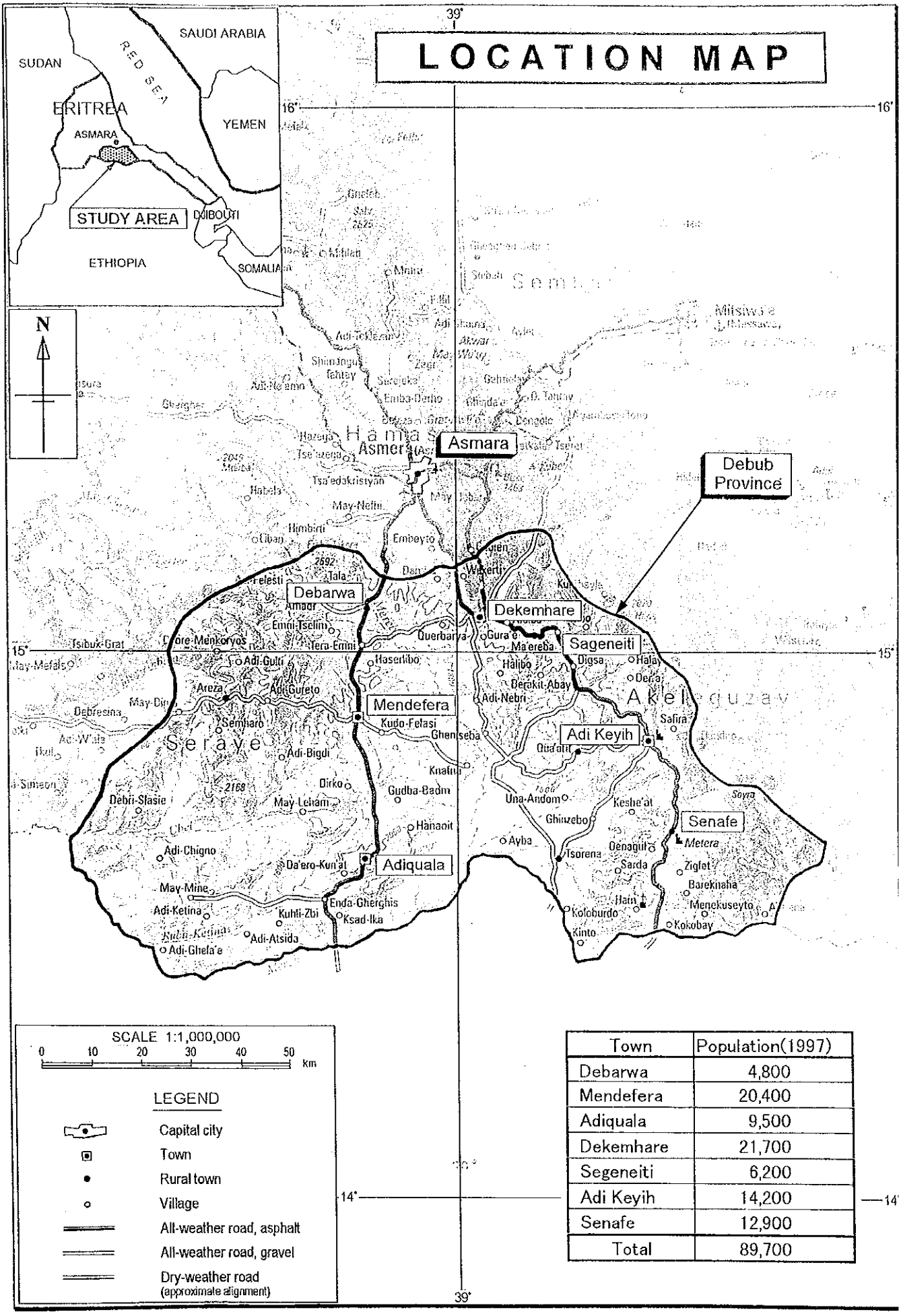
Hygiene Education Manual

Training Manual for Staff of WSA

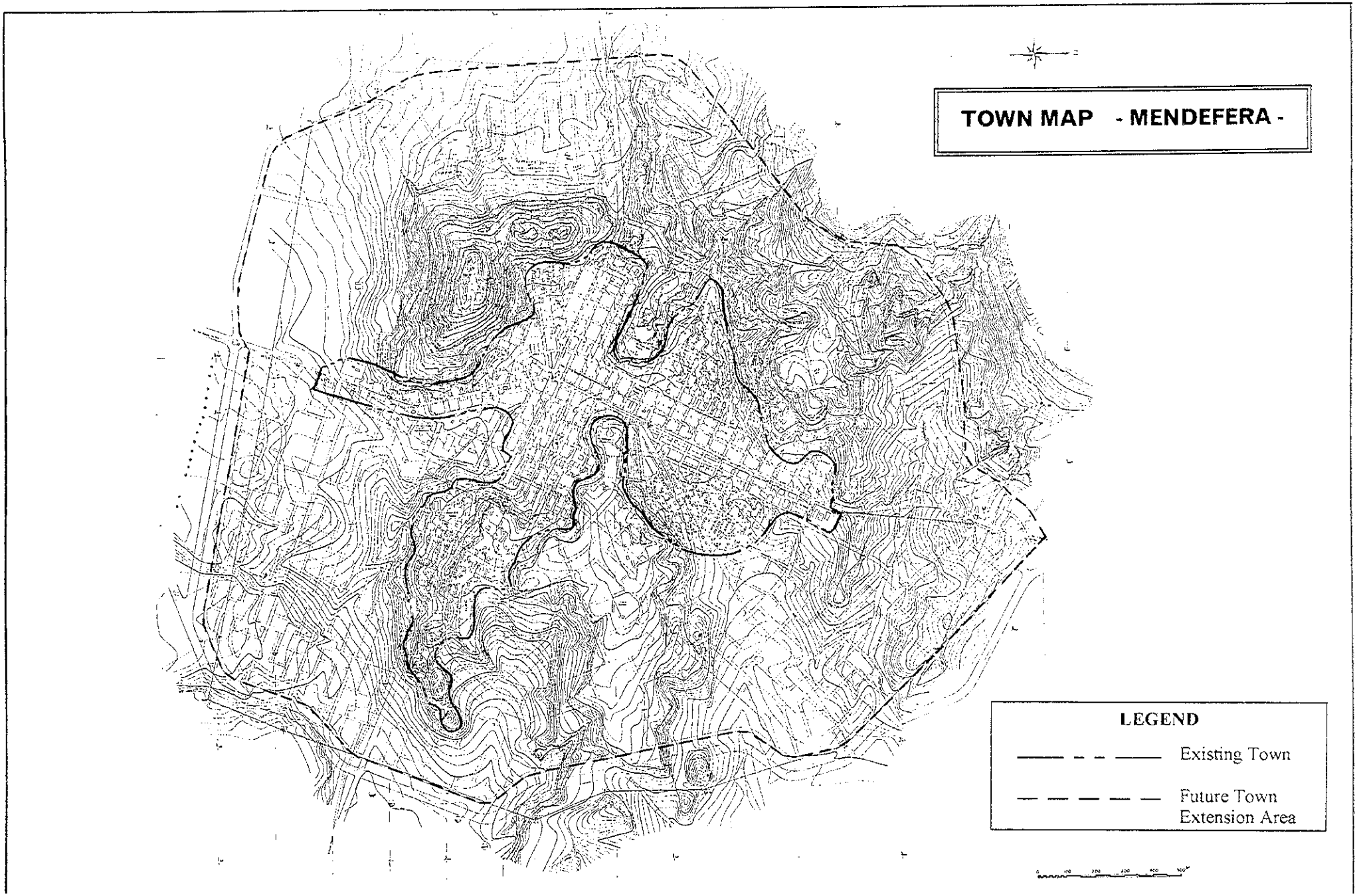
Exchange Rate

1 US Dollar	=	7.0 Nakfa
1 US Dollar	=	135.0 Japanese Yen
1 Nakfa	=	19.3 Japanese Yen

March 1998



Town	Population(1997)
Debarwa	4,800
Mendefera	20,400
Adiquala	9,500
Dekemhare	21,700
Segeneiti	6,200
Adi Keyih	14,200
Senafe	12,900
Total	89,700


TOWN MAP - MENDEFERA -
LEGEND
Existing Town
Future Town Extension Area

SUMMARY

1 INTRODUCTION

Eritrea gained its independence in 1991, after 30 years of debilitating war. This war has hampered the country's development in all aspects. Since independence, many donor countries/organizations have extended assistance to Eritrea in the field of water supply and sanitation. Japan also has come forward with the offer of technical assistance, in response to the request of the Eritrean Government.

The Scope of Works on for this project was formulated and signed by/between the Preparatory Study Team sent by Japan International Cooperation Agency (JICA) and the Ministry of Mines, Energy and Water Resources (at the time), the Government of Eritrea, in April 1997. In accordance with the Scope of Works, JICA sent the Study Team consisting of twelve members headed by Mr. KUME Takao. The counterpart agency of Eritrea is the Water Resources Department (WRD) under the new Ministry of Land, Water and Environment (MoLWE).

The objectives of the Study are:

(1) to evaluate potential of water resources, focusing on groundwater,
(2) to formulate a development plan for water supply and sanitation,
(3) to conduct a feasibility study for the water supply project, and
(4) to pursue technology transfer to counterpart personnel in the course of the Study.

The Study covers the following 7 towns in the Debub Region:

Debarwa, Mendefera, Adiquala, Dekemhare, Segeneiti, Adi Keyih, and Senafe.

Through around seven months of field works, since 27 August 1997, Inception Reports I/II, Progress Report, and Interim Report were prepared and submitted to WRD. A Draft Final Report was prepared and sent to WRD at the early November, through five months of domestic works. And the Report was finalized and submitted to WRD at the beginning of January 1999, in response to the comments by WRD.

2 OVERVIEW OF ERITREA

Eritrea covers an area of 124,320 km^2, and is bordered by the Red Sea to the north and northeast, Sudan to the north and northwest, Ethiopia to the south and southwest and Djibouti on the far south-eastern corner. Despite being a relatively small country, it is divided into three major geographic and climatic regions: the Central Highlands, the Western Lowlands and the Easter Lowlands running parallel to the Red Sea.

Historically, Eritrea was occupied by successive colonial rulers first by the Turks, followed by the Italians and British and finally by the Ethiopians. It emerged as a sovereign state in 1991, after three decades of bitter struggle with the Ethiopians. Following an internationally-supervised national referendum, Eritrea proclaimed its de jure independence in May 1993.

In Eritrea, no census has been carried to date. The estimates put the country's population at around 3.5

million, and they are culturally and linguistically diverse, consisting of nine ethnic groups namely: Afar, Bilen, Hedarib, Kunama, Nara, Rashaida, Saho, Tigrigna and Tigre.

The Government of the State of Eritrea is made up of 17 ministries, most of whom are represented at the regions, and six regional administrations. Ministries at the center are responsible for policy matters and for developing guidelines/procedures for program development and implementation, while the Regional (called Zoba) Administration is vested with the responsibility of program or project implementation.

3 THE STUDY AREA: THE DEBUB REGION

3.1 Natural Condition

The Study targets of seven towns are located in the Debub Region, one of six regions in Eritrea with about 8,350 km^2 of total area. The region shares the southern half of the central highlands, characterized by flat or gently undulating plateaus surrounded by escarpments and deeply dissected valleys.

Although the area is located in rather low latitudes, the mean annual maximum temperature is around 27°C and the mean annual minimum temperature is as low as about 4°C, because of the high altitude. Average annual precipitation in the region varies from 393 to 696 mm, and the highest rainfall occurs during July and August.

Hydrologically, the Mereb and its tributaries govern the region but all of them are ephemeral. Along these streams, many micro-dams were constructed mainly for agricultural, livestock, and/or artificial recharge purposes, however, surface-water scarcity always exists in the region.

Geological environment of Eritrea is made up of Precambrian basement rocks. The basement in Eritrea is divided into several segments and the region is located in part of the eastern segment, the "Nakfa Terrain". The terrain is made up of metavolcanic rocks conformably overlain by a metasedimentary sequence such as schist or phyllites, and the sequence is cut in places by granites. Mesozoic sedimentary rocks, called as Adigrat Sandstone are exposed in the southeastern part of the region, and plateau-forming Tertiary basalts, called as Trap Basalt, are exposed over a wide range in the western part of the area. Alluvial sediments cover areas along the Mereb and its tributaries, especially in the Hazema Plain in the central of the region.

In contrast to surface water, the groundwater of the region is more abundant. It occurs in all geological formations though, useful quantities and qualities may not be extensive. The main hydrogeologic units are the followings;

1) Basement rocks, metamorphic and intrusive rocks with localized low-moderate permeability along fractured and weathered zones,
2) Volcanic rocks with fracture and fissure permeability, and
3) Unconsolidated sediments with various inter-granular permeability.

3.2 Socio-economic Condition

There are 11 sub-regions, called "Neus Zoba", with 212 village administrations at the lowest

administrative unit called "Kebabi" under them. These in turn have 884 villages under them. Total population of the Debub Region is around 702,500 with a total of 89,660 in the target 7 towns, as of 1997. The population in all of the towns is increasing rapidly due to migration from the surrounding villages and due to influx of returnees.

It is reported that around 65% of the total population of Eritrea is concentrated in the central highlands. As indicated by the name, the "Christian Highland", most of inhabitants in the central highlands, including the Debub Region, are overwhelmingly Christian, followed by a few Moslems. As an ethnic group, the Tigrigna is the majority, followed by the Saho and Tigre groups.

Most of the inhabitants of this region live in the rural area and derive their livelihood from agriculture. Aside from the civil servants in government institutions, urban people are mostly petty-traders, daily workers and small shop owners. Some towns like Dekemhare and Debarwa are rapidly growing into important industrial zones. The area is also reputed to be rich in minerals and substantial mining exploration activity is taking place.

3.3 Water Supply and Sanitation

For the water sector, the Debub Region has analogy with the whole country. Most of water and sanitation facilities existing in the region date back to the Italian period. They were concentrated in urban areas and designed mainly to serve colonial administrations and export-oriented cash-crop production. Despite the growing population, very little improvements have been done to them during the British and Ethiopian occupations.

Misrule and neglect caused irreparable damage to water and other infrastructure. Now a day, access to safe drinking water is very low. UNICEF sources indicate that only 7% in rural areas and 44% in urban areas are estimated to have safe water supply. This, coupled with recurrent drought, caused wells and other water sources to dry up resulting in inconvenience, ill-health and morbidity of the society, especially that of children and woman. Shortage of pipe-borne water forces people to use water directly taken from the rivers, ponds, pools and open dug-wells. This state of affairs give rise to a high incidence of water-borne or related diseases.

Household access to sanitation facilities is also inadequate. According to UNICEF, it is at less than 1% in rural areas and 48% in urban areas. In the absence of latrines, defecation in the open becomes the norm. However, existing facilities are reportedly clean, odorless and well-maintained.

3.4 Environmental Situation

Eritrea has inherited a degraded natural environment, due to colonization and 30 years of war. During this time, the natural forests have been reduced from an estimated 30% of the total land area to a little more than 2%. This was mainly due to logging for timber, firewood, charcoal and poles, and clearing for agricultural land, uncontrolled grazing, worsening climate and extensive soil erosion.

The vegetation includes Acacia tortilis, Acacia seyal and Acacia abyssinica on rocky and steep sites. Along the rivers, Faidherbia albida, Balanites aegyptiaca and Ziziphusphus spina-christi form the limited

woodland forest. Historical records indicate that Eritrea was rich in wildlife. However, the present wildlife condition is little known. According to the Ministry of Agriculture, the main species of wildlife in the region that may be present are leopards, baboons, foxes, jackals, squirrels and monkeys. It was also reported the numbers of variety of birds are increasing year by year.

4 CURRENT SITUATION OF MENDEFERA

4.1 Natural Condition

Mendefera situates on the corridor-like narrow plateau, so-called Mendefera plateau. Both sides of the corridor are quite steep cliffs dissected by the Mereb, but the ground surface on the plateau is very gently undulated, scattered by several remaining hills.

The plateau-forming Tertiary basalts are exposed over a wide range in this area. Precambrian basement exposes only in the valley bottoms on both sides of the plateau. Because of the situation, a major aquifer in the area is to be a fissure aquifer type of basaltic volcanics, associated with aquiclude consisted of fresh basalts.

There is a first class meteorological station (MOA) in Mendefera. Average monthly temperature varies from 15 to 21℃. Evaporation varies between 5 and 7.5 mm/day, and annual rainfall is about 612mm. Most of them occur in the months of July and August.

There are some streams running in and around the town such as Mai Takhala, Mai Aron, and Mai Chiare, but none of them has a constant flow. Mainly for agricultural and livestock purposes there are 14 micro dams. Major dams in this sub-region are Kilowlie, Zeban Una, Dander-Ghenet, Mai Aron and Adi Mongoti. However, the dams are suffering severely from sedimentation problem.

In this area, a series of hydrogeological and geophysical surveys were conducted. Based on the results of surveys, a well inventory and hydrogeological map on the area were constructed. Then, two Test Wells (MEN-1 and 2) and two Observation Wells (MEN-3 and 4) were drilled at Mai Takhala and Mai Chiare basins, respectively. After completion of drilling and pumping tests, an automatic water level recorder has been installed in one Test Well (MEN-2) and two Observation Wells. Yields of those well are 2.0and 0.2 lit/sec for Test Wells, and 0.1 and 0.8 lit/sec for Observation Wells. Water samples taken from dams and some dug-wells are contaminated by faecal coliform bacteria but the water in boreholes are enough clean and safe.

4.2 Socio-economic, Water Supply and Sanitation Condition

(1) Socio-economic condition

The Italians established Mendefera for their military garrison in the early 1930's. Presently, because of its central location, it has become the capital city of Debub Region.

The population figure for Mendefera is about 20,370 comprising of 47% males and 53% females. In term of ethnic composition, around 98% are of Tigrigna while that of Soho is 1% and few Tigre ethnic group. An estimated 74% of the residents are Christianity while Moslema account for 23%.

Mendefera has the largest concentration of students and schools. There are 22 schools (3 kindergartens, 14 primary, 4 junior and 1 senior secondary school) enrolling a total of 15,120 students with 123 teachers.

(2) Water supply condition

The main modes of water services of Mendefera are private connection, communal water points and water tanker. Currently, there are 650 of house connection, 5 communal water points, and a water tanker. The present daily per capita consumption by house connection, yard connection, and communal water point are about 24, 15 and 10 l/c/d, while by water tanker is more than 16 liters. Proportion of water supply by pipes and by water vender is estimated nearly 44% and 50% respectively.

Water of two main sources are transmitted to the town. One is surface water from a dam (Kilowlie dam) located in the northern part of and approximately 4.2 km far from the municipality, and the other is underground water from two boreholes located at a western part of and from 1.3 to 2.0 km far from the municipality.

(3) Sanitary condition

Mendefera town administration provides refuse truck. However, the service coverage is only to accessible areas which is 85% of the town. Each house gets two to three days service a week, and refuse is collected directly from the houses.

There is an Italian constructed sewerage system, combined for the sewage and storm water. The town administration of Mendefera is maintaining and expanding the system. Open sewers are covered with concrete slabs, and an additional 400 meters length of pipeline has been installed.

Four public latrines exist but due to problems in operation and maintenance only two are functional. The Town administration has plan to construct additional public latrines in Mai Chenawi which is a densely populated area and in the new market.

(4) Financial Condition of WSS

Water tariffs per cubic meter are 1.5-2 Nfa for house connection users, 5 Nfa for communal water point users, 6.25 Nfa for users of water from the water tanker and 7 Nfa for users of water from water vendors. Numbers of water supply facilities are 650 for house connections, 5 for communal water points and 1 for water tanker.

Under the conditions, WSS of Mendefera earned 202,009 Nfa from Jan. to Aug. in 1997, while the expenditures incurred amounted to 179,723 Nfa. It means profit ratio of 11.0%. This is a good financial performance. The number of workers is 17. Income per worker comes to 18,978 Nfa, which is on the high side among the 7 towns.

5 STRATEGY ON PLANNING

5.1 Basic Strategy

(1) Target year

The project for water resource development, water supply and sanitation improvement is to be formulated as a phased plan to the year 2015. A preliminary assumption would be that the project would comprise 3 phases, with phase horizons of 2005, 2010, and 2015, respectively. With regard to the first phase (priority project with a target date of around 2005) of the project, facility design and costing would be to the feasibility study level.

(2) Water resources development plan

The water resources development plan would focus primarily on groundwater and underflow. This would include studies on shallow groundwater and deep groundwater.

(3) Water use

Water supply would give priority to domestic water, however, industrial water use would also be considered in the case of towns such as Debarwa and Dekemhare.

(4) Water supply and Sanitation improvement plans

Water supply and sanitation plan would comprise: a) facility plan with appropriate attention to natural and socio-economic condition, b) project cost estimation, c) O&M plan for sustainability of facilities, d) institutional strengthening plan, e) examination of the financial feasibility of the project, and f) project implementation schedule.

(5) Sustainability of the project

Water supply project for rural towns lies with the municipal government of the concerned town with the aim to achieve budgetary independence. Specific recommendations on an operating structure for water supply systems which is sustainable under independent budget will be done.

5.2 Population Projection

For the planning purposes, the seven towns are categorized into two, high growth rate of categoriy-1 and relatively low growth rate of category-2.

Based on the basic population in 1997, informed by the Ministry of Local Government and the growth rate mentioned above, the population in the each target year are to be projected.

5.3 Water Demand Projection

(1) Water consumption

From the consideration on the current situation, the target towns are categorized into three classes for future water consumption growth rate. Highly facilitated towns are in category-1, relatively low facilitated towns are in category-3, and category-2 for the medium. Projected water consumption, at each town and target years are shown in Table 5.3.1.

(2) Domestic water demand

Service populations of each target year are calculated based on the projected population and water supplied area. And, the domestic water consumption at each target year are estimated as Table 5.3.2.

Table 5.3.2 Domestic Water Consumption (l/c/d)

Name of the Town	In 2005	In 2010	In 2015
Debarwa	18.8	19.9	22.6
Mendefera	23.1	29.4	34.8
Adiquala	20.5	23.6	30.7
Dekemhare	23.1	29.4	34.8
Segeneiti	18.8	19.9	22.6
Adi Keyih	23.1	29.4	34.8
Senafe	20.5	23.6	30.7

(3) Other water consumption

Other water consumption is considered base on the field investigation and design criteria of the similar countries.

School	5 l/pupil
Hospital, Clinic	100 l/bed
Hotel, Bar, Tea shop, Restaurant	210 l/shop
Church, Mosque	5 l/visitor
Office	5 l/person
Factory	1,000 l/factory
Light industry	5,500 l/ha
Other industry	15,000 l/ha

(4) Physical loss

Physical losses caused by water leakage from pipes, reservoir and taps, illicit connections, etc., are put at 15 %, assuming that the new facilities will be constructed in the target year.

(5) Maximum daily and peak hour demand

Max. daily water demand = C1 x Average daily water demand

Peak hour water demand = C2 x Max. daily water demand

Coefficient of C1 = 1.2

Coefficient of C2 = 1.5

Table 5.3.1 Water Consumption

Name of town	Present water consumption pattern			Expected water demand											
	Mode of supply	Consumption l/c/d	Consumers % of household 1)	Year 2000-2005				Year 2005-2010				Year 2010-2015			
				Consumers (% of hld)		Ave. Consumption (l/c/d)		Consumers (% of hld)		Ave. Consumption (l/c/d)		Consumers (% of hld)		Ave. Consumption (l/c/d)	
				2000	2005	2000	2005	2005	2010	2005	2010	2010	2015	2010	2015
Debarwa	House connection	25	1. 25	15	17	25	28	17	19	28	30	19	22	30	35
	Yard connection	-	-	20	22	20	22	22	24	22	24	24	27	24	27
	Communal water point	8. 56	41. 7	65	61	15	15	61	56	15	15	56	51	15	15
	Water tanker	15. 61	27. 8												
Mendefera	House connection	24. 11	10. 94	25	29	30	35	29	34	35	40	34	39	40	47
	Yard connection	14. 95	6. 56	30	33	20	22	33	66	22	24	66	61	24	27
	Communal water point	10. 13	29. 2	45	38	15	15	38	0	15	15	0	0	15	15
	Water tanker	16. 39	53. 3												
Adiquala	House connection	20. 45	13. 86	20	23	25	29	23	27	29	34	27	31	34	39
	Yard connection	12. 07	6. 14	30	33	20	22	33	37	22	24	37	69	24	27
	Communal water point	14. 31	63. 6	50	44	15	15	44	37	15	15	37	0	15	15
	Water tanker	-	-												
Dekemhare	House connection	25. 59	5. 67	25	29	30	35	29	34	35	40	34	39	40	47
	Yard connection	15. 67	8. 67	30	33	20	22	33	66	22	24	66	61	24	27
	Communal water point	-	-	45	38	15	15	38	0	15	15	0	0	15	15
	Water tanker	16. 51	78. 1												
Segeneiti	House connection	11. 66	3	15	17	25	28	17	19	28	30	19	22	30	35
	Yard connection	5. 94	5	20	22	20	22	22	24	22	24	24	27	24	27
	Communal water point	8. 79	90. 5	65	61	15	15	61	56	15	15	56	51	15	15
	Water tanker	5. 59	-												
Adi Keyih	House connection	28. 73	4. 95	25	29	30	35	29	34	35	40	34	39	40	47
	Yard connection	12. 64	10. 64	30	33	20	22	33	66	22	24	66	61	24	27
	Communal water point	16. 45	13. 94	45	38	15	15	38	0	15	15	0	0	15	15
	Water tanker	-	78. 86												
Senafe	House connection	10. 3	7. 78	20	23	25	29	23	27	29	34	27	31	34	39
	Yard connection	6. 8	6. 62	30	33	20	22	33	37	22	24	37	69	24	27
	Communal water point	8. 04	83. 8	50	44	15	15	44	37	15	15	37	0	15	15
	Water tanker	16. 49	1. 82												

1): The sums aren't necessarily 100% because of multiple answers and neglected other sources.

(6) Water Demand Projection

Average water demand for each target year is assumed from above mentioned factors and water supplied areas divided into three phase to cover the whole towns.

5.4 Water Supply System

(1) Water supply system

The project plan for the water supply system employs the same system with the existing one, as a rule. Water sources are to be groundwater because of economic and quality reasons. New water sources and/or the existing water sources involved are connected to the reservoir by pipeline. Water is supplied by pump from water source(s) to a reservoir, and distributed by gravity from the reservoir to water taps.

(2) Water supply area

All of the target towns have a master plan for town planning, demarcating future extension area. Based on the current social conditions and the master plan, taking the topographical feature into the consideration, the administrative town area shall be divided into three zones: developed by the year of 2005, 2010, and 2015, respectively.

(3) Facility plan

Existing water supply facilities are mostly replaced under the project because of obsolete materials or insufficient capacity. However, the existing wells counted as the water sources in the project will be used continuously, and only the well pumps will be replaced to meet the demand. Reservoirs having enough capacity will be used after rehabilitation.

The following major water supply facilities are planned under the project.

- Intake facility: borehole, dug well, well pump,
- Transmission facility: transmission pipeline, booster pump, pump pit,
- Distribution facility: reservoir, distribution pipeline,
- Water service facility: individual connection, communal water point,
- Electricity facility: power supply, generator,
- Others: pump house, valves, flow meter.

5.5 Sanitation Improvement

The first step is getting a clear picture of the current sanitation and health condition of the town with regard to facilities and practices. Following, the collected information is to be analyzed: needs and objectives, the specific targets and the specific target groups are identified. The potential developments are foreseen, and future plans for improved sanitation facilities program are to be formulated for the three consecutive phases. Management and educational plans for effective and sustainable improved sanitation program shall be proposed.

5.6 Financial and Economic Analysis

(1) Water price and revenue

Water price is determined by category of customers and target years, based on:

- Average monthly household income,
- Distribution of household income by category of customers,
- Willingness to pay for water,
- The World Bank recommendation (4% of household income),
- Tariff system by purpose and mode of supply,
- Progressive tariff inclined price by consuming volume,
- Future growth of household income, and
- Financial sustainability of water supply facilities to be constructed.

Revenue from water charges will be projected from:

- Number of households, by the year and by the category of customers,
- Annual water consumption per household, by the year and by the category of customers,
- Water price, by the year and by the category of customers, and
- Bill collection rate.

Some other revenue sources, such as technical service charge, meter rent, and so on, shall also be considered.

(2) Financial analysis

Basic factors for financial analysis are as follows:

- Project life: 20 years for F/S projects, 30 years for M/P projects
- Discount rate: 10%
- Financing conditions for the initial cost: subsidy
- Cost recovery principle: O&M cost and replacement cost of equipment/facilities to be borne by the beneficiaries
- Durable life of equipment and facilities:
  - (i) Pumps and other electro-mechanical equipment: 15 years
  - (ii) Facilities including boreholes, reservoirs, pipes, communal water points, pumping stations and treatment plants: 50 years
- Corporate income tax: free

Financial analysis will take two forms: projection of financial statements and estimation of financial criteria. Income statement, fund statement and balance sheet will be projected annually. At the same time, major financial indicators such as cost revenue ratio, net profit ratio, the ratio of working capital to revenues, and the ratio of net profits to total assets, will be calculated based on those statements. Using cost benefit streams, financial criteria shall be estimated.

Financial feasibility of the project will be evaluated from the above statements and indicators.

(3) Economic analysis

Based on the estimation of project benefit and economic cost consideration, economic analysis of the Project will be performed for each town. Through the economic analysis, the economic parameters such

as NPV, B/C and EIRR will be calculated.

Major benefits accruing from the implementation of the Project are the reduction of water related diseases and general improvement of life-level of the inhabitant on one hand, and the saving of water fetching time on the other. Such benefits can be considered to be reflected into the price of water.

6 DEVELOPMENT PROGRAM

Development programs are formulated, based on the strategy on planning mentioned before, as a phased plan to the year 2015, with target years of 2005, 2010, and 2015.

6.1 Population and Water Demand Projection

(1) Population projection

Population in the target years are projected as Table 6.1.1

Table 6.1.1. Summary of Total Population Projection for the Seven Towns

Year	Debarwa	Mendefera	Adiquala	Dekemhare	Segeneiti	Adi Keyih	Senafe	Total
1997	4,831	20,371	9,488	21,675	6,146	14,215	12,934	89,660
2005	9,490	32,450	15,430	34,370	10,680	22,150	20,330	144,900
2010	13,020	41,630	19,320	44,030	13,680	27,310	25,140	184,130
2015	17,230	52,830	23,700	55,880	17,000	33,180	30,610	230,480

(2) Service area and water demand

Current town area of Mendefera is consisted of two sub zones (western and eastern) with 3, 4 blocks and three villages (Adi Bari, Adi Wegri, and Adi Hare). Future town extension area is surrounding the two zones and Adi Bari. Service areas to be covered by the project are planned as follows:

Target year 2005: Western zone and eastern zone,
Target year 2010: Adi Bari and eastern extension area,
Target year 2015: Western extension area, Adi Wegri and Adi Hare.

Water demands are estimated mainly from the projected population of the water service area. Thus, the water demands in each target year are estimated as follows:

Table 6.1.2 Water Demand

Target Year	2005	2010	2015
Supplied Population	19,750	33,270	52,880
Service ratio (%)	60.9	79.9	100.0
Average Water Consumption (l/c/d)	42.2	57.2	59.3
Average Daily Demand (m^3/d)	834	1,902	3,134
Max daily demand (m^3/d)	1,001	2,283	3,761
Peak hour demand (m^3/hour)	62.6	142.7	235.1

6.2 Water Resources Development

(1) Potential of water resources

An origin of water in a certain basin is basically rainfall. Major part of rainwater is lost by evaporation/transpiration and flowing out through drainage. Only the last remaining part can percolate into a ground recharging groundwater.

a) Rainfall – (effective) Evapotranspiration = Effective rain (mm)
b) Effective rain x catchment area = Total water source (m^3)
c) Total water source – Surface runoff = Groundwater recharge (m^3)

Full development of the yearly recharging volume is, however, almost impossible because of natural groundwater flow and biased rains in particular in the monsoon area. Although it depends upon the topographic and aquifer conditions in the site, the groundwater development potential is estimated from 10 to 50% of the yearly recharging volume.

Annual rainfall in average is 611.5 mm/a, and groundwater recharging amount is estimated as 69.0 mm/a. The top of Mendefera corridor is occupied by only one groundwater basin with around 165 km^2 of area. However, the main aquifer of the basin is fissure type in basalt, which shows fair yield sometime but hardly continuous. Thus, the groundwater development potential in the basin is estimated as not promising as around 2600 m^3/day.

(2) Groundwater resources development plan

Total yield of current water sources (BH-4 and 5) and Test Well (MEN-1) is only 725.7 m^3/day, while the water demand in 2005 is 1001 m^3/day, thus, two other wells shall be drilled to cover the demand of 2005. The projected water demand in 2010 is 2283 m^3/day, and to cover the deference, supposedly five new wells must be drilled. Groundwater development potential of the Mendefera basin is around 2600 m^3/day, and it is enough to supply water for the demand in 2010 but almost at the limit. Water demand in 2015 is around 3761 m^3/day, and the deference volume of 1478 m^3/day of water is no longer covered by groundwater. Thus, surface water from the dam must be introduced in the water supply system of Mendefera by the year 2015.

(3) Surface water development plan

Two potential damsites in the Mereb basin were identified during the Asmara Water Supply Feasibility Study (1987): Mereb-3 locates about 1.0 km upstream of Debarwa bridge, and Mereb-5 locates about 10 km downstream of the former. For the study, a landmark survey and a topo-mapping from aerial photos were conducted, and as a result, 1:10,000 scale topo-maps for the those sites were prepared.

From the topographical viewpoint, both sites are suitable for dam construction. However, the Mereb-5 is recommended for the development, considering a distance from source to supply point, an inflow amount and diversity of water use in the future. At the site, the average annual rainfall (for 13 years) is around 659 mm. According to the preliminary analysis of existing runoff data and consideration on them, the runoff coefficient was estimated as 10%. Catchment area of the damsite is about 492 km^2, and thus, the annual inflow into the Mereb-5 site is around 31.0 MCM/a in average.

In general, the optimum reservoir capacity should be selected through reservoir operations with known

water demand and rainfall, however in this case, the dam shall be planned to be constructed with its maximum capacity, in order to store water for multipurpose uses year around. From the viewpoint of inflow, even if an average value is selected, a dam of 31.0 MCM capacity may be constructed. However, from the topographical restrictions, the capacity of proposed dam is decided to be 25.0 MCM.

According to the conditions of the damsite and availability of dam construction materials, a compacted rock-fill dam with concrete facing is recommendable. The required embankment volume may be calculated as 665,000 m^3. Using a unit cost per unit of filling volume, the approximate cost including appurtenant facilities may be estimated as 21.0 million USD.

The proposed dam shall have a 25.0 MCM of reservoir capacity, while the shortage water volume for water supply in Mendefera by the year 2015 shall be 0.54 MCM/a, quite small compared with the capacity (around 2.2%).

6.3 Water Supply and Sanitary Facility Plan

(1) Water supply facility plan

Water supply facilities of this project consist of intake facilities (borehole and well pump), transmission facilities (transmission pipeline, pump pit and booster pump), distribution facilities (reservoir and distribution pipeline), service facilities (individual connections and communal water points) and others (power supply and control house). These facilities are planed and summarized as Table 6.3.1.

(2) Sanitary facility plan

a) School and public latrines

School latrine

The type of toilet designed is one unit with two compartments, for girls and for boys in the opposite direction. Each compartment has five latrines. The latrine is water carriage type, but pour flush latrine with tap provided at lower level on the side of the Turkish WC, in order to avoid water wastage and breakage of flushing system. The tap water shall also be used for anal cleansing purpose, but for those who prefer to use paper basket shall be provided. In order to develop hand washing practice after using the toilets, hand wash troughs are provided for both girls and boys section.

Public latrine

From the public health point of view, public areas such as market places, bus terminals, stadium etc. are proposed to be provided with public toilets. The type of public toilet recommended is the same as that of school toilets.

Table 6.3.1 Number of Facilities

Item		Unit	Year		
Facility	Description		2005	2010	2015
Intake Facility	New borehole	sets	2	5	
	Existing borehole	sets	2		
	Observation borehole	sets	1		
	Dam	sets			1
	(Sub-total)	sets	5	5	1
Well Pump Facility	Submersible pump		BH-5, 0.096m3/min 81.0m, 1set	nMEN-7, 0.180m3/min 90.0m, 1set	
			MEN-1, 0.120m3/min 87.7m, 1set	nMEN-6, 0.180m3/min 65.6m, 1set	
			nMEN-2, 0.120m3/min 68.4m, 1set	nMEN-5, 0.180m3/min 45.2m, 1set	
			nMEN-1, 0.120m3/min 18.2m, 1set	nMEN-4, 0.180m3/min 30.7m, 1set	
			BH-4, 0.288m3/min 75.8m, 1set	nMEN-3, 0.180m3/min 32.8m, 1set	
	(Sub-total)	sets	5	5	0
Transmission Pipeline	DCIP 200mm	m			
	ditto 150mm	m		2,900.0	43,000.0
	ditto 125mm	m	1,779.0	3,800.0	
	ditto 100mm	m	624.0	1,600.0	
	ditto 80mm	m	4,577.0	3,800.0	
	ditto 60mm	m	2,667.0		
	(Sub-total)	m	9,647.0	12,100.0	43,000.0
Booster Pump Facility	Centrifugal pump		BP.1, 0.240m3/min 99.8m, 1set	BP.3, 0.720m3/min 95.8m, 1set	BP.5, 1.026m3/min 110.9m, 5set
			BP.2, 0.240m3/min 101.1m, 1set	BP.4, 0.900m3/min 77.0m, 2set	
	(Sub-total)	sets	2	3	5
Pump Pit	Made of RC		15m3, 2set	25m3 30m3, 2set	35m3, 5set
	(Sub-total)	sets	2	3	5
Reservoir	Made of RC		340m3	430m3	240m3 180m3 50m3 40m3
	Made of F R P				
	Existing				
	(Sub-total)	sets	1	1	4
Distrbution Pipeline	P V C 300mm	m			
	ditto 250mm	m			
	ditto 200mm	m	980.0		
	ditto 150mm	m	832.0		883.0
	ditto 125mm	m	1,970.0	210.0	513.0
	ditto 100mm	m	454.0	1,484.0	1,877.0
	ditto 75mm	m	1,114.0	2,228.0	3,329.0
	ditto 50mm	m	22,716.0	31,887.0	31,140.0
	(Sub-total)	m	28,066.0	35,809.0	37,742.0
Control House		sets	7	8	5
Communal Water Point		sets	13	13	19
Individual Connection		sets	2,593	1,307	1,777
Tempolaty Road	Width 3.0m	m	5,500	8,000	3,500

b) Public sanitation facility

Mendefera at present is lacking most of public sanitation facilities. Provision of all of necessary public facilities at the first phase of the project may not be economically feasible. However, required improvement of public facilities are discussed bellow.

Wastewater and storm water drainage

In Mendefera, the wastewater flow in a sewerage system shall be too low due to anticipated low consumption rate. A very low flow rate results in poor self cleaning of the sewerage system. However, Mendefera already has a sewerage system. Thus, it is proposed to rehabilitate and expand the system in stages. In the first target year it is recommended that the sewerage system to cover 1/3rd of the area, in year 2005-2010 to cover 2/3rd of the area, and in 2010-2015 a complete coverage.

Refuse disposal

As part of sanitation safe refuse collection and disposal is essential to improved public health. It is anticipated that Mendefera, during the target year 2000-2005, need to have at least two refuse trucks with compaction to go round and collect garbage and dispose at environmentally safe place outside the town. During the three target years, provision of refuse containers in all areas of the town is proposed.

c) Private sanitation facility

The kind of latrines recommended are in line with the type of water supply facilities provision. The coverage anticipated is proportional to the water supply facilities coverage. Basically three types of toilet for three modes of water services are recommended as tabulated below, but communal latrines are not recommended for the reason of difficulty in its management. It is rather recommended shared latrines for up to four families.

House connection users:	Cistern flush latrine (CFL)
Yard connection users:	Pour flush latrine (PFL)
Communal water point users:	Ventilated improved pit latrine (VIP)

6.4 Institutional Strengthening Plan

Major discussions on the institutional strengthening plans, mainly for national level, are summarized below.

(1) The Ministry of Land, Water and Environment (MoLWE)

The MoLWE has three Departments, one each for water, land and environment. The former Water Resource Department (WRD) has been reorganized within the new MoLWE, now called as Water Department (WD) having two divisions under it. The WD will need additional manpower if it is to dispense its mandate properly. Then, training in several grades and terms will be needed in order to enhance the level of skills of the experts.

(2) The Ministry of Local Government (MoLG)

The primary mandate of the MoLG is to act as the main coordinating and facilitating body for the regions

in their dealings and relationships with the ministries at central level. The Regional Affairs Department (RAD) is one of the five departments under it. When a major water project to be implemented arises, the RAD establishes a project management unit (PMU), which would assume direct responsibility for the implementation of the project. For this Project also a PMU will be established under RAD. It is proposed that the Head of the PMU be an engineer with extensive technical knowledge and experience in water facility construction and first hand knowledge of international cooperation.

(3) Ministry of Health (MoH)

Environmental Health and Sanitation Unit (EHSU) is one of the five units under the Primary Health Care Division (PHC), Health Service Department (HSD). It is responsible for developing and revising legislation, policies, standards and guidelines concerning environmental health and sanitation. Additionally it is involved in training of personnel, research and evaluation and rendering technical advise to regions. The EHSU will be strengthened both at the national and region level, by training 6 sanitation specialists for first degree and 30 assistant sanitarians for diploma to be stationed at the regions and sub-regions.

(4) Water Supply and Sanitation Authority of Eritrea (WSA)

A WSA should be established as an autonomous body charged with management of all water and sewerage/sanitation facilities in the country. It is proposed that the national level WSA should be overseen by a Board whose members should be from the main focal ministries and other interest group in the country. The Board will report to the Minister of the MoLWE. It is important to have two main departments under it: one for urban and another for rural and it is proposed that these two main departments ought to have separate divisions for water supply and for sanitation. Under these two divisions, there will be six units one for each six regions of the country.

It is proposed that each town's WSA management become an autonomous unit with its separate cost center, possibly retaining its own income for maintenance and repair works. In order to minimize costs, local WSA should operate with minimum staff. The number of staff in local WSA will be determined as per the requirement of the facilities and number of beneficiaries.

6.5 Project Cost

6.5.1 Project Cost for Water Supply

Project cost consists of the following main facilities and items:

a) Construction cost
   Intake facilities (borehole, well pump, etc.)
   Transmission facilities (booster pump, pump pit, transmission pipeline, etc.)
   Distribution facilities (reservoir, distribution pipeline, etc.),
   Service facilities (individual connection, communal water point, etc.)
   Electric facilities (control house, power supply, etc.), and
   Others (temporary road etc.)
b) Engineering fee,
c) Administration cost

d) Physical contingencies, and
e) Price contingencies

Project costs for local currency component consists of earth works, concrete works, pipe laying works, installation of mechanical and electrical facilities, temporary works, etc., while for foreign currency component consists of materials and equipment, such as pipes and its fittings, valves, pumps control panels, etc..

To the construction cost, percentages for engineering fee and administration cost are assumed as 10% and 2% respectively. Physical contingencies are assumed as 10% of the sum of the construction cost, engineering fee and administration cost. Finally, price contingencies also assume 6% per year. Project costs of each target year are estimated as follows:.

Project cost in 2005: **26,883,400 Nfa**
Project cost in 2010: **43,899,700 Nfa**
Project cost in 2015: **130,706,500 Nfa**

6.5.2 Project Cost for Sanitation

Project cost for sanitation is estimated as follows:

Target Year	School Latrine	Public Latrine	Total
Project cost in 2005:	419,810 Nfa	419,810 Nfa	**839,600 Nfa**
Project cost in 2010:	112,360 Nfa	112,360 Nfa	**224,700 Nfa**
Project cost in 2015:	150,360 Nfa	150,360 Nfa	**300,700 Nfa**

6.6 Sustainability of Water Supply Facility

6.6.1 Capacity building for WSA

The draft Water and Sanitation Law envisages the establishment of WSA whose mandate will be to manage water and sanitation facilities and thus ensure the provision of water supply and sanitation services to both urban and rural areas of the country. Smooth and successful implementation of water supply project, as well as O&M of the facilities constructed, will depend upon the capability of WSA Mendefera.

For a quick establishment, the current WSS shall be transferred to the new WSA. The primary objective of WSA Mendefera is to supply clean and safe water in a sufficient, sustainable and efficient manner. To fulfill it, the WSA has to become technically, financially and legally fully competent. Organizationally, WSA Mendefera shall ultimately be composed of 4 divisions and 15 sections, under a Manager, Customer Services, and Internal Audit. Divisions are Administrative Service, Financial Service, Technical Service, and Sanitary Service.

The Manager is responsible for the stable and successful management of WSA Mendefera and represents the WSA in the dealings with committees, the town municipality and National WSA. Customer Service functions as a window or opening for communications with the consumers in general. Internal Audit is essential for a strict observance of rules and regulations in financial management.

6.6.2 Operation and Maintenance cost (O&M Cost)

All water supply facilities are to be operated and maintained under the full responsibility of WSA. Required material for O&M are electricity, fuel, chemicals, and spare parts for submersible pump and/or other equipment.

Total O&M cost in each target year is estimated following table:

Table 6.6.1 Annual O&M Cost

(Nakfa)

Description	2005	2010	2015
1. Personnel cost	346,460	6407069	968,990
2. Electricity & fuel cost	295,070	1,018,400	2,379,700
3. Chemical cost	16,960	38,690	63,730
4. Repairing cost	112,590	258,590	581,200
5. Miscellaneous cost	77,110	195,610	399,360
Total	**848,200**	**2,151,700**	**4,393,000**

6.6.3 People's Participation

People's active participation and self-reliance constitute the main pillars of the Government's development policy. Participation is multi-faceted and may include, and involves almost all stages of the project cycle. Based on the implications drawn from the development principles, the following recommendations are made to enhance people's participation.

a) Continuous sensitization and awareness creation program will need to be an in-built feature of the program.
b) The study team shall continue to involve beneficiary communities, and recommend on the broad strategy which the Government could follow in ensuring people's participation in the management and administration of water and sanitation facilities.
c) Introduce and develop a viable management system for water and sanitation facilities that will be managed by the communities.
d) Education and training need to be an in-built system of any program that seeks the active involvement of communities.

6.6.4 Community Based Management

In Mendefera, community based management would involve the following principles:

(1) Communities must own and manage the improved, as well as unimproved or existing, water points and sanitation facilities, with all that such ownership entails.
(2) Hardware and software components of the water supply and sanitation facilities need to be given equal attention.
(3) The importance of linking hygiene and sanitation interventions with water supply infrastructures is indeed obvious.
(4) There exist various interest groups in Mendefera, such as those pertaining to age, sex, income, occupation, values and attitudes. It is important, therefore, not to rely solely on community elders

but rather to bring various groups, notably women and young men into the process. And so on.

6.7 Sustainable Sanitation Improvement

6.7.1 Sanitation Management Plan

At present, the managing body for all public facilities is the town administration. The town administration has big duties and responsibilities, not only too much to manage but also ineffective. Therefore, introduction of autonomous management systems is highly recommended. The town administrator remains as the overall inspector of the facilities. And the management responsibility of public facilities shall be given either to an individual, on contractual or rental basis, or a community committee for sanitary facilities which shall be formed to operate and manage the systems.

The public latrines proposed incur minimum cost which is limited to monthly expenses of water, detergent and cleaning material and once in two to three years of de-sludging. For the school latrines, cleaning and keeping the latrines in good condition shall be the students responsibility.

The solid waste management, at present, is under the responsibility of town administrations with a great deal of cooperation of the people. For more effectiveness, it is highly recommended to develop a plan which introduce a waste handling norm which involves the participation of all groups of the society in a day to day life.

6.7.2 Educational Program Development

The educational program developed should be able to address different groups of beneficiaries by age, sex, education, cultural and religious background. The educational program once developed does not mean the end of it. Every time, the program shall be updated to fit to whom it is addressed. Choosing appropriate teaching mechanism to fit the addressed target group such as radio, posters, TV, video, or face to face communication, is very important.

School children can be given the education in the schools, and youth association. The most effective way of teaching children in sanitation and hygiene is to practically make them get used to clean latrine usage, develop hand washing habit after using latrine and cleaning latrine. Church and Mosque are places where elderly people have trust. These institutions if possibly be used to reach elderly people in hygiene/sanitation educational programs effective outcome can be envisaged. Because of the busyness, an independent hygiene/sanitation program schedule for housewives may not be effective and realistic. An effective and easy way of addressing women might be through the existing radio educational programs which is broadcast during working hour or through existing institution such as the Eritrean Women Association, community administration, church or mosque.

The educational posters are one of the basic means for the sanitation improvement of the town. The intended messages to be conveyed in the posters are: explanation on risk of pathogens on health, keeping food and water safe from contamination, responsibility of the society on protecting the environment and surface waters from pollution, developing habit of hand washing and latrine usage, demonstration of low cost/safe household latrine, and so on.

6.8 Financial Plan

6.8.1 Willingness to Pay

Households were classified into three groups by their monthly income level: below 600 Nfa as the low, 600 to 999 Nfa as the middle, and 1,000 Nfa or more as the high income group. The socio-economic survey reported that the average willingness to pay was 9.0, 11.8 and 16.8 Nfa for the low, middle and high income groups respectively, while it was 2.4%, 1.5% and 1.1% of their monthly income. The whole average willingness to pay for water comes to 11.7 Nfa, around 1.5% of the average monthly income.

The figure tells that the riches have a will to pay high tariff, but the share of it in their income is less than the poor. It results, in fact, the riches have less willing to pay for water in terms of the percentage of their income.

6.8.2 Water Tariff Analysis

To fulfill the financial objective of sustainable management for WSA Mendefera, as well as the social objective of justice, water price is proposed to be the highest for the house connection users, at a medium level for the yard connection users and the lowest for the communal water point users. In the same context, the payment for water in terms of the percentage of income will also be higher for the house/yard connection users than for the communal water point users. In all cases, the percentage of water payment to income will not exceed 4% as recommended by the World Bank.

After repeated mathematical model simulations to attain financial viability and stability for WSA Mendefera, and at the same time to fulfill social fairness and justice, the proposal for water prices in the target years are figured out as shown in Table 6.8.1.

Table 6.8.1 Proposed Water Tariff

Year	House Connection		Yard Connection		Communal Water Point	
	Lcd	Price/m^3	lcd	Price/m^3	lcd	Price/m^3
2005	35	9.0 Nfa	22	6.0 Nfa	15	2.0 Nfa
2010	40	12.0 Nfa	24	9.0 Nfa	15	2.0 Nfa
2015	47	12.0 Nfa	27	9.0 Nfa	15	2.0 Nfa

6.8.3 Revenue Estimation

The revenue sources of WSA Mendefera are water charge, technical service charge, meter rent and miscellaneous revenues.

Water charge is the main revenue source. It is collected from the house connection, yard connection and communal water point users. Water charge has been calculated from the number of households, family size, consumed volume and water price by the mode of water supply in each year. In translating the amount of water charge into the revenue, bill collection efficiency was assumed to be 98% based on the current situation.

When WSA installs an individual connection for a customer, it collects the technical service charge in addition to the material cost from him. It is calculated as 378 Nfa in average. The third revenue source, the rental fee of the meter is assumed to be 1 Nfa per month per individual connection. Besides those, there are miscellaneous revenues such as the sale of materials, fines, etc., however, they shall not be taken into account because they are of an irregular and unpredictable.

The revenue deriving from the above-mentioned sources must be sufficient and stable enough to sustain the management of WSA Mendefera in the years to come.

Taking all the above-mentioned things into consideration, the future revenue of the WSA is estimated as follows:

Table 6.8.2 Estimated Revenue

(Unit: Thousand Nfa)

Year	2001	2002	2003	2004	2005	2006	2007	2008
Revenue	1,386	1,504	1,637	1,786	1,954	3,745	4,133	4,642
Year	2009	2010	2011	2012	2013	2014	2015	2016
Revenue	5,303	6,163	6,762	7,435	8,191	9,041	9,998	9,859

6.8.4 Cost Analysis

Initial cost is comprised of construction cost, engineering fee, administration cost and physical contingency. Each of the cost was divided into local and foreign components.

Construction cost was classified into the cost for pumps and other facilities because of the difference in depreciation period between the two categories. Engineering fee, which belongs to foreign components is assumed to be 10% of construction cost, while administration cost, which is composed of local currency by nature is estimated at 2% of construction cost. Finally, 10% was added to the sum total of the above-mentioned cost as physical contingency.

Initial cost is estimated at 23926, 30948 and 68855 thousand Nfa at 1997 prices for the works for the target years of 2005, 2010 and 2015 respectively. Operation and maintenance costs to be incurred annually after the completion of works in each phase are estimated as 848, 2152, and 4393 thousand Nfa for the respective year.

6.8.5 Projection of Financial Statement

For preparing projected financial statements, the following were assumed:

(1) Initial cost will be totally subsidized by the government.
(2) The people of the town will bear the replacement cost of all facilities.
(3) No tax will be imposed on the profit from water supply operations.
(4) Project life will be 30 years since the start of the first phase implementation.

The resultant financial statements: revenue to cost ratio, profit ratio, and profit to assets ratio, are figured out as 125.5%, 17.1%, and 1.2% respectively. The figure shows, WSA Mendefera will be able to have a

financially successful and stable management.

6.9 Project Evaluation

6.9.1 Economic Evaluation

(1) Benefits of water

Implementation of the Project will release women, girls and boys from the daily repetition of water fetching drudgery, drastically reduce water related diseases, and level up the people's sanitary and living standard totally.

These economic benefits can be reflected in the prices of water. Currently, the prices of water is fixed, ranging from 1.5 to 6.3 Nfa/m^3 depending on the service modes. Such water prices only partially represents the economic benefits of water, but not fully due to institutional consideration. It is regarded that the economic benefits of water is fully reflected in the prices of the water bought from water vendors. In Debarwa, water prices from water vendors range 16 to 40 Nfa/m^3. Thus, the economic benefits of piped water is assumed as 20 Nfa/m^3.

(2) Projection of water consumption and population without project

The unit consumption rate of piped water, in the seven towns, is calculated as 10.3 l/c/d on an average. In the case without project, it is assumed that this law water consumption rate will continue throughout the project life period.

If the Project is not implemented, it is expected that the population of the town will not grow as fast as envisaged in this study due to constraints in water supply. In the case without project, it is assumed that the growth rate of population will go down to a half of the rate foreseen in the case with project.

(3) Other conditions/assumptions

The following conditions/assumptions were presupposed besides the above ones.

a) Project life: 30 years from the start of the first phase works
b) Opportunity cost of capital: 10%, an average value perceived appropriate by the World Bank
c) Standard conversion factor: 0.9, to be applied to local components of initial cost

(4) Economic analysis

Cost benefit streams were prepared based on all the above-mentioned conditions and assumptions. Those are –18,825 thousand Nfa of NPV, 0.75 of B/C, and 6.2% of EIRR. The EIRR of the Project is 6.2%, which is below 10% or the assumed opportunity cost of capital (OCC). However, the value may be tolerable considering the social nature of the Project.

(5) Sensitivity analysis

Sensitivity analysis was performed to see how EIRR would change if cost overrun of 20% happens (case-1) or if the cost overrun of 20% and the 10% decrease of benefits simultaneously occur (case-2). The result shows that the EIRR stays substantially above the discount rate of zero even under the unfavorable

situation of Case 1 (EIRR=3.8%), and still stands above zero even under the severest assumption of Case 2 (EIIR=1.9%).

6.9.2 Financial Evaluation

It was found that the financial internal rate of return (FIRR) cannot be calculated due to the peculiar state of cost benefit streams, characterized by the absence of initial cost in the cost stream. Therefore, financial evaluation was done for the projected financial statements only.

The projected financial statements are summarized below.

- Revenue to Cost Ratio: 125.5%
- Profit Rate: 17.1%
- Working Capital to Revenue Ratio: 46.3%
- Profit to Total Assets Ratio: 1.2%

The figure shows that WSA Mendefera will have a reasonable extent of profit to cushion unpredictable financial turbulence, a thick reserve of working capital to prepare for replacement of facilities and a nominal profit to the assets invested in the years to come.

6.9.3 Organizational Evaluation

The evaluation of the organizational measures can be summarized as follows:

(1) Planning and execution of water supply and sanitation projects in the country and in Mendefera will be streamlined and properly effected, and appropriate capacity building measures will be taken to ensure this.
(2) A viable training component will be developed in order to meet the skilled manpower requirements at the country, Debub region and Mendefera town levels.
(3) Project execution will be effected by the PMU which will be established in the MoLG.
(4) WSA will be established in Mendefera and assistance rendered to strengthen it institutionally and to the training of skilled personnel.
(5) Sanitation and environmental health will institutionally occupy its proper position in the town's WSA to fulfill the urgent needs for its sanitary improvement.
(6) The community in Mendefera will assume prime position in the planning, implementation and management of water and sanitation facilities in their locality.

6.9.4 Technological Evaluation

The proposed water supply system is composed of relatively simple facilities, those of which are not quite different from the existing ones. Main materials for the project, such as PVC pipe, submersible pump, ductile cast iron pipe, etc. are recently common in Eritrea. Although a new material made of fiberglass reinforced plastic (FRP) is to be introduced for elevated tank, the light material could facilitate the construction work very smoothly. And it is also expected to have a long life span comparing with other conventional materials, thus the long run cost could be reduced for the reservoir.

The construction works are carried out by manual labor at present. However, use of construction machinery shall be considered to minimize the construction period. The construction works by

machinery will be useful and popular in future in Eritrea.

6.9.5 Social and WID Evaluation

The value added to a society and women are as follows:

(1) The improvement in piped water supply in the town will result in the significant reduction of time and energy spent in the collection of water, particularly for women, girls and boys.
(2) This should improve the quality of life for these social groups, making the town a more pleasant place to live.
(3) By the provision of toilets, there will be not only more hygienic environments, but will also allow women and girls the privacy which they have been not allowed to have.
(4) The project will allow the participation of the community in making decisions regarding the location of public water and sanitation facilities, thus enhancing their sense of empowerment.

6.9.6 Environmental Impact Assessment

The characteristic of the subject project is to develop groundwater for drinking in the seven urban towns. The scale of the project is not large. There is no major construction involved except borehole drilling at some locations. Almost no major negative impact on the environment is expected in terms of social, natural environment including pollution. Therefore, attention should be given on the amount of water that is planned to withdraw from the source and its effect on the surroundings. For this purpose, monitoring of water level is recommended. On the other hand, supply of safe water will improve the living condition and formulation of sanitary education plan will upgrade the existing health and hygienic conditions of the inhabitants.

Environmental screening and scooping for IEE in JICA format have been performed for this sub-regional town. From the result of the IEE it is concluded that no EIA is necessary for this project.

6.10 Project Implementation Plan

Major works of this project are borehole drilling work, pipe laying work, civil works, mechanical and electrical works, etc.

The implementation schedule is divided into three phases to meet the target year and into two stages, namely, a) preparation of finance including the foreign currency portion and of detail design together with tender documents, and b) implementation of the project.

Seven towns are also divided into two groups. Group 1 is three towns of Debarwa, Mendefera and Dekemhare. Locations of these towns are near the capital of Asmara and the population projection is higher than other towns. Group 2 is remaining four towns.

The schedule is proposed as follows:

a) First phase
First stage: Preparation in 1999

Second stage: Implementation in 2000

b) Second phase

c) First stage: Preparation in 2003
Second stage: Implementation in 2004

d) Third phase
First stage: Preparation in 2008
Second stage: Implementation in 2009

7. PROJECT FEASIBILITY STUDY

Project feasibility was studied for the priority projects targeting the year of 2005.

7.1 Groundwater Development Plan

The existing groundwater resources including the Test Well MEN-1 have a total yield of 725.7 m^3/day, which can cover the water demand in 2000 but 2005. To cover the water demand in 2005 (1001 m^3/day), another two production wells shall be required, because around 275 m^3/day of the shortage water in 2005 can hardly be supplied by one well, considered from the aquifer property.

Groundwater development plan, for Mendefera town targeting 2005, shall be as follows:

a) Completion of MEN-1 as one of the water sources for 2005,
- pump installation, pumping house and a panel board, supply pipe line, etc.-

b) Completion of existing BH-4 and BH-5, also as one of the water sources,
- pump installation, pumping house and a panel board, supply pipe line, etc.-

c) Siting for new water sources, at along Mai Takhala,
- hydrogeological reconnaissance, TEM prospecting, comprehensive analysis, etc.-

d) Drilling of new water sources (two success wells among three drilled, most probably),
- drilling, borehole logging, pumping test, water quality analysis, etc.-

e) Completion of newly drilled nMEN-1 and nMEM-2, also as one of the water sources.
- Pump installation, pumping house and a panel board, supply pipe line, etc.-

7.2 Facility Design

Total facility plan for the target year 2005 is summarized below.

(1) Well pump

Submersible pump is recommended as well pump. Capacity and total head of pump are designed to meet the water demand in 2005. Specifications of the well pump are as follows:

Table 7.2.2 Specification of Well Pump

Well No.		BH-4	BH-5	MEN-1	nMEN-1	NMEN-2
Discharge	M^3/m	0.288	0.096	0.120	0.120	0.120
Elevation of intake	EL.m	1939	1932	1942	1852	1826
Elevation of reservoir	EL.m	1983	1983	1983	1855*	1855*
Total head	M	76.8	81.0	88.7	18.1	68.4
Number of unit	Set	1	1	1	1	1

Note) *: elevation of pump pit

(2) Transmission pipeline

Diameters of the pipelines shall be decided for the water demand in the target year 2010, because of the difficulty of expansion.

Diameters of pumped pipeline is a subject to the flow velocity in pipe. The flow velocity for the water demand in 2005 shall be more than 0.6 m/s as the most suitable velocity for the small diameter pipe. Thus, ductile cast iron pipe (DCIP) with diameter of 125 to 60 mm is selected for the transmission pipeline.

Two pipelines shall be planned; one is from MEN-1, BH-4 and BH-5 to new reservoir, and another is from nMEN-2 and nMEN-1 to the reservoir.

(3) Booster pump and pump pit

Booster pump shall be planned in case that the static head is more than 130m. Two centrifugal pumps with discharge capacity of 0.24 m^3/min are planed to be set as booster pump along the pipeline from newly drilled boreholes to the reservoir.

Pump pit is planned for the booster pump with a capacity is 30-minute discharge by booster pump, but a minimum capacity is to be $15m^3$.

(4) Reservoir

A reservoir is newly constructed. Capacity of the reservoir is equivalent to the 8-hours of the maximum daily water demand: 340 m^3, ground type made of concrete.

(5) Distribution pipe

Main distribution pipeline is also designed for the water demand in the target year 2010 under this project: as 200mm. The minimum diameter of the distribution pipeline adopted is 50 mm. Pipeline network of the distribution pipeline is designed through Hardy-Cross formula, and the terminal pressure shall be more than 7 m.

(6) Service facilities

Number of individual connections is estimated from the percentage of consumers in the target year 2005. Communal water points are arranged to cover up the area by approx. 150m-radius circles. Service facility plan for the target year is as follows:

Number of individual connections:	2,593 sets
Number of communal water points:	13 sets
Temporary road:	5,500 m

(7) Control house

Number of control house is 3 set of type A, 2 set of type B, and 2 set of type C. Herein, type A and B are an control house for well pump, type C and D are for booster pump, and type B and D have a generator room.

(8) School latrine

The type of toilet designed is one unit with two compartments, for girls and for boys in the opposite direction. Each compartment has five latrines. The latrine is water carriage type. Five school latrines shall be constructed by the year 2005.

(9) Public latrine

The type of public toilet recommended is the same as that of school toilets. Five units of public latrines shall be constructed under the Project.

7.3 Institutional Strengthening Plan

(1) The Central government

Water Department of MoLWE

To date, the 12 experts assigned to the newly re-organized WD have not been assigned to the two divisions under it. Even though the placement of personnel is finalized, it is still proposed that WD be given capacity building and training especially in water resources development, in collection, compiling and analysis of hydro-meteorological information and water resource information related tasks.

RAD of MoLG

In the three divisions of RAD, it has been identified that there is a gap in fulfilling the task of planning and software aspect of the project. In order to fill the gap in the function of these three, it will be convenient for RAD to assign the task to the three divisions under it. Accordingly, the Economic Division will assume the responsibility of planning and demand projection, the Social Service will take care of the software aspects and the Infrastructure Services for facility design. This, in effect, means adding three more experts one each for each Division.

MPU under RAD

During the implementation phase of the project, a Project Management Unit (PMU) will be established under the Engineering and Project Management Unit of RAD. It is proposed that the Head of the PMU be an engineer with extensive technical knowledge and experience in water facility construction and first hand knowledge of international cooperation. He will be assisted by three contractual experts: two engineers and one expert in community organization and management.

The Environmental Health Unit of the MOH

There are 5 experts under this Unit, but one graduate in public health sanitation is required for each region of the country. Additionally, at least one sanitarian will be required for each of the 52 sub zones of the country. Presently, there are only 26 and it will be necessary to train another 26. This means that Debub Region will require 12 sanitarians including one for Mendefera.

(2) Water Supply and Sanitation Authority (WSA Mendefera)

The existing WSS Mendefera office will be transferred to the newly established WSA Mendefera Office. It will be a semi autonomous unit of the national WSA. Mendefera WSA will be fully strengthened with trained staff and facilities. It will have its own board, and the board members will be the Mendefera Water and Sanitation Committee members. Key staff of the office include at least a board chairman, manager, finance officer, technical officer, and sanitation officer.

(3) Water and Sanitation Committee (WSC)

In Mendefera, WSC will be formed, whose members will be school directors, health center/clinic heads, religious leaders, WSA, town elders, the bank, and other notables in the town. It is the committee that will act as the Board of Mendefera town WSA.

(4) Communal Water Points Committee (CWPC)

CWPC will be formed for each public/communal water point in Mendefera. The committee will report to the town's WSA board chairman. It will have a secretary, technical officer and members who will be given specific assignments when the need arises. Members will be volunteers serving the community without pay, except for the water point care-taker/guards who will be paid agreed monthly salary. It is proposed that at least 50% of the members of this committee be females including office holders of the committee.

(5) Community Toilet Committee (CTC)

CTC will be formed for each zone of Mendefera town. The committee will work in close collaboration with the sanitation officer, but will report to the town's WSA Board Chairman. It will have a secretary, technical officer and members who will be given specific assignments when the need arises. Members will be volunteers serving the community without pay, except for the community toilet guards who will be paid agreed monthly salary. It is proposed that at least 50% of the members be females.

7.4 Project Cost

(1) Project cost for Water Supply

Project cost is estimated in the following table.

Table 7.4.1 Project Cost

(Nakfa)

Description	Local C.	Foreign C.	Total
1. Construction cost			
Borehole	45,000	717,190	762,200
Well pump	52,800	745,420	798,220
Transmission pipeline	1,990,950	4,869,430	6,860,380
Booster pump	3,980	247,990	251,980
Pump pit	125,530	77,940	203,470
Reservoir	588,430	242,760	831,190
Distribution pipeline	3,798,950	2,687,690	6,486,630
Individual connection	0	0	0
Communal water point	234,250	89,260	323,516
Control house	1,197,960	71,500	1,269,470
Temporary road	1,633,500	0	1,633,500
Sub total	**9,671,360**	**9,749,190**	**19,420,560**
2. Engineering fee (10% of 1.)	-	1,942,060	1,942,060
3. Administration cost (2% of 1.)	388,410	-	388,410
4. Physical contingencies (10% of 1.+2.+3.)	1,005,980	1,169,120	2,175,100
Total	**11,065,750**	**12,860,370**	**23,926,130**
5. Price contingencies (6% p.a.)	1,367,730	1,589,540	2,957,270
Ground total	**12,433,400**	**14,449,900**	**26,883,400**

(2) Project cost for Sanitation

Project cost is estimated as follows (unit: Nfa):

Item	Quantity	Unit Price	Amount
School Latrine (PFL)	5 units	83,960	419,800.
Public Latrine (CFL)	5 units	83,960	419,800.
Total			**839,600**

7.5 Sustainability of Water Supply Facility

7.5.1 Capacity building for WSA

The draft Water and Sanitation Law envisages the establishment of WSA whose mandate will be to manage water and sanitation facilities and thus ensure the provision of water supply and sanitation services to both urban and rural areas of the country. For a quick establishment, the current WSS shall be transferred to the new WSA.

Organizationally, WSA Mendefera shall ultimately be composed of 4 divisions and 7 sections under the Manager, in the first phase. Divisions are Administrative Service, Financial Service, Technical Service, and Sanitary Service.

The Manager is responsible for the stable and successful management of WSA Mendefera and represents the WSA in the dealings with committees, the town municipality and National WSA.

7.5.2 O&M Cost

All water supply facilities are to be operated and maintained under the full responsibility of WSA. Total numbers of personnel required for operation and maintenance are 37 for the target years of 2005. Required material for O&M are electricity, fuel, chemicals, and spare parts for submersible pump and/or other equipment.

O&M cost in the target year is estimated in the following tables.

Table 7.5.1 O&M Cost

(Unit: Nfa)

Item	2005
1. Personnel Cost	346,460
2. Electricity and Fuel Cost	295,070
3. Chemical Cost	16,960
4. Repairing Cost	112,590
5. Miscellaneous Cost	77,110
Total	848,200

7.5.3 Community Based Management and Peoples Participation

Community based management and people's participation are the both faces of the one issue: the owner of the project should be the people living there, looking the people as a mass or looking the people as a member.

To achieve the issue, the following recommendations are forwarded:

- Communities must actually own the improved water points, with all that such ownership entails.
- Activities should be focused specifically on building self-reliance, self-confidence, technical and management skills, and so on.
- Frequent participatory appraisal techniques need to supplement committee meetings or contacts with opinion leaders, in the consideration for improvement of software delivery.
- For an affordability, service delivery agents need to recognize that communities are consumers and would like to maximize the returns from the money they pay for the service required.
- To include a strong component of sensitization and awareness creation program in the project by employing a community agent, organizer and/or adviser during the execution and post execution of the project.
- The need for the continuous and active involvement of beneficiaries should be secured by establishing strong water and sanitation committees.
- Education and training need to be an in-built system of any program that seeks the active involvement of communities in project planning, implementation and management.

7.5.4 Training Plans

A major factor for a successful O&M on water supply facilities is a manpower of the local WSA, in both quantitative and qualitative. Especially, such personnel as financial, technical/engineering and legal

experts occupy a crucial position in evaluating the overall manpower strength of a WSA.

In this meaning, the training/education of those experts deems to be an essential and urgent matter. It is thus proposed that a training center be established under the National WSA to meet the requirements of such experts in the seven towns with the target year set at 2005.

The training need of local for WSA Mendefera is 8: 2 financial, 5 technical and 1 legal experts. Also, on the job training of technical experts using the operation manual is essential to elevate their skill as well as to enrich their experience.

7.6 Financial Plan

(1) Willingness to pay

Willingness to pay as the result of socio-economic survey is summarized as the table below.

Item	Low Income	Middle Income	High Income	Total
1. Average Monthly Income, 1997 (Nfa)	369	769	1,565	774
2. Share (%)	41.8	36.6	21.6	100.0
3. Willingness to Pay for Water (Nfa/m)	9.0	11.8	16.8	11.7
4. Willingness to Pay for Water (%)	2.4	1.5	1.1	1.5

Herein, income groups are classified: below 600 Nfa as the low, 600 to 999 Nfa as the middle, and 1,000 Nfa/month or more as the high income group.

(2) Water tariff analysis

To fulfill the financial objective of sustainable management for WSA Mendefera, as well as the social objective of justice, water price is proposed to be the highest for the house connection users, at a medium level for the yard connection users and the lowest for the communal water point users. In the same context, the payment for water in terms of the percentage of income will also be higher for the house/yard connection users than for the communal water point users.

It is proposed that the water price per cubic meter will be 9, 6 and 2 Nfa for house connection, yard connection and communal water point users respectively in the target year of 2005.

(3) Revenue estimation

Water charge is the main revenue source. It is collected from the house connection, yard connection and communal water point users. Water charge has been calculated from the number of households, family size, consumed volume and water price by the mode of water supply in each year. In translating the amount of water charge into the revenue, bill collection efficiency was assumed to be 98% based on the current situation.

When WSA installs an individual connection for a customer, it collects the technical service charge in addition to the material cost from him. It is calculated as 378 Nfa in average. The third revenue source, the rental fee of the meter is assumed to be 1 Nfa per month per individual connection. Besides those,

there are miscellaneous revenues such as the sale of materials, fines, etc., however, they shall not be taken into account.

Taking all the above-mentioned things into consideration, the future revenue of the WSA is estimated as follows:

Table 7.6.1 Estimated Revenue

(Unit: Thousand Nfa)

Year	2001	2002	2003	2004	2005	2006
Revenue	1,386	1,504	1,637	1,786	1,954	1,752

(4) Cost analysis

Initial cost is composed of construction cost, engineering fee, administration cost and physical contingency. Each of the cost was divided into local and foreign components.

Construction cost was classified into the cost for pumps and other facilities because of the difference in depreciation period between the two categories. Engineering fee, which belongs to foreign components is assumed to be 10% of construction cost, while administration cost, which is composed of local currency by nature is estimated at 2% of construction cost. Finally, 10% was added to the sum total of the above-mentioned cost as physical contingency.

Initial cost is estimated at 23,926 thousand Nfa at 1997 prices for the works of the first target year. Operation and maintenance costs to be incurred annually after the completion of works in the first phase are estimated as 848 thousand Nfa.

(5) Projection of financial statement

For preparing projected financial statements, the following were assumed:

(6) Initial cost will be totally subsidized by the government.

(7) The people of the town will bear the replacement cost of all facilities.

(8) No tax will be imposed on the profit from water supply operations.

(9) Project life will be 30 years since the start of the first phase implementation.

The resultant financial statements: revenue to cost ratio, profit ratio, and profit to assets ratio, are figured out as 124.5%, 19.3%, and 1.2% respectively. The figure shows, WSA Mendefera will be able to have a financially successful and stable management.

7.7 Project Evaluation

7.7.1 Economic Evaluation

Implementation of the Project will release women, girls and boys from the daily repetition of water fetching drudgery, drastically reduce water related diseases, and level up the people's sanitary and living standard totally. These economic benefits can be reflected in the prices of water. As a result, the economic benefits of piped water is assumed as 20 Nfa/m^3.

The unit consumption rate of piped water, in the seven towns, is calculated as 10.3 l/c/d on an average. In the case without project, it is assumed that this law water consumption rate will continue throughout the project life period. In the case without project, it is assumed that the growth rate of population will go down to a half of the rate foreseen in the case with project.

Cost benefit streams were prepared based on all the above-mentioned conditions and assumptions. Those are –1,046 thousand Nfa of NPV, 0.95 of B/C, and 9.3% of EIRR. The EIRR of the Project is 9.3%, which is slightly below 10% or the assumed opportunity cost of capital (OCC). However, the value may be tolerable considering the social nature of the Project.

Sensitivity analysis was performed to see how EIRR will change if cost overrun of 20% happens (case-1) or if the cost overrun of 20% and the 10% decrease of benefits simultaneously occur (case-2). The result shows that the EIRR stays considerably above the discount rate of zero (EIRR=6.7) even under the unfavorable situation of Case 1, and still stays above zero even under the severest assumption of Case 2 (EIRR=3.3%).

7.7.2 Financial Evaluation

It was found that the financial internal rate of return (FIRR) cannot be calculated due to the peculiar state of cost benefit streams, characterized by the absence of initial cost in the cost stream. Therefore, financial evaluation was done for the projected financial statements only.

The projected financial statements are summarized below.

- Revenue to Cost Ratio: 124.5%
- Profit Rate: 19.3%
- Working Capital to Revenue Ratio: 47.0%
- Profit to Total Assets Ratio: 1.2%

The figure shows that WSA Mendefera will have a reasonable extent of profit to cushion unpredictable financial turbulence, a thick reserve of working capital to prepare for replacement of facilities and a nominal profit to the assets invested in the years to come.

7.7.3 Organizational Evaluation

(1) The skeletal administrative/organizational structures of the PMU and WSA will enable the smooth execution of the first phase of the project and indeed its management latter on.

(2) The ultimate organizational structure that will be realized in the year 2005 for Mendefera WSA is elucidated, and the management of communal water points and toilets will involve all the possible actors or beneficiaries in the town.

(3) In case of Mendefera WSA, there will be the Town's Water and Sanitation Committee that will also act as the board of WSA. It will have wide powers and responsibilities especially in seeing the efficient management of communal water points and toilets.

(4) The manager of Mendefera WSA has wide responsibilities and challenges to meet. He will be greatly assisted by the Board and the national WSA in all his efforts.

(5) The existence of a separate unit in Mendefera WSA charged with sanitation issues will greatly improve the town's sanitation. It is expected that there will be easy access to credit facilities to

construct latrines for those who should afford.

7.7.4 Technological Evaluation

Major facilities to be constructed under the Project are boreholes, control houses, pump pits, transmission/distribution pipelines, a ground reservoir, and some latrines. All of these facilities are already common in this country. The construction works for those have been conducted by the local constructor. Major materials required for the works are submersible pump, PVC pipe, ductile cast iron pipe, and cement, also popular in the country. Thus, there is none of difficulty to implement the Project.

For the siting works for new borehole, a geoelectric sounding technique is exist (but only in Mining Department). However, the sounding technique and the results are, looks like, not so efficiently utilized in these groundwater development projects. Introducing new sounding technology, systematic hydrogeological survey inclusive of electro-magnetic prospecting, is recommendable. While, most of construction works are carried out by manpower at present. Utilizing of construction machinery shall be considered to minimize the construction period.

7.7.5 Social and WID Evaluation

(1) Both newly constructed and existing communal water points will be managed by the community, 50% of whom will be women.

(2) Well-managed community water and sanitation facilities are expected to minimize current community' frustration with opening hours, breakdowns and repairs, water tariff, etc. The community is expected to be financially self-sufficient and will be vested with decision making powers in financial, personnel and when appropriate in technical terms as well as.

(3) The value-added related to WID are as follows:

- The project should result in the shift in the quality of life of all social groups from a lower level to a higher level.
- By improving the piped water supply in Mendefera, the intended benefits will include the significant reduction of time and energy spent in the collection of water, for men, women, boys and girls.
- The construction of latrines and public toilets, will enable women and girls to have more privacy than they have had in the past for urination, defecation and menstruation.
- The project will allow the community to have a say in the determination of the location and design of the facilities in Mendefera, thereby increasing their sense of empowerment in matters that directly concern them.

7.8 Project Implementation Plan

Major works of this project are borehole drilling work, pipe laying work, civil works, mechanical and electrical works, etc. Implementation schedule is divided into two stages: a preparation stage and an implementation stage. Period of the implementation for both stages shall be around two years.