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JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MINISTRY OF WATER RESOURCES

THE STUDY
ON
ELEVEN CENTERS WATER SUPPLY AND SANITATION
IN
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

FEASIBILITY REPORT
BURE

(Volume II-IX)

FEBRUARY, 1996

SANYU CONSULTANTS INC.

KYOWA ENGINEERING CONSULTANTS CO., LTD.

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
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PREFACE

This is the Feasibility Study Report for Bure presenting the results of the Study on Eleven Centers Water Supply and Sanitation (the Study) carried out in accordance with the Scope of Work agreed upon between the Government of Federal Democratic Republic of Ethiopia (GOE) through the Water Supply and Sewerage Agency (WSSA) of the Ministry of Natural Resources Development and Environmental Protection (MNRDEP), which was recently reorganized Water Supply and Sewerage Service Department (WSSD) under Ministry of Water Resources (MWR), on the one part and the Government of Japan (GOJ) through the Japan International Cooperation Agency (JICA) on the other part dated April 8, 1994.

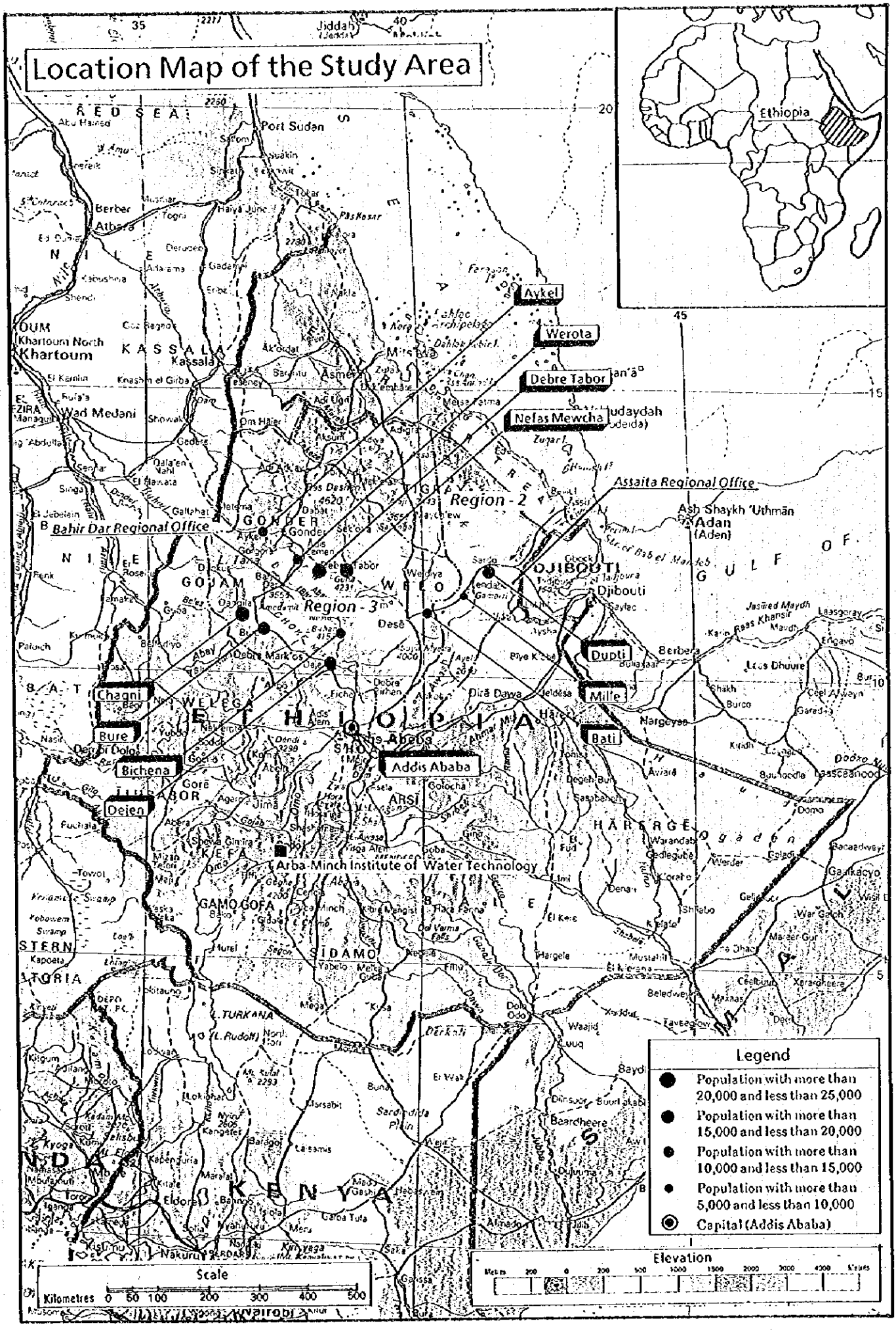
The major objectives of this Study are 1) to conduct a feasibility study on the water supply system in order to improve living condition of the population in the Study area by enhancing the level of the water supply services in terms of water quantity, water quality and its accessibility, 2) to formulate a plan for sanitary education and the diffusion of sanitary facilities in order to raise peoples' awareness on hygiene and improve environmental sanitation, which will be able to prevent the contamination of water source(s) and to secure safe water supply, and 3) to transfer technologies to the Ethiopian counterpart personnel in order to strengthen the managerial aspects of water supply services.

The Study had been conducted over a two (2) Japanese fiscal year-period from 1994/95 to 1995/96 and divided into two (2) phases. The Phase I study was conducted between December 1994 and March 1995, and Phase II was conducted between May 1995 and February 1996, for a total study period of 15 months during which three (3) times of visit to Ethiopia were made.

The survey items and major activities are meteo-hydrological survey, geo-electric prospecting (GEP) survey, water quality, water use condition, sanitary and health condition and people's awareness, social background, socio-economy, initial environmental examination (IEE), environmental impact assessment (EIA), sanitary education practice, and existing pump investigation.

With the survey and the study, this report presents the formulation of the Project of the water supply system with the implementation program, improvement plan of sanitary facilities with the diffusion program, set-up and strengthening of organization, and strengthening of operation and management.

The Study Team extends heartiest thanks to WSSD especially those assigned counterparts for their close cooperation and hard work in both office and the field, and the officers of related agencies of Japan.


Location Map of the Study Area
Ethiopia
Legend
Population with more than 20,000 and less than 25,000
Population with more than 15,000 and less than 20,000
Population with more than 10,000 and less than 15,000
Population with more than 5,000 and less than 10,000
Capital (Addis Ababa)
Elevation
Scale
Kilometres 0 50 100 200 300 400 500
Bahir Dar Regional Office
Assaita Regional Office
Arba-Minch Institute of Water Technology
Region - 2
Region - 3
Aykel
Werota
Debre Tabor
Nefas Mewcha
Dupti
Mille
Bati
Addis Ababa
Bichena
Deien
Bure
Chagni
Dire Dawa
Djibouti
Port Sudan
Khartoum
Nairobi
Eldoret
Nakuru
Kisumu
Lake Turkana
Red Sea
Gulf of Aden

General Description of Current Condition in Bure

Items	Description
Administration	Amhara Region, West Gojjam, No. of Kebele : 4
Residents	Total population : 14,742 (1.2 persons/ha) Average family size : 6.8 persons Amhara : 94% Christians : 92% (3 churches) Agew : 4% Moslems : 7% (1 mosque) Oromo : 2%
Educational Conditions	Kinder garden / Elementary school / Junior & Senior high s. No. of school : 2 / 3 / 1 No. of teachers : 2 / 92 / 52 No. of students : 136 / 2157 / 2031
Medical Conditions	Hospital : - Doctor : 1 Health center : 1 Nurse : 9 Health clinic : -
Economic Conditions	Hotels/restaurants : 65 Shops : 140 Cottage industry : 30 Others : 11 Average monthly household income : 253 birr
Water Supply Condition	The source of WSS : Spring (2) Major other sources : Spring & River Domestic consumption : 130.5 cum/day (10.7 lpcd) Other consumption : 27.1 cum/day (total 157.6) Water service coverage : 83% House connection : 23.6 lpcd (4%, 1.0 birr/cum) Yard connection : 25.0 lpcd (19%, 1.0 birr/cum) Neighbors : 10.4 lpcd (8%, 1.0(2.8) birr/cum) Public fountain : 4.6 lpcd (52%, 1.0(2.4) birr/cum)
Sanitary Condition	Septic toilet : - /100HH Dry pit toilet : 57/100HH Community toilet : - /100HH Open field : 43/100HH Toilet condition : Ill-maintained and constructed. Sullage disposal site : No allocated and vacuum track is required. Drainage facilities : No existed except along main road, poorly maintained.
People's Health Awareness and Needs	Group awareness : 75% Diarrhea awareness : 33% ORS awareness : 30% Sanitary behaviors score : 939/1600 (59%) Needs : Adequate Water, Improved Sanitation, Employment
Remarks	1. Water charge in bracket is actually paid. 2. HH means "household". 3. ORS means Oral Rehydration Solution. 4. Faecal coliforms found in samples from connections and household containers. 5. Chlorination being made at the collecting chamber.

Project Description of Bure

Items	Description
Project Title	Eleven Centers Water Supply and Sanitation
Executing Agency	Water Supply and Sewerage Service Department(WSSD)
Objectives	To supply domestic water which meets people's demand and to improve sanitary condition in the center.
Population Projected	in 1995 2000 2005 2010 14,745 (5.0%) 18,819 (4.5%) 23,452 (4.0%) 28,533
Water Demand Projected in cum/day	in 1995* 2000 2005 2010 Domestic : 131 382 594 942 Non Domestic : 27 70 94 124 Losses : 42 50 94 188 Total : 200 502 782 1,254
Dimensions of Water Supply System	Target Service Coverage: 95%(83% at present) Target Year of 2005 Water source : Spring+River Rising Main : ϕ150(3.17km) Booster of Rising : ϕ100mm,Q=0.66m^3/min,H=90m Reservoir : 110m^3(55×2) Distribution : ϕ200(620m), ϕ150(3,040m), ϕ75(4,220m), ϕ50(4,290m) Booster of Dist'n : ϕ200mm,Q=1.1m^3/min,H=7m ϕ150mm,Q=1.1m^3/min,H=46m Target Year of 2010 Deep Wells : 2 (194m) Rising Main : ϕ100(1.90km),ϕ75(2.30km)
Water Tariff Structure & Accounting System	Introduction of Progressive Water Tariff** HC: 3.00 birr/m^3,YC: 2.07 birr/m^3,PF: 0.76 birr/m^3 Introduction of Double Accounting System
Plan of Sanitary Facilities Improvement	Construction of 3 public toilets and facilitation of other type toilets. Provision of toilet emptying system. Maintenance of main drainage and construction of supplemental drainages. Facilitation of waste water disposal pit and dry solid waste disposal system.
Plan of Sanitary Education and Implementation Program	Utilization of sanitary education manual and video. Application of sanitary education priorities(see report). Set-up of Sanitary/Health Committee. Assignment of Community Participation Promoter.
Organization Set-up	Strengthening of Planning & Project Department of MWR and relationship among central, regional and town. WSS to be composed of Administration, Financial, Technical and Sanitary Service, and manpower to be 32 in 2005 and 42 in 2010.
Remarks	* Actual Consumption ** Water Tariff for industry and institution is same as HCs'.

Composition of the Report

Report
- Executive Summary
- Main Report (Volume I)
- Feasibility Report (Volume II-I to II-XI)
- Appendixes (Volume III-I to III-XI)

Others
- Operation and Maintenance Manual
- Sanitary Education Manual
- Sanitary Education Video (titled Simple Steps... for Better Health)

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ABBREVIATIONS

[ORGANIZATION]

AfDB or ADB	-	African Development Bank
AfDF or ADF	-	African Development Fund
AWTI	-	Arba-Minch Water Technology Institute
CIDA	-	Canadian International Development Agency
CPPS	-	Community Participation Promotion Services
CSA	-	Central Statistical Authority
EELPA	-	Ethiopian Electric Light and Power Authority
EIGS	-	Ethiopian Institute for Geological Survey
EMA	-	Ethiopian Mapping Authority
EPD	-	Environmental Protection Department
GOE or TGE	-	Transitional Government of Ethiopia
GOJ	-	Government of Japan
IBRD	-	International Bank for Reconstruction Development (The World Bank)
JICA	-	Japan International Cooperation Agency
KFW	-	Kreditanstalt fur Wiederaufbau
MEDP	-	Ministry of Economic Development Planning
MEEC	-	Ministry of External Economic Cooperation
MNRDEP	-	Ministry of Natural Resources Development and Environmental Protection
MOA	-	Ministry of Agriculture
MOH	-	Ministry of Health
MPI	-	Master Plan Institute
MPWUDH	-	Ministry of Public Works and Urban Development and Housing
MWR	-	Ministry of Water Resources
NMA	-	National Meteorological Authority
NMSA	-	National Meteorological Service Agency
NGO	-	Non-Governmental Organization
NRDPEPB	-	Natural Resources Development & Environmental Protection Bureau
PWUDB	-	Public Works and Urban Development Bureau
REA	-	Regional Education Authority
REWA	-	Revolutional Ethiopian Women Association
RRC	-	Relief and Rehabilitation Commission
UN	-	United Nations
UNDP	-	United Nations Development Program
UNICEF	-	United Nations Children's Fund
TADE	-	Tendaho Agricultural Development Enterprise
WAB	-	Women's Affairs Bureau
WHO	-	World Health Organization
WRDA	-	Water Resources Development Authority
WSS	-	Water Supply Service
WSSA	-	Water Supply and Sewerage Agency
WSSD	-	Water Supply and Sewerage Service Department (former WSSA)
WWCE	-	Water Works Construction Enterprise
WWDE	-	Water Well Drilling Enterprise

[OTHERS]

BOP	- Balance of Payment
CPP	- Community Participation Promoters
DCI	- Ductile Cast Iron
Dia	- Diameter
DWL	- Dynamic Water Level
EB	- Ethiopian Birr (Birr or birr)
E.C.	- Ethiopian Calender
ERRP	- Ethiopian Relief and Rehabilitation Programme
EIA	- Environmental Impact Assessment
EIRR	- Economic Internal Rate of Return
FIRR	- Financial Internal Rate of Return
FRP	- Fiberglass Reinforced Plastic
GDP	- Gross Domestic Product
GNP	- Gross National Product
GS	- Galvanized Steel
HC	- Household Connection
IEE	- Initial Environmental Examination
lpcd	- liters per capita per day
l/s	- liters per second
m.asl	- meters above mean sea level
mg/l	- milligram per liter
ND or DN	- nominal diameter
NP or PN	- nominal pressure
O & M	- Operation and Maintenance
pa	- per annum
PC	- Private Connection
PF or P.F.	- Public Fountain
pm	- per month
PCM	- Project Cycle Management
PDM	- Project Design Matrix
PVC	- polyvinyl chloride
SWL	- Static Water Level
TB	- Tuberculosis
TOR	- Terms of Reference
USD	- United States Dollar
VES	- Vertical Electric Sounding
WID	- Women in Development
YC	- Yard Connection

Exchange Rate

1 US Dollar = 6.3 Birr

1 US Dollar = 94.5 Yen

1 Birr = 15.0 Yen

GLOSSARY

Belg	- Short & moderate rain in spring, autumn or winter
Birr, Br	- Ethiopian currency unit
Debo	- Small association in rural area to work collectively in farm
Eder	- Community organization for social occasions & social problems
Kebele	- Smallest unit of administration
Keremt	- long & heavy rain in summer
Kilil	- Region (a group of zones)
Shet	- Stream
Wenz	- River
Woreda	- An administrative sub-district (also referred to as Wereda)
Zone	- A group of Weredas

Note: There is, as yet, no standardized spelling of Ethiopian words written in Roman Letters and based on English phonetics. Consequently, different spellings of the same word may be encountered in the report, particularly on the EMA maps.

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Chapter 1 Introduction

1.1 Background

Most of the Ethiopian population do not have adequate and safe access to potable water supplies or sanitation facilities, leaving people vulnerable to water-borne and sanitation-related infectious diseases.

In 1994, only 26 % of the total population and 18 % of the rural population were estimated to have access to potable water. Consequently, the majority of the population is exposed to polluted water and thus to water-borne diseases. It is also estimated that less than 12 % of the total population uses latrines. An estimated 1 % only of the rural population have access to adequate refuse disposal systems.

Surveys of morbidity patterns and levels have pointed the consequence to the effects of poor water supply and hygiene practice, and unsanitary excreta disposal. Addressing health problems through water supply and sanitation activities is evident.

In Bure, water service coverage is 83 %, however the water consumption per capita per day is extremely low with the amount of 10.7 lpcd in average. Although water quality of the sources is acceptable with reference to WHO drinking water guideline in terms of physico-chemical aspects, many faecal coliforms have been detected in samples collected from connections and household containers. This suggests that contamination is expected in such way through cross-connection, leaking and back-siphoning associated with aged facilities.

Although toilet coverage is 57 %, which is relatively high, those toilets are mostly ill-maintained and poorly designed/constructed in terms of ventilation and emptying, thus the majority of the population dispose off their body waste in open field. Also, sullage disposal sites are not prepared, making difficult to dispose of emptied ones. Drainage facilities are not well constructed except ones along main road, constructed by road authority. And, even the drainage along main road is not well maintained, accompanying blockade by garbage or refuse disposal.

In view of the above situation, the Government of Ethiopia (GOE) put priority on the Eleven Centers Water Supply and Sanitation among 230 rural centers listed in the National Development Plan (ERRP 1993-95). Bure is the one, located in Amhara Region, among the Eleven Centers along with Dupti, Mille, Bati, Nefas Mewcha, Aykel, Werota, Debre Tabor, Chagni, Bichena and Dejen as shown on the attached Location Map.

1.2 Overall Progress of the Study

The Team arrived in Ethiopia on January 5, 1995 and submitted the Inception Report to Water Supply and Sewerage Service Department (WSSD). Both parties had discussed and confirmed the plan of approach, plan of operation, schedule of the Study, undertakings of the both parties and other related matters. Following the confirmation, the Team immediately commenced the Phase I survey/study.

The Team had collected and reviewed the existing data and information related to the Study. After reviewing the data and information gathered, reconnaissance survey covering all Eleven Centers had been carried out throughout the month of January by the Team members and their counterparts. The survey was conducted to recognize the overall situation of the centers, give common understandings among the members, and identify the centers to be studied in Phase I and Phase II respectively. Bure was selected for the detailed survey during Phase II. The survey items and major activities are described below:

Meteorological and hydrological survey had been conducted through the aerial photographs, topographical maps, related rainfall/river discharge data collected, and further field observation in order to understand the drainage and recharge systems of the Study area.

For the geological part, geo-electric prospecting (GEP) survey had been conducted to identify the hydrogeological condition to be required for designing water supply systems. The 18 points at each center had been prospected with a maximum depth of 150 meters.

Water quality of the existing water sources and surface water had been examined in terms of physico-chemical characteristics. The analysis items and procedure were made in accordance with WHO drinking water quality guidelines. Also water samples had been undertaken for bacteriological tests, which were collected from the water sources, public fountains, private connections and household containers in order to identify the place of contamination.

Topographic survey had been made along the existing water supply transmission lines and distribution lines through the reservoirs. Also, proposed water supply distribution lines, which start at prospective water source(s) identified by GEP, had been surveyed.

Survey on water use condition had been conducted by filling-out questionnaire form(s) at 100 households as well as schools, institutions, industries, hotels and restaurants in each center. A census for water consumption had also been carried out in all areas being supplied with piped water. These surveys have clarified the water supply quantity and service rate as well as people's demand for water both in quantitative and qualitative aspects.

Survey of sanitary and health condition had been also carried out together with the above water use condition survey. Interviews had been conducted at the above 100 households, and sanitary facilities such as the type of toilet, condition of facility and utilization, treatment of dejecta/excretion and situation of solid wastes disposal had been observed.

Survey of social background aims at minimizing the possible negative effects which may be expected on the society and the people. The survey had been carried out by the same 100-household-interviews, questioning key informants such as Wereda, Kebele, school teachers, health workers and other community leaders, and meetings with various focused groups.

Socio-economic survey had been conducted with 100-household-interviews as well as questioning key organizations and institutions. This survey clarifies household level economy and financial condition of those organizations/institutions, contributing to introduction of affordable water tariff system and sound account of WSS.

Initial environmental examination (IEE) had been carried out on all Eleven Centers during reconnaissance and Phase I surveys. As a result of IEE conducted in Phase I, detailed environmental survey had been carried out during Phase II survey in accordance with the terms of reference made on IEE. Based on the result of IEE and the detailed environmental survey, environmental impact assessment (EIA) for each center had been made in parallel with the project formulation.

Besides the surveys mentioned above, a sanitary education video titled "Simple Steps.....for Better Health" was firstly produced in this water & health sector of Ethiopia with different languages as Amharic, Afar and English.

With the completion of those surveys mentioned above, comprehensive evaluation and understanding of problems had been made based on the present situation. Then, concept and basic strategy of the Project had been formulated at the end of field survey in Phase II, and presented in the Interim Report.

After returning to Japan, the Team started Home Work in Japan to finalize the project formulation based on the concept mentioned in the Interim Report and agreed by WSSD through discussions. Those outcomes are presented in this report together with operation and maintenance manual and sanitary education manual.

Chapter 2 Natural Condition

2.1 Meteorology and Hydrology

Bure is located in mid Gojam in the west of Mangestu mountains. The land has a moderate undulation and all the rivers in the area drain to the Abay.

In Bure, there was a meterological station of NMSA a river gauging station of WRDA on Silala river at the bridge on the road to Debre Markos. However, they were abonduned long time ago. The watershed area of Silala river at the bridge is 38 km^2.

The study team built a gauging station on Manzana stream near the mineral water factory in May, 1995. The watershed area at the station is 2.0 km^2. The flow measurements were conducted in July and August in order to construct the rating curve which aims to convert the gauge readings to discharge values. The rating curve as well as the cross section at the station, the area-depth curve and the table containing daily readings and dischanges are shown in Appendices.

Bure has springs in which two (2) of them are sources of the water supply. Another major spring is located near Edget Behibret elementary school. The locations and the watersheds of those described above are shown in Figure 2.1.1.

Table 2.1.1 shows the long term monthly mean values of precipitation, potential evapotranspiration and air temperature processed from the monthly historical data obtained from NMSA.

Table 2.1.1 Long Term Monthly Mean Values of Precipitation, Potential Evapotranspiration and Air Temperature

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P(mm)	10.9	21.4	34.0	69.0	111.0	162.7	220.5	226.1	122.2	80.0	43.9	21.8	1,123.5
ETo(mm) *	117	116	116	116	115	114	112	111	112	113	115	116	1,373
A.Temp.(°C) *	15.8	16.8	17.7	17.8	15.3	15.3	14.6	14.4	14.6	15.0	15.1	15.1	15.8

Remark: * = Data of Debre Markos

The monthly precipitation is distributed with a peak in August. It ranges from 10.9 mm in January to 226.1 mm in August. The mean annual precipitation amounts to 1,123.5 mm. Since the record of potential evapotranspiration is not available, the data of Debre Markos is listed in the table. the monthly potential evapotranspiration has a very little variation ranging from 11 mm in August to 117 mm in January. The monthly air temperature is not available either. The data listed in the table is of Debre Markos. The monthly air temperature has a range of 14.4°C in August to 17.7 °C in March.

The discharge records of Manzane stream is available for 76 consecutive days from May 28th to August 11th, 1995, covering the late dry season to the mid rainy season. The maximum flow is 2.169 m^3/s observed in July 26th and the minimum flow is 0.011 m^3/s observed in July 17th. According to the probability analysis using log-normal two

parameter distribution function, the average flow, the 275 day flow and the 355 day flow are estimated at 0.076 m^3/s, 0.040 m^3/s and 0.012 m^3/s respectively.

The yield of the springs is available in the report named "Additional Source Development Investigation Report for Bure, 1991". Although it is reported that Spring No. 1 yields 0.5 l/s in dry season, the production of WSS is recorded at 1.9 l/s in June, 1995 which is one of the lowest records of dry seasons in these years. Since Spring No.2 was not functional in these years, the production record is regarded as the sole yield of Spring No.1 and the yield (1.9 l/s) is considered as the 355 day yield of Spring No.1 hereafter.
The average production of rainy season (August and September) of 1993 and 1994 is 5396 m^3/month (2.0 l/s) referring Table 3.2.1, which verifies the reported rainy season yield of Spring No.1.

The average flow of Manzana stream in dry season is estimated to be less than the 275 day flow, because the discharge data does not contain much of the dry season flow. The yield of the springs and the discharge of Manzana stream is summarized below in Table 2.1.2.

Table 2.1.2 Spring Yields and Discharge of Manzana Stream

	Dry Season	Rainy Season
Spring No.1	1.9 l/s(355 day flow)	2.0 l/s
Spring No.2	2.0 l/s	5.0 l/s
Spring near Edget Behibret Elementary School	2.0 l/s	4.0 l/s
Manzana Stream	12 ℓ/s(355 day flow)	-

The ground water recharge in an average year is estimated employing the surface water balance analysis. The water balance sheet for the watershed area of Silala river is prepared as shown in Table 2.1.3 assuming the potential evapotranspiration to be same as the long term one and the reference crop evapotranspiration to be 70% of the potential evapotranspiration. The precipitation data is prepared from the six (6) year records between 1964 and 1976. The runoff data is prepared by the simulation using a Tank model for the years in which precipitation data is available but not runoff data. The model was calibrated with the runoff record and the precipitation record of 1964 and 1965.

Table 2.1.3 Spring Yields and Discharge of Manzana Stream

Unit : mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	6.1	7.9	9.9	79.1	82.7	130.3	264.8	213.4	118.1	91.7	41.1	19.0	1,064.1
Q	6.7	4.5	4.0	4.8	27.6	20.9	119.9	149.6	53.8	29.9	9.5	19.7	450.9
P-Q	*	3.4	5.9	74.3	55.1	109.4	144.9	63.8	64.3	61.8	31.6	*	
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,372
ETcrop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	960.4
ETa	—	3.4	5.9	74.3	55.1	79.8	78.4	63.8	64.3	61.8	31.6	—	—
ΔS	—	0	0	0	0	29.6	66.5	0	0	0	0	—	96.1

Note: P = Precipitation
Q = Runoff
ETo = Potential Evapotranspiration
ETcrop = Reference Crop Evapotranspiration
ETa = Actual Evapotranspiration
ΔS = Recharge
* = Distorted Data
— = not calculated due to missing data or distorted data

According to this sheet, the recharge takes place only in July and August, which amounts to 96.1 mm in an average year. The proposed sites for new wells are located in a small valley adjacent to the watershed area of Silala river to the west. The valley has a watershed area of 0.55 km^2 at VES St. 15 located 1.5 km far from the road to Debre Markos. Since the watershed area is very small, it must be checked if there is a sufficient recharge for the wells.

Yearly water balance sheets were prepared for six (6) years between 1964 and 1976 as shown in Appendices. The recharge of each year is shown in Table 2.1.4.

Table 2.1.4 Monthly Recharge Estimated by Means of Surface Water Balance Analysis, Silala River at Bure

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1964	0	—	—	—	13.5	0	175.0	0	0	0	—	0	188.5
1965	—	0	—	11.0	0	2.0	120.1	0	0	13.9	0	—	147.0
1968	—	—	—	—	0	40.9	117.4	0	0	0	0	—	158.3
1970	0	0	0	0	0	68.3	80.5	0	1.0	—	—	—	149.8
1973	—	—	—	—	0	16.7	0	0	0	37.4	0	—	54.1
1976	—	—	—	—	—	100.3	0	41.3	0	—	—	—	141.6

Note: — = not calculated due to missing data

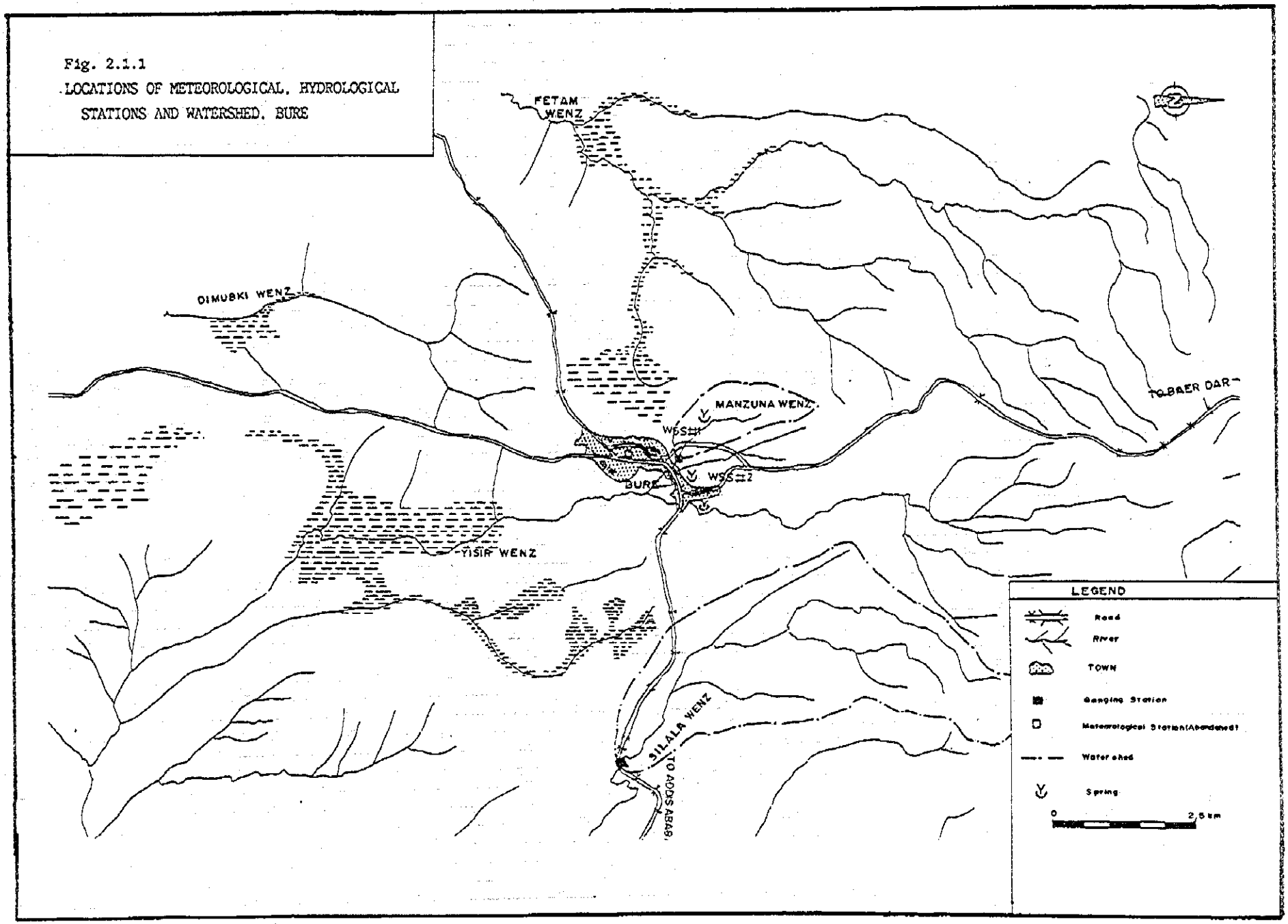
According to the probability analysis of annual recharge using log-normal two parameter distribution function, 5-year recharge and 10-year recharge of dry years are resulted at 90.0 mm and 74.0 mm respectively.

If it is allowed to apply these values for the watershed area of VES St. N. 15, the quantity of recharge is estimated:

5-year recharge $0.090 \times 0.55 \times 10^6 = 0.0495 \times 10^6$ m^3/year
10-year recharge $0.074 \times 0.55 \times 10^6 = 0.0407 \times 10^6$ m^3/year

These are equivalent to 136 m^3/day and 111 m^3/day respectively.

Fig. 2.1.1
LOCATIONS OF METEOROLOGICAL, HYDROLOGICAL STATIONS AND WATERSHED, BURE



2.2 Hydrogeology

2.2.1 Geology

Bure is located on the northern part of the central plateau. The rugged surface and uneven landform which are dissected by seasonal streams spread in the Bure area and the surrounding. The altitude of the area is about 2100 m.asl. Generally, this area gradually dips south and numerous small flood plains are scattered in the southward of the town. Reddish brown soil covers the hills and grayish clay predominates along the valley floor. The alkali basalt and tuff which belong to Ashangi group of paleocene-miocene are overlain by the surface soil. Columnar joints are well present on the basalt. Weathering is observed on the surface of basalt and along the joints.

2.2.2 Hydrogeology

(1) Groundwater

The source of water supply for the town is the springs, Spring No.1 and No.2, which were developed with the assistance of the Government of China in 1975. Spring No.1 is located at about 1 km north of the town and No.2 is located at about 500 m east of the town. The spring water yield reduces during dry season and the seasonal fluctuation is shown as follows.

	Dry season	Rainy season
Spring No.1	0.5 l/s	2.0 l/s
Spring No.2	2.0 l/s	5.0 l/s

(from "Additional Source Development Investigation Report for Bure,1991)

The existence of a number of springs imply that shallow ground water potential is encouraging in this area.

Two wells were drilled at the points along the Yisir River before the construction of the spring water source. These boreholes, however, have not been productive because of the water quality problem which borehole water is mineral rich water and its conductivity is about 3500 micro-mho (from "21 TOWNS WATER SUPPLY AND SANITATION PROJECT PRE-FEASIBILITY STUDY REPORT" by WSSA). The rehabilitation for these boreholes was done due to use of the water source for Bure Baguna Mineral Water Factory. The depth, location of the slot casing and lithological information of these boreholes are not known because drilling reports and lithological logs of the boreholes were not obtained. Only following information is obtained from the rehabilitation work and the pumping test report (by EWWCA,1993).

Borehole No.1	Depth	deeper than 65 m
	Static Water Level	GL-4.0 m
	Safe yield	4.2 l/s
Borehole No.2	Depth	deeper than 62 m
	Static Water Level	GL-4.7 m
	Safe yield	6.2 l/s
	Transmissivity	8.143 m^2/day

Carbonated ground water is observed at the hand dug well near the Borehole No.1. This water is confined ground water, therefore, it implies that impervious strata overlie the shallow part near the subsurface. Carbonated ground water springs out at the river bed of 4km west of the town.

(2) Other Water Source

The Manzena River and the Silala River have sufficient flow as perennial surface water. At present, utilization of the surface water for resource of the water supply to the town is undesirable due to necessity of conventional treatment which could require much investment compared with the ground water resource.

Chapter 3 Present Social, Water Supply and Sanitation Condition

3.1 Result of Water Quality Analysis

Water quality analysis has been made in both physico-chemical and bacteriological aspects, using calorimetric, volumetric analysis and filtration technique methods respectively. In the operational procedure and application of guideline value, "WHO Guidelines for Drinking-Water Quality 1993" has been referred to. The results are shown in Appendix-2 "Result of Water Quality Test" of Appendixes (Volume III).

3.1.1 Physico-chemical aspects

There are six (6) samples tested for the physico-chemical aspects. Of those, each one (1) sample is from spring No.1 and No.2, both of which are the water source operated by WSS, one (1) sample from Manzana Spring located beside the road leading to Bahir Dar with a distance of about 1km away from the town, one (1) sample from a river named Manzana flowing beside Mineral Water Factory under construction, and two (2) samples from an artesian well just beside the factory on different date.

The analyzed parameters for the source (spring No.1&No.2) and Manzana Spring are within the acceptable range set by the WHO guideline. For the sample from the river, color and turbidity are above the guideline value as the river was observed to have been highly turbid. Also, total iron content of 7.55 mg/l for the river sample was found to be above the guideline value set at 0.3 mg/l. At levels of about 0.3 mg/l, the iron stains laundry and plumbing fixtures and causes an undesirable taste in beverages. Moreover, high iron content leads the river water to have high color value (especially true color) and be reddish in appearance.

Samples from the artesian well show that the chemical constituents are above the guideline values in terms of total dissolved solids and total hardness as well as iron, copper and nitrate, and thus the water is highly mineralized and very hard water.

3.1.2 Bacteriological Aspects

Thirty two (32) samples were undertaken for faecal coliform test. Although the water supplied by WSS is regularly chlorinated by calcium hypo-chloride at the collecting chamber and the results are relatively good as compared to other towns', some public fountains and connections showed certain number (0 to 32 in the number per 100 ml) of faecal coliforms. Also, household containers showed considerable level of faecal coliform contamination (0 to too-many-to-count in the faecal coliform number per 100 ml).

There are two (2) samples among those 32, each of which was collected at spring of Manzana and Edgetbehbret, latter of which is located beside the Edgetbehbret elementary school. The former sample showed free from faecal coliform contamination, but the latter showed contamination with 51 number of faecal coliforms per 100 ml.

3.2 Current Water Consumption and Demand

3.2.1 Current Water Consumption and Production

The data of the production and the billed consumption for past 2 years were given by the staff and summarized in Table 3.2.1. According to the consumption data, monthly consumption rate decreases in rainy season. Total consumption and production for past two years are given below.

Production	128,500 m^3
Consumption	101,509 m^3
Losses	about 21 %

3.2.2 Water Users

According to the water consumption census conducted by the Team, it the total population served by the water supply is about 12,200, which accounted for 83% of the total population of 1995. Domestic, institutional, commercial and industrial consumption are estimated based on the consumption records of May, 1995 and the census data. Domestic consumption is subdivided into house connection, yard connection, public fountains and those who buy and borrow water from neighbors (vendors), considering mode of services. Table 3.2.2 shows the results of the data processing.

Table 3.2.2 Water Consumption and Demand

Categories	No. of Customers	Population served		Day Consumption		Day Demand	
		Population	(%)	(m^3)	(LPCD)	(m^3)	(LPCD)
Domestic	2777	12226	(100)	130.5	(10.7)	232.3	(19.0)
House Connection	36	527	(4.3)	12.4	(23.6)	13.2	(25.0)
Yard Connection	425	2817	(23.0)	70.3	(25.0)	70.3	(25.0)
Public Fountain	1917	7654	(62.6)	35.0	(4.6)	125.5	(16.4)
Neighbors	399	1228	(10.06)	12.8	(10.4)	23.2	(18.9)
Institutional	18			8.2			
Commercial	606			14.5			
Industrial	25			4.4			
Total	3426			157.6			

There are 40 customers with house connection. The larger consumers are institutions such as Agriculture Mechanization Enterprise, ETCA, Bure Agro-Technical School and Butchery of the municipality. The former three (3) institutions are located along the Addis Ababa-Bahar Dar road. There are many houses which engsage in businesses such as coffee bars, eateries and hotels (lodgings). The domestic lpcd is calculated at 23.6 from the census data, which is almost same as the domestic lpcd of yard connection customers. The domestic consumption of house connection customers is estimated at 12.4 m^3/day from this lpcd figure and the population served accounted at 527. Their commercial consumption is estimated at 4.4 m^3/day excluding their domestic consumption. The institutional consumption is estimated at 6.6 m^3/day, excluding their domestic consumption as well because there are many residents in the institutions mentioned above. ETCA has many workers and their family members in its camp. Their consumption is

mostly domestic, however all the consumption is sorted as institutional because they are temporarily stationed.

There are 432 customers and many use water for their businesses as well as domestic purposes. The domestic lpcd is calculated at 25.0 from the census data. From this lpcd figure and the population served accounted at 2,817, the domestic consumption of yard connection customers is estimated at 70.3 m^3/day. There are seven (7) institutional customers and their consumption is 1.6 m^3/day. There are 113 commercial customers whose businesses are coffee bars, eateries, breweries (Tej, Tala, Araki houses), tea rooms, shops, grain store, etc. Their commercial consumption is estimated at 9.0 m^3/day, excluding the domestic consumption of the residents. There are six (6) industrial customers who are blocket makers, building contractors, oil mills and grain mills. Their industrial consumption is estimated at 2.3 m^3/day which is mostly of the blocket makers and the building contractors.

Majority of the water users are public fountain users accounting for 63% of the total population served. There are 417 households engaged in small businesses such as breweries (Araki, Tala, Tej houses) and tea rooms. Since the lpcd of PF users is as little as 4.6, it is considered that their consumption for businesses is negligible. There are also five (5) institutions which use PFs. However, their consumption is minimal.

Those who borrow and buy water from the neighbors (vendors) are accounted for 399 households. Their domestic lpcd is calculated at 10.4 from the census data. The domestic consumption of those who borrow and buy water are accordingly estimated at 12.8 m^3/day from the lpcd figure and the population served accounted at 1,228. There are 65 households which engage in small businesses such as brewercial (Araki, Tala, Tej houses), shops and grain mills. Their commercial and industrial consumption are estimated at 1.1 m^3/day and 0.2m3/day.

3.2.3 Current Water Demand

The water required by the users of different mode of services for different domestic purposes was surveyed. In this study, five (5) major categories of the users are adopted including Traditional Source Users (TSU). Six (6) sample households of each category are selected from those which do not give or sell water to neighbors and do not engage any businesses either. Most of the samples are located in Kebele 01 where piped water is relatively sufficient. For the samples of TSU, the area in the east of old Bure is selected, where there is a spring. The survey was not effective for the house connection users because there were very few houses which meet the selection criteria.

The survey result seems very reasonable although the demand of yard connection users is less than their present consumption. This is because many of them use water for gardening.

In order to estimate day demand of those user categories, it is assumed that the demand of yard connection users and house connection users in lpcd is the same as the present consumption of yard connection users in lpcd.

Table 3.2.1 Water Production and Consumption in Bure

	Consumption (m3)														Production (m3)	Unaccounted Losses	
	IC	PF1	PF2	PF3	PF4	PF5	PF6	PF7	PF9	PF10	PF11	PF12	PF13	Sub Total	Grand Total	Chamber	(m3)	(%)
Jul-93	2,097	39	45	61	144	36	147	50	114	70	14	148	10	878	2,975	3,483	508	15
Aug-93	2,939	39	58	38	179	39	98	28	181	77		140		877	3,816	6,403	2,587	40
Sep-93	2,792			50	146		98	49	146	47		145	40	721	3,513	4,634	1,121	24
Oct-93	2,766	49	50	49	146	54	149	50	195	145	36	198		1,121	3,887	4,530	643	14
Nov-93	3,441	50		50	204	93	147	97	186	148		143		1,118	4,559	5,849	1,290	22
Dec-93	3,280		50	49	197	49	149	98	134	98		150	48	1,022	4,302	6,038	1,736	29
Jan-94	3,781	50	50	50	150	99	112	50	100	148	49	195	49	1,102	4,883	5,868	985	17
Feb-94	4,626	47	50	49	100	99	100	50	51	50	49	337		982	5,608	6,440	832	13
Mar-94	4,593	99	50	50	349	98	200	100	49	50	49	344	47	1,485	6,078	6,767	689	10
Apr-94	5,510			49	60	49	53		50	49		32	10	352	5,862	6,201	339	5
May-94	4,142												14	14	4,156	5,228	1,072	21
Jun-94	3,384	66	47	87	198	35	146	66	100	50		87	15	897	4,281	5,498	1,217	22
Jul-94	2,823	48	34	67	106	55	91	49	22	108	91	148	10	829	3,652	4,606	954	21
Aug-94	2,573	33	71	91	140	57	106	84	131	88		68	11	880	3,453	5,383	1,930	36
Sep-94	3,468	117	39	177	118	128	109	56	155	94	5	200	15	1,213	4,681	5,162	481	9
Oct-94	3,560	48	42	90	148	89	117	108	137	223	20	116	18	1,156	4,716	6,162	1,446	23
Nov-94	2,958	36	29	63	115	43	120	86	116	81	25	147	16	877	3,835	5,402	1,567	29
Dec-94	3,221	47	50	80	135	67	118	111	87	84	55	45	21	900	4,121	5,556	1,435	26
Jan-95	3,927	49	53	89	221	65	116	84	83	46	49	121	21	997	4,924	5,962	1,038	17
Feb-95	4,137	52	52	73	198	77	142	87	170	42	18	260	27	1,198	5,335	6,179	844	14
Mar-95	4,188	66	62	84	164	65	144	85	212	61	6	156	40	1,145	5,333	6,308	975	15
Apr-95	4,341	61	56	82	104	50	131	81	187	78	16	216	24	1,086	5,427	5,243	-184	-4
May-95	1,063	45	52	75	125	56	134	75	223	36	18	186	24	1,049	2,112	5,598	3,486	62
Total	79,610													21,899	101,509	128,500	26,991	21
Average															4,413	5,587		
Maximum															6,078			

* Recorded in Ethiopian Calendar

IC: Individual Connection

PF: Public Fountain

3.3 Water Supply Facilities Condition

3.3.1 General

Water source in this town is spring, and water supply is served by the piped water system. The existing water supply system consists of intake facilities, transmission facilities, and distribution facilities as shown 3.3.1.

3.3.2 Water Source

There are two collecting chambers of spring, and water is delivered by gravity to the collecting chamber in the boosting station.

No.1 collecting chamber is made of masonry, and the leakage was observed. No.2 collecting chamber is also made of masonry with the cover, which is jointed by mortar, so it is difficult to maintain the chamber. No measurement instruments are provided, so the current flows are not quantified.

In addition, there is a plan to construct a new spring collecting chamber including pipeline, but the study is yet to be carried out.

3.3.3 Transmission Facilities

The collected water is delivered to the service reservoir by the boosting pump. The existing transmission facilities consists of a collecting chamber with a submersible pump and on-site generator.

The collecting chamber is a R.C. reservoir with a capacity of 150 m^3. Disinfection facility is provided with the collecting chamber previously but is not presently functioning. Collecting chamber is equipped with a pressure gauge, flush-out, flow meter, and a check valve. Air pressure and flow were quantified at 12.4 kg/cm^2 and 5.8 l/s, respectively. The existing submersible pump is driven by one on-site generator. The existing generator is of Indian-made with a capacity of 30KVA. A submersible pump is installed in the collecting chamber, and the specifications of the pump are not available.

Water is supplied directly to the town from the collecting chamber by pumping. The existing service reservoir is located near the church and cylinder R.C. reservoir with a capacity of 150 m^3. No measurement appurtenance was provided, and no leakage was observed.

The distribution network is branched system with galvanized steel pipes and DCI. The diameters of the pipes range from DN 32 to DN 100. The lengths of pipelines including rising main are summarized as follows:

Table 3.3.1 Existing pipeline data (Bure)

Diameter (mm)	Length (m)	Material
32	150	GS
40	1080	-do-
50	1180	-do-
65	1280	-do-
80	3410	-do-
80	430	DCI
100	2250	GS

3.3.4 Service Level

Water service level is divided into two modes: individual connection and public fountain. There are 481 individual connections, and the individual connection is subdivided into 4 categories:private(441), commercial(24), and governmental & public institution(16). Individual connection is about 78% of the total consumption, and public fountain about 22%.

About 200 customers have requested to change for house connection since the past three years. Of these 200 water users, only 20 customers have connected.

There are 13 public fountains, and operational 12 public fountain. The design of the fountain is a cylinder-type, and four faucets per public fountains are provided.

3.3.5 Disinfection

There is no disinfection facility in the existing water supply system. Chlorine is added in the service reservoir two or three times annually.

3.3.6 O & M

Bure is classified as urban town, and the waterworks is under the control of the Regional Office in Amhara Region. This office manages three satellite towns. WSS office is managing not only financial works but also maintenance works. Daily routine work and simple maintenance such as switching on/off of the generator, the replacement of valve and meter, etc. are carried out by the staff stationed. Major maintenance such as the replacement of the pipes and pumps is carried out with the assistance of the Regional Office. WSS office has neither the vehicle nor spareparts and has only few tools for daily routine work.

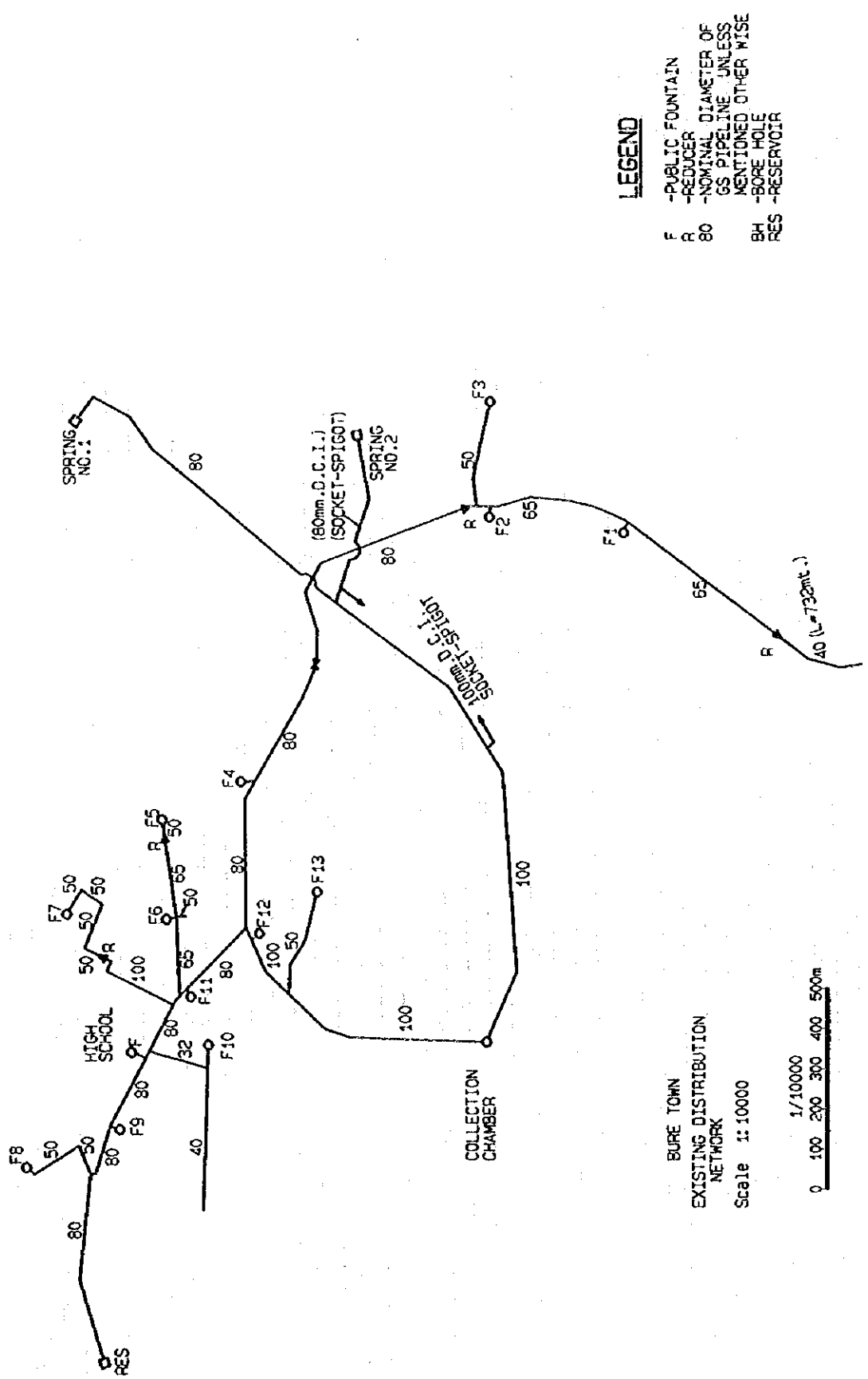


Figure 3.3.1 Schematic layout of Existing Facilities (No scale)

3.4 Sanitary Facilities Condition

3.4.1 Toilet Facilities

The people of Bure use traditional pit latrines, open-field toilets as toilet facilities. There was once one public toilet at the bus terminal in Bure. The toilet is now completely filled up, and the people use the open-area nearby to discharge their body wastes. There is no sewerage system in Bure.

The Population and Housing Census of 1984 and updated in 1993, has reported on the distribution of housing units by type of toilet facilities used as follows;

Table 3.4.1 Distribution of Housing Units by Type of Toilet Facilities in Bure

Number and percentage	Type of Toilet Facility						
	Flush		Dry pit		None (open-field)	Other	Total
	Private	Shared	Private	Shared			
• Number	41	3	367	157	1,281	22	1,871
• Percentage (%)	2.2	0.1	19.6	8.4	68.5	1.2	100.0

Table 3.4.1 indicates that 68.5% of people in Bure do not have toilet facilities and they are using open-area for disposing their body wastes; while 28% use dry pit latrines and only 2.3% have flush toilets.

The Team has carried out a survey of 100 households in Bure. The results pertaining to sanitation is indicated in Table 3.4.2.

Table 3.4.2 Results of the Survey of 100 Households in Bure Pertaining to Toilet Facilities

Percentage	Type of Toilet Facility					
	Septic Tank	Dry Pit Latrine	Community Toilet	Open field	Other	Total
%	-	57	-	43	-	100

The above tabulation indicates that 57 households out of 100 use dry pit latrines as toilet facilities, and 43 households do not have any kind of toilets, but use open-field for disposing their body wastes.

The most frequently used toilet facility, the pit latrines, get filled up usually in 2-3 years. If the owners have space they dig new ones. If the owners do not have space, they either will have them emptied by vacuum truck if they can afford to pay and if they can arrange to get vacuum truck from Bahir Dar or Debre Markos. Usually it is difficult to get one, and most of the time the people start to use open-area for excreta disposal. If the people of Bure can get a vacuum truck from Bahir Dar or Debre Markos and have their latrines emptied, there is no prepared place to dump the sludge. It is dumped at the outskirts of the town where convenience place is available.

The Population and Housing Census of 1984 has also surveyed the distribution of housing units by type of materials used to construct the walls, roofs and floors. The result is shown in Table 3.4.3 below:

Table 3.4.3 Distribution of Housing Units by type of Materials used in the Construction of Walls, Roofs and Floors in Bure

Wall			Roof		Floor		
Wood & Mud	Stone & Mud	Stone & Cement	Corrugated Iron Sheet	Thatched (Grass)	Earth/Mud	Cement/ Concrete	Wood Tile
94%	<1%	<2%	90%	7%	90%	4%	<2%

In Bure, as it can be seen from the Table 3.4.1, 94% of the walls of the households are constructed out of wood and mud, 90% of the roofs out of corrugated iron sheets, and 90% of the floors out of earth/mud. The toilet facilities follow the same pattern of the housing units regarding use of local materials with exception of flooring where toilets in addition to sticks covered with mud/earth, they make considerable use of cement/ concrete as flooring.

3.4.2 Other Sanitary Facilities

Most of the people in Bure throw the dry solid wastes along the streets and in open are nearby. The survey of 100 households carried out by the Team has revealed the following pertaining to disposal of refuse.

- 60% of the households throw refuse anywhere where it is convenient,
- 21% dump in open pit,
- 19% dump in covered pit, and
- none of them burn the refuse.

The same survey showed the following formation regarding disposal of sullage.

- 82% of the households out of one hundred throw their sullages anywhere,
- 13% they dump in pits,
- 4% in drains, and
- 1% they dump in vegetable gardens.

This dumping of dry wastes and sullage everywhere has greatly created environmental pollution, water contamination and serious health hazards specially to children.

There are as such no industries in Bure, and consequently there are no industrial wastes. Bure does not have abattoir. The people slaughter their meat animals at any convenient places and throw the resulting wastes nearby.

There are no adequate storm drainage facilities in Bure except for along the two major roads that pass through the town. Even here since maintenance is not regular, some of drainage facilities are blocked by rubbishes and outside solid materials. The secondary

roads within the town do not have ample drainage facilities, and stagnation of water occurs during the rainy season.

3.5 Organization and Management

It is advised to refer to Tables 1 and 2 of Appendix-5 when you read this section.

The number of personnel for the Water Supply Service of Bure is 22, which is the second largest among the 11 towns. Its breakdown by position/function is shown below.

Table 3.5.1 Number of Personnel and Positions/Functions

Positions/Functions	Gender		Type of Employment		
	M	F	Permanent	Contract	Temporary
1. Head, WSS	1	0	1	0	0
2. Administration					
Head	1	0	1	0	0
Admi. clerk	1	0	1	0	0
Store clerk	0	1	1	0	0
Store keeper	1	0	1	0	0
Guards	4	0	4	0	0
Cleaner	0	1	1	0	0
Sub-total	7	2	9	0	0
3. Finance					
Head	1	0	1	0	0
Accountant	1	0	1	0	0
Cashier	1	0	1	0	0
Bill collector	0	1	1	0	0
Meter reader	1	0	1	0	0
Water sellers	0	4	4	0	0
Sub-total	4	5	9	0	0
4. Technical					
Motor operator	1	0	1	0	0
Plumbers	2	0	2	0	0
Sub-total	3	0	3	0	0
Total	15	7	22	0	0

As the table shows, there are only permanent workers. Female workers are 7 in number or 32%. It is more than 27%, which is the average percentage of female workers in 11 towns. When one classifies the functions into administrative, financial and technical ones, the head of WSS being included in technical functions, their respective shares work out to 41%, 41% and 18%. On the other hand, their 11 town averages are 37%, 41% and 22%. It means that the broad functional composition of personnel is not much different from that of the 11 town average.

Annual water production per worker, which is the broadest labor productivity indicator is calculated at 3,013 m^3. It is at a medium level. The monthly remuneration per worker is 241 birr, which is the highest.

It follows from the above that female participation in the workforce is marked and there is no problem regarding the functional composition of personnel, but there might be problems regarding the size of workforce and the level of remuneration.

3.6 Financial Condition of WSS

It is advised to refer to Tables 1 and 2 in Appendix-5 when you read this section.

The price of water is 1 birr per m^3 for all clients.

Production and consumption of water in the last fiscal year (Jul. 1993 to Jun. 1994) were 66,278 m^3 and 55,008 m^3 respectively. Both are one of the largest among the 11 towns (NO. 3). Leakage ratio works out to 17.0%, which is on the low side. The daily water consumption as divided by population comes to 10.2 liter. This is on the high side.

Income for the last year was 66,791 birr. The major sources of income are meter water sales (64.8%), cash water sales (16.7%), water meter rental (7.6%) and service charge (2.3%). Income per m^3 of water consumed works out to 1.21 birr, which is at the lowest level among the 11 towns. Bill collection rate is 98.2%, which is the second highest, next to 99.9% in Werota.

Expenditures for the same year were 102,309 birr. Major items of expenditures were salaries (60.9%), fuel (23.9%) and office supply (3.8%). Expenditures per m^3 of water produced work out to 1.54 birr, which is at a medium level. The income-expenditure ratio comes to 65.3%. This is one of the lowest among the 11 towns.

The number of personnel is 22. It is the second largest, following 25 in Bati. Annual water production per worker is calculated at 3,013 m^3, which is at a medium level. Annual income per worker is 3,035 birr, which is on the low side. Expenditures per worker are 4,650 birr, which is the second highest, following 5,290 birr in Bati. Average monthly salaries are 241 birr. It is the highest among the 11 towns.

It follows from the above that managerial disciplines are well practiced, exemplified by a low leakage ratio and a high bill collection rate. However, two factors contribute to pulling down the incom-expenditure ratio deeply below the break-even point. One is an over-sized workforce coupled with too high remuneration. Another is a lack of efforts to look for income sources other than water charge.

3.7 Social Background and People's Awareness

3.7.1 Population and Social Composition

During the field survey period, Bure had a population of 14,742. Responses to the household questionnaire suggested a ratio of 96% Amhara, 2% Oromo and 2% Agew. 96% of respondents spoke Amharic as their first language. The religious mix from the household survey was 93% Christian and 7% Muslims. The land ownership level of the respondents was 31%, there were 26% female headed households and the average family size was relatively large at 6.8. The town has 4 Christian based EDERs and one Muslim Society fulfilling a similar social function to the EDER's. There is a large market on Saturdays and on Tuesdays. Kebele 01 and 03 are mostly business people and therefore are the more wealthy sectors. Kebele 04 includes the area with the poorest people.

3.7.2 Sanitary Condition

A large number of people in Bure did not have latrines and practiced open defecation, including the poor, those in rented housing and the business people who owned their own houses. The household survey indicated that 42% of respondents practiced open defecation. For most people in Bure the lack of control over land for latrine construction seemed to be the major reason for the lack of latrines. For some there is also the issues of lack of affordability and lack of motivation. Lack of health awareness may not a constraint; the group meetings revealed a reasonable awareness of water and sanitation related disease prevention. However, the household survey indicated that only 32% of respondents knew fully about the prevention of diarrhea.

People were in favor of community latrines and said that they could manage them and keep them clean by themselves. The majority of groups preferred to share the facility by groups of families. No groups requested pour flush latrines but the household survey recorded 72 households in favor of loans for sanitation facilities. Not all groups could afford to consider having water in the latrines for cleaning purposes or afford desludging. If a public shower facility were available in the center of Bure, the facility would be used by some men and women if the service was relatively inexpensive.

3.7.3 Water Situation

The water situation in Bure did not appear to be critical during the site visit in July 1995. However people in the group meetings identified water as their first priority need. The majority of town people use spring water, piped water, well water, rain water and river water on occasions for all purposes. There were reported to be large queues at the springs for water. Both water collection and laundry were undertaken mostly by women using any of the available sources. The household survey indicated that well, spring and river water was collected mostly by women, a little by girls and a very small amount by boys and men. Water from public fountains almost exclusively by females. Women would benefit most from improvements in the availability of piped water.

The center of the town was well served with public fountains and private connections however the area below the WSS office and some outer edges of the town were some

distance from the nearest piped supply and this was the source of much community concern. When functioning, the supply from the public fountains seemed to be insufficient to supply the water demand of the town. Public fountains did not operate on Sundays as water sellers did not work on Sundays. The price of water was fixed at 10 cents for three average size clay pots from public fountains. The cost was about 10 cents for one clay pot from private connection vendors. Most groups said they were prepared to pay more for a better water supply service, only the poorest group (Group 1) said that they were unable to pay any more for water.

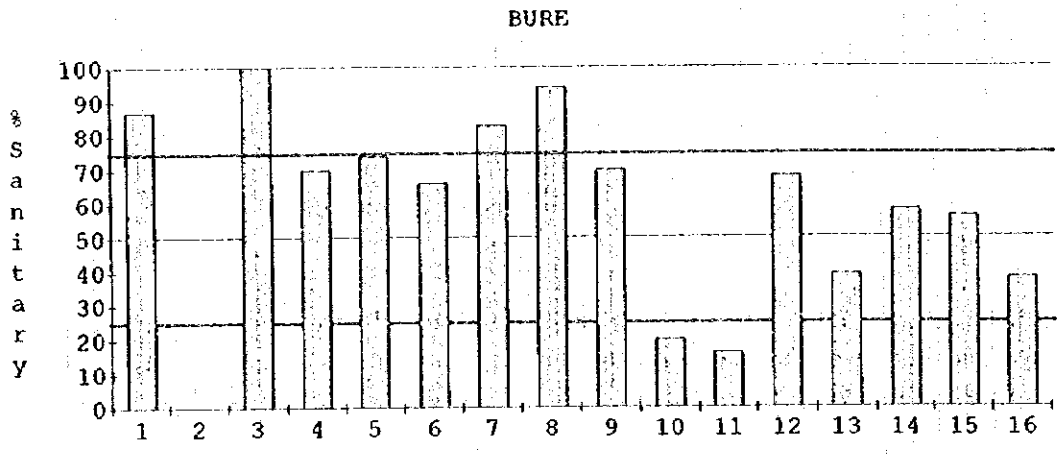
The main requirement was longer water point service time. In the area covered by the water supply system there were probably enough public fountains to satisfy demand if they functioned for four hours every day. However there were areas where additional public fountains were required. In these sites people expressed an interest in community management of these new public fountains. A number of other people expressed a desire and ability to pay for private water connections, including some who have already lodged their request with the WSS office.

3.7.4 Health Indicators

Bure had a Health Center which served a population of 86,795 (the Woreda). Among the staff there were two sanitarians. The sanitation program has had serious problems due to a lack of budget. Intestinal Parasites were the most common cause of people presenting at the health center in 1994/5 and the next most common diseases included amebic dysentery, typhoid and shigella dysentery. Malaria and Elephantiasis (Filariasis) were also common diseases among people living in the more rural areas of the Woreda.

The household survey reported that only 32% of households had received health education in the town and of them 65% were satisfied by it. 18 responded that they would like the Authorities to provide health education as part of the sanitation program. Most groups were aware of the sanitary education program being carried out at the health center to in-patients. The health center staff thought they would be more effective if they had materials to make the health education inputs more interesting. At that time all health education is verbal. There was also a need for more community health agents and TBAs, all of whom require incentives and a small budget for materials. The health center supported the school's Anti-AIDS and Red Cross Clubs.

The town population had a relatively low level of sanitary awareness compared with other towns in the study. This is lower still for people in the lowest income groups. However the chart below shows the average level of indicator sanitary behaviors recorded in the household survey. The major gaps in sanitary behaviors seemed to be the use of piped water supply always, safe disposal of refuse and drainage of waste water. The safe disposal of children's excreta and excessive fly numbers were also poor. Food and water hygiene was reasonable. 74% of households said they washed their hands with soap after defecating and 66% of households with young children said they washed their hands with soap after handling children's stools. 18% of respondents requested sanitary education as part of any sanitation program. Poorer people have lower access to latrines and poorer management of children's excreta.



No.	SANITARY BEHAVIOURS	%Sanitary
1	Access to piped water	87
2	Use piped water supply always	0
3	Covered water container	100
4	Water scoop kept off the floor	70
5	Handwashing with soap after defecating	74
6	" after handling childrens stools*	66
7	Covering cooked food during storage	83
8	Not eating unwashed raw fruit and vegetables	94
9	Kitchen utensils stored off the floor	70
10	Rubbish burried or burned	20
11	Wastewater disposed in pit/drain/veg. garden	16
12	No animals kept in the house	68
13	Home not infested with flies	39
14	Latrine in use by household	58
15	Latrine in use by all household members	56
16	Infant's excreta disposed of in latrine*	38
TOTAL SCORE FOR SANITARY BEHAVIOURS		939

*As proportion of households with young children

Figure 3.7.1 Indicator Sanitary Behaviours

3.7.5 Education

Bure had one elementary school, three junior schools, one junior high school and a new senior high school for grades 10 to 12. The percentage of female staff at the schools included in the questionnaire survey was 46% for elementary schools and only 9% for the high school. There were 816 pupils at the senior high school of which 443 were boys and 374 were girls. The school operated a shift system. In class 10 the sexes were equal in number but in the higher grades there were increasingly more boys than girls. Girls tended to have a higher drop out rate than boys and tended to do less well at their studies. Girls tended to have more work to do in the home and therefore have less time to study than boys.

The school had a Health/Anti AIDS and Red Cross Club, led by the science teachers and well supported by the staff of the health center on request. Health education had been given to these clubs at flag ceremonies, sometimes by the health center staff. Subjects included HIV and other common diseases.

There were no water facilities at the school, so a nearby spring was being used. There were latrines for boys and girls, located away from each other. Boys were using their latrine more than the girls used theirs, because traditionally girls are discouraged from excreting during the day.

3.7.6 Religious institutions

The Abo Church had not already been involved with sanitary education, but they had been handing out pamphlets about HIV and AIDS. Although willing to participate in health education, the Priests felt that people's awareness was such that sanitation would automatically improve if the economic situation improved. The Church had requested a private connection and had no access to latrines. The Priests felt that community latrines would be a good option for poor communities and for the area near the Church and could assist with the management and organization of this facility.

The Mosque was new. It already had a private connection and had plans to construct a latrine. The elders considered that community latrines would be a solution to the sanitation problem faced by poorer people in the town. The Mosque had not been involved in health education to date but was willing to get involved. Females and males normally attended the Mosque hence this channel would give access to both sexes in the Muslim community.

From the household survey, the responses showed that Muslims are few in number but have a wide variety of incomes and generally have good access to facilities.

3.8 Socio-Economy

It is advised to refer to Tables 3 and 4 in Appendix-5 when you read this section.

3.8.1 Administrative Conditions

There are 20 governmental organizations excluding schools dealing with general administration, finance, education, health, water supply and sanitation, communications, police, justice, water resources development, agriculture, culture & sports, road transport, road construction, commerce, and municipal affairs.

The number of government employees is 845. It is the second largest, following 1,674 in Debre Tabor. The number of them per 1,000 population works out to 57, which is on the high side. Their average monthly salaries are 292 birr, which is the lowest among the 11 towns.

Bure can be said to be one of the towns where government functions concentrate.

This town has four Kebele. There are one NGO and eight public organizations.

3.8.2 Population

The population of the town is estimated at 14,742 based on the results of the cartographic census conducted by Central Statistical Authority in 1993. It belongs to a medium size group among the 11 towns. Ethnically, Amhara is dominant, occupying 94.1% of population, followed by Agew with 3.9% and Oromo with 2.0%. Religion-wise, 92% of the population is Christians and 7% Moslems. There are 3 churches and 1 mosque.

This is one of the Amhara and Christian towns.

The average family size is 6.8 persons. This is the biggest along with Dejen among the towns concerned. The area of the town is 1,280 ha. It is one of the largest. The population density is calculated at 11.5 persons/ha. This is the second lowest, next to the estimated 9.2 persons/ha in Dupti.

Bure is a growing town and has much potential to be developed in future.

3.8.3 Educational Conditions

There are 2 kindergartens, 3 elementary schools, and 1 junior high school and 1 senior high school. The total number of pupils/students is 4,388. It is on the large side (No. 3) among the 11 towns. The number of pupils/students per 100 population is calculated at 30, which is on the high side (No. 3).

Literacy ratio and primary school enrollment ratio were 61.3% and 69.4% respectively according to the 1984 population census. The former is the second lowest, next to 48% in Bati. The latter is on the high side. This is the situation 11 years ago. Since the town has markedly grown since then, the present status might be different.

Bure can be characterized as an educational town.

3.8.4 Medical Conditions

There are 1 health center and 2 pharmacies. The total number of medical personnel in the health center comes to 22, which is medium among the 11 towns. It means that there are 1.5 medical personnel for every 1,000 population. It is at a medium level.

The types of diseases people suffer most are water-borne and sanitation-related diseases such as intestinal parasites, skin infections, diarrhea and T.B., and respiratory tract infections such as bronchitis, upper respiratory tract infection and pneumonia. The number of top ten disease cases treated in the medical institutions in 1993/94 was 15,112, which is on the large side among the 11 towns.

The estimated total number of cases treated last year in the hospital was divided by the estimated service population. It came to 30.7%, which is one of the highest (No. 3).

Under 5 mortality rate and life expectancy were 130.9/1,000 and 56.0 years respectively according to the 1984 population census. The former is on the low side, while the latter is on the high side.

Ratio of households more or less using septic tanks and pit latrines is 58%. This is at a medium level.

It is to be noticed from the above that the incidence of diseases is on the high side, although other medical/sanitary indicators are average or better among the 11 towns. More efforts in the related fields, such as more medical personnel and promotion of the dissemination of sanitation facilities are to be desired.

3.8.5 Economic Conditions

The number of hotels and restaurants is 65 (26.4%), that of shops 140 (56.9%), that of cottage industry 30 (12.2%) and that of others 11 (4.5%), adding up to 246 (100.0%). This total number of commercial/industrial establishments is on the small side among the 11 towns. The total number per 1,000 population comes to 17, which is at the lowest level along with Bati. The number of hotels and restaurants per 1,000 population is 3, which is one of the lowest.

It appears that the existing economic environment is not commensurate with the growing population.

Major occupations in the town are trade, agriculture, day laborers, government employees and industry.

Major products are edible oil and flour. Major marketable items are agricultural products such as tef, dagusa, maize and barley, livestock such as oxes, cows, sheep, goats, donkeys, mules, horses and chickens, etc.

The market is held twice in a week. 10,000 and 25,000 people are said to gather on Tuesday and Saturday respectively.

The average monthly household income is 252.7 birr. This is medium among the 11 towns.

3.9 Town Planning and Development

The master plan for town planning has been formulated in the era of the Imperial government. According to the field survey, it is expected that fifty percent of the current master plan has been completed as shown in Figure 3.9.1.

The electric power is now supplied to the Centers by the hydroelectric power by EELPA, but the existing water supply facilities is operated by the on-site generators. The future water supply facilities at the target year of 2005 and 2010 will be also operated by the hydroelectric power.

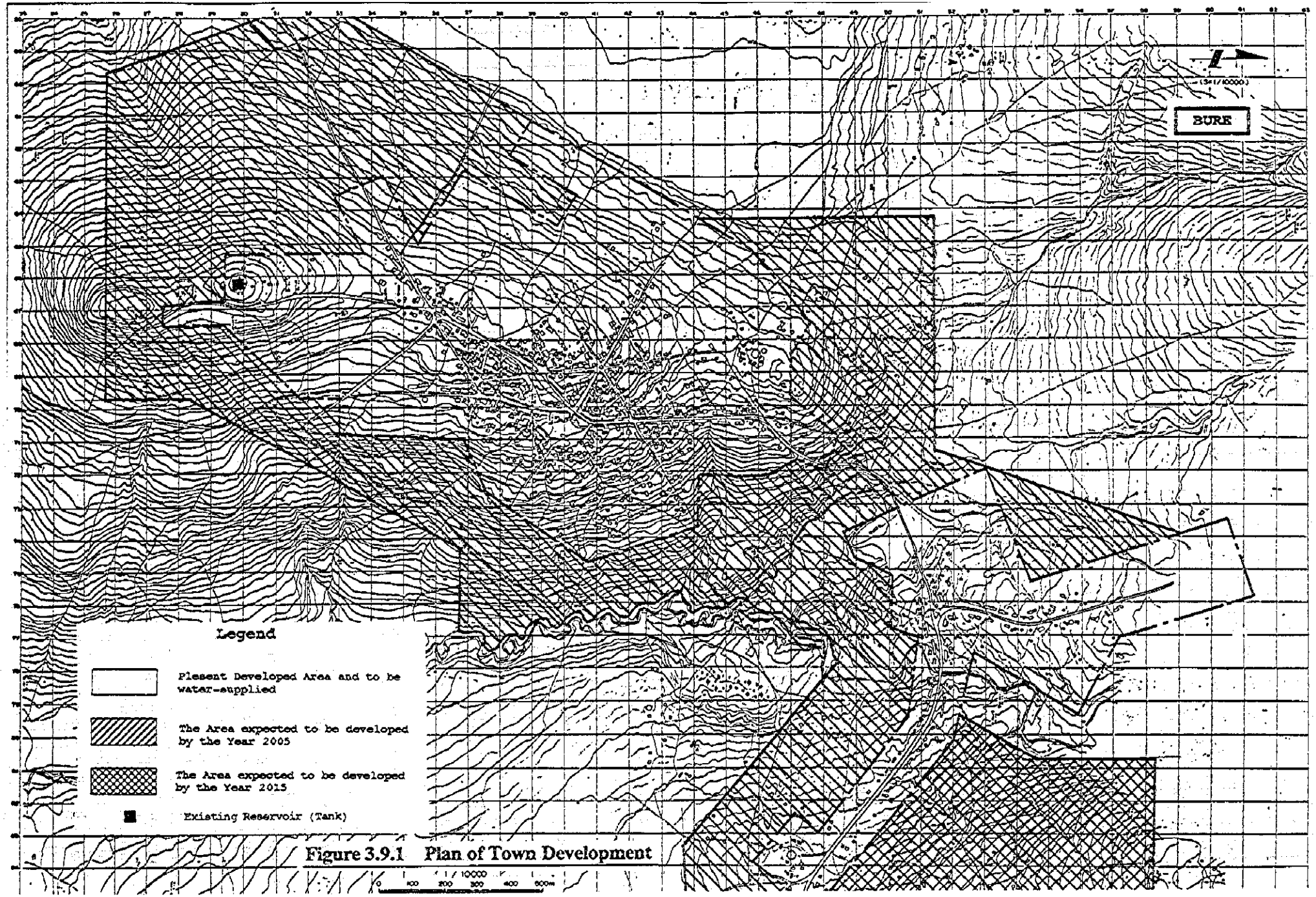


Figure 3.9.1 Plan of Town Development

Chapter 4 Plan of Water Supply System

4.1 Water Demand Projection

4.1.1 Population Projection

The population of Bure was 8,191 in 1984 according to the results of the 1984 Population Census. The census is the first one the Ethiopian government has ever took.

Before 1984 no established population figures are available. However, Central Statistical Authority (CSA) published 1974 population estimates for those towns whose population was supposed to be more than 2,000. Also, it had similar 1972 and 1973 estimates.

According to CSA estimates, 1974 population for the town was 7,440. Similarly, 1972 and 1973 population was 6,570 and 6,990 respectively. When one adopts CSA estimates, the average annual population growth rate during the 10 years 1974 to 1984 is calculated at 0.97%.

Since 1984 also CSA published its own estimates of population. According to them population of the town in 1992 and 1993 was 15,353 and 16,291 respectively.

In 1993 to 1994 CSA conducted the Cartographic Census for all the towns over the nation, using its own staff just before the 1994 Population Census. CSA says the results of the former is dependable, even more than those of the latter.

According to the Cartographic Census the population of the town was 13,250 in 1993. When one uses the figures, the average annual population growth rate during the 9 years from 1984 to 1993 works out to 5.49%. The JICA Study Team projected future population of the town based on the rate.

In October, 1994 the second Population Census was carried out. The results are not yet published. There was no way for the team to get even the preliminary figures of the census for Bure. Therefore, the team projected the 1995 population using the 1984 to 1993 average annual growth rate. It came to 14,745.

Weroda people consider the Finote Salem - Bure Hydro-Electric Power Project now being implemented to be important for the future development of the town. Also, it is to be noted that a mineral water factory is being constructed.

As the average annual population growth rate 1995 to 2000 5.0% was adopted based on the average annual population growth rate 1984 to 1993. The more a projection is long-term, the more the incertainty increases regarding the projection. Therefore, one should be more cautious and conservative for a longer-term projection. In line with this reasoning the average annual population growth rates 2000 to 2005 and 2005 to 2010 were projected to be 4.5% and 4.0% respectively.

As a result the projected population of the town for 2000, 2005 and 2010 works out to 18,819, 23,452 and 28,533 respectively (Refer to Table 4.1.1).

Table 4.1.1 Population of Bure

1. Past Population

1974 Estimates by CSA	1984 Population Census	Average Annual Growth Rate 1974 to 1984
7,440	8,191	0.97%
1984 Population Census	1993 Cartographic Census	Average Annual Growth Rate 1984 to 1993
8,191	13,250	5.49%

2. Population Projection

1995	2000	Average Annual Growth Rate 1995 to 2000
14,745	18,819	5.0%
2000	2005	Average Annual Growth Rate 2000 to 2005
18,819	23,452	4.5%
2005	2010	Average Annual Growth Rate 2005 to 2010
23,452	28,533	4.0%

4.1.2 Water Demand Projection

(1) Domestic Water Demand

a) Population Projection by Service Modes

Based on the current population data by service modes, the population at the target years by modes is projected and estimated in the Table 4.1.2.

95% of the population is targeted at the year of 2010 to be served by the piped water system, and the ratio served by the traditional water source is estimated at 5%, considering the current ratio of the population served. Based on the the ratio of the households who are payable for the mode-wise water charge, target ratio of the sum of house and yard connections (YC) at the year of 2010 is 60%, and 20% of this ratio is house connection (HC).

Table 4.1.2 Population Forecast by Service Modes

	Population (%)							
	1995		2000		2005		2010	
HC	527	(3.6)	1,185	(6.3)	2,743	(11.7)	5,705	(20.0)
YC	4,045	(27.4)	5,551	(29.5)	7,926	(33.8)	11,413	(40.0)
PF	7,654	(51.9)	10,000	(53.1)	11,060	(47.2)	9,990	(35.0)
Sub total	12,226	(82.9)	16,736	(88.9)	21,729	(92.7)	27,108	(95.0)
TSU	2,519	17.1	2,083	11.1	1,723	7.3	1,425	5.0
Total	14,745	100.0	18,819	100.0	23,452	100.0	28,533	100.0

b) Projection of Domestic Water Demand

Water demand figure by service modes formulated by WSSA is applied for the projection, i.e, House Connection 60 lpcd, Yard Connection 35 lpcd, Public Fountain 15 lpcd. In addition, these figures multiply by 0.9, considering the natural condition (annual mean rainfall is more than 900 mm). Based on these conditions, the domestic water demands at the years of 2000, 2005 and 2010 are obtained as follows:

Table 4.1.3 Total & Average Domestic Water Demand

	m^3/day (lpcd)							
	1995		2000		2005		2010	
HC	12	(23.6)	64	(54)	159	(58)	359	(63)
YC	83	(20.5)	178	(32)	269	(34)	422	(37)
PF	35	(4.6)	140	(14)	166	(15)	160	(16)
Total	131		382		594		942	
Average	44	(10.7)	127	(23)	198	(27)	314	(35)

(2) Non Domestic Water Demand

a) Current Non Domestic Water Demand

As a result of field survey, the following current non domestic water demand is obtained.

Table 4.1.4 Current Non Domestic Water Demand

Item	Unit	Nos.	Demand (m^3/day)	Remarks
School	5 l/person	4,388	21.9	
Hospital	20 l/staff	24	0.5	
Hotel	100 l/bed	228	22.8	6 beds/place × 38 places = 228 beds
Bar...	200 l/bar	7	1.4	
Mosque	5 l/visitor	200	0.2	200 visitors/place × 1 place = 200
Offices	5 l/person	845	4.2	
Total			51.0	

b) Non Domestic Water Demand in Target Years

The public and institutional water demand increase in a geometric ratio of population growth, and the commercial water demand increases in a geometric ratio of population growth plus 3%. Non domestic water demands in the target years are estimated as follows:

Table 4.1.5 Total Non Domestic Water Demand in Target Years

Item	Demand (m^3/day)				Remarks
	1995	2000	2005	2010	
School	21.9	28.0	34.9	42.5	Population growth rate
Hospital	0.5	0.6	0.7	0.9	-do-
Hotel	22.8	33.5	48.1	67.5	Population growth rate +3%
Bar, Tea shop	1.4	2.1	3.0	4.2	-do-
Mosques	0.2	0.3	0.4	0.5	Population growth rate
Offices	4.2	5.4	6.7	8.2	-do-
Total	51	70	94	124	

(3) Total Water Demand

Total water demand at the target years including the accounted losses are estimated as follows:

Table 4.1.6 Total Water Demand in Target Years (m^3/day)

	1995*	2000	2005	2010
Domestic	131	382	594	942
Non Domestic	27	70	94	124
Losses	42	50	94	188
Total	200	502	782	1,254

* Actual consumption

(4) Maximum Day Demand and Peak Day Demand

Taking the seasonal difference into account, the factor 1.2 is adopted for the projection of maximum day demand. Furthermore, the factor 1.6 is adopted for the projection of peak day demand. The maximum day demand and peak day demand at the target years are obtained as follows:

Table 4.1.7 Maximum Day Demand Peak Day Demand

Item	Factor	1995	2000	2005	2010
Average Water Demand (m^3/day)		200	502	782	1,254
Maximum Day Demand (m^3/day)	1.2	240	602	938	1,505
Peak Day Demand (m^3/hour)	1.6	16	40	63	100

4.2 Water Resources Development

4.2.1 Evaluation of Water Resources

Bure has annual precipitation of 1,123.5mm and annual ground water recharge of 96.1 mm in an average year. The perennial river nearest to the town is Yisir river. Manzana stream is a tributary of Yisir river flowing between Old Bure and New Bure. This stream is also perennial.

The Study Team build a gauging station on this stream in May, 1995. The daily discharge data of a few months is available. There are some springs in Bure in which two (2) springs are sources of the water supply. Another major spring is located in Old Bure near Edget Behibret elementary school. The yields of the springs aforementioned and the discharges of Manzana stream is described in 2.1 and the representative figures are shown in Table 2.1.2. However, the record of Manzana stream is short and thus it is statistically insufficient.

Ground water development in the town area is not feasible because the water is rich in minerals and carbonated. The WSS had two (2) deep wells but had transferred them to the mineral water factory as the water is not suitable for water supply. Those wells which yield potable water are located more than 10 kms far from the town.

The geology of the area is described that basalts and tuffs of Ashangi group are dominant but sedimentary rocks are rare. The area is dissected by the linearments according to the aerial photograph interpretation. The primary permeability of volcanic rocks is low but it could be increased with secondary porosity caused by faults and fracture openings. It is expected that the rocks are fractured and weathered along the linearments as favorable as for ground water exploitation.

Geoelectrical survey was conducted at 18 points including the existing deep well sites as shown in Drawing. Majority of the apparent resistivity curves show bumpy shapes whose values range from 10 to 100 ohm-m. These stations have the layers of 10 to 50 ohm-m in specific resistivity, which imply existence of water bearing weathered and fractured basalts. The curves of Station No.4, No.5 and No.6 show simple forms whose inflection points with apparent resistivity values of 10 to 20 ohm-m are marked at about 10m depth and the values simply rise up to about 100m depth. In subsurface shallower than 10m, the specific resistivity values range from 10 to 20 ohm-m and it implies the existence of rich shallow ground water. In the deeper portion below 10m, the specific resistivity values range from 50 to 420 ohm-m which imply the values of fresh basalt or weathered basalt without water. The results of VES interpretation are shown in Appendices.

Considering the lineation, the result of VES interpretation and the locations preferably not around the town because of the water quality problem, borehole sites are selected at VES Station No.12 and then No.15 totally two (2) sites. Since the watershed area for St. No.15 is very small i.e. 0.55 km^2, the 5-year annual recharge of dry years is checked as described in 2.1. It is estimated to be equivalent to 142 m^3/day.

4.2.2 Strategy of Water Resources Development

Spring No.1 and No.2 and new deep wells are considered in this development plan because the spring near Edget Behibret elementary school may be contaminated in future by the latrine of the school and the feasibility of Manzana stream is not determined yet. The VES sites of No.1 to No.8 are suitable for shallow wells but may dry up in dry seasons because their watershed areas are small.

According to the design criteria and usual practice, the minimum intake rate of surface water and springs is defined as the 355 day flow and the maximum intake rate is the average flow of rainy season. Since the watershed area of Spring No.2 is larger than the one of Spring No.1 under similar geological conditions, it is reasonable that the reported dry season yield of Spring No.2 is the 355 day flow.
the maximum and the minimum intake rate of the springs are summarized in Table 4.2.1.

Table 4.2.1 The Maximum and the Minimum Intake Rates for Spring No.1 and Spring No.2

	Minimum Intake Rate (Dry Season)	Maximum Intake Rate (Rainy Season)
WSS Spring No.1	1.9 l/s	2.0 l/s
WSS Spring No.2	2.0 l/s	5.0 l/s
Total	3.9 l/s	7.0 l/s
	(337 m/day)	(605 m/day)

The following three (3) sites are feasible for the deep wells. Characteristics of the major aquifers are described in Table 4.2.2.

Table 4.2.2 Characteristics of Aquifers

Well No.	Locations	Depths of Major Aquifers (GL-m)	Lithology of the Aquifers	Total Thickness of the Aquifers (m)	Permeabilities (m/day)	Remarks
1	VES St.1	64 - 85※	Weathered and Fractured Basalt	10.5	1	New well
2	VES St.12	78 - 100※	Weathered and Fractured Basalt	11	1	- Ditto -
3	VES St.16	4 - 13 13 - 52	Weathered and Fractured Basalt Slightly Weathered and Fractured Basalt	24	1	- Ditto -

Note: ※ = The aquifer bottom is probably deeper than the figure.
The depths of the major aquifers are detected by the geoelectrical survey. The thickness of major aquifers is reduced into a half because a part of basalts are highly weathered and may become claylsh. The permeabilities are assumed at 1 m/day according to the design criteria. The optimal yields of the wells are estimated with the formula listed in the design criteria with a drawdown of 20m and diameters of wells to be 200 mm. The optimal yields and the water levels of the wells are shown below.

Table 4.2.3 Optimal Yields and Water Levels of the Wells

Well No.	Dia. of Well (m)	Optimal Yield (m^3/day)	Static Water Level (GL-m)	Dynamic Water Level (GL-m)	Remarks
1	0.20	127	5	25	New well for 2005
2	0.20	138	4	24	- Ditto -
3	0.20	301	4	24	- Ditto -

In Bure, since the maximum day demand appears in dry season and the demand of rainy season is less than the average demand, the dry season yields are taken into consideration. The yields of the springs and the wells are summed at 903m^3/day, which is sufficient for the average day demand of year 2005 i.e. 782m^3/day but not the maximum day demand i.e. 938m^3/day.

In order to cover the maximum demand as well as for the further future demand, other water sources including Manzana stream and the spring near Edget Behibret elementary school must be studied.

Test boring is required for the proposed deep wells because they might yield mineral rich water.

4.2.3 Design of Water Source Facilities

The new deep wells are designed as follows.

(1) Casing

Fiber Reinforced Plastic (FRP) pipe is adopted considering its elasticity for the case that the drilled hole is not straight. The diameter of casing is decided at 200mm, taking into consideration the outer diameter of the submersible pump (standard 80 - 140mm) and the allowance. The length of the pipe is six (6) m long per piece.

(2) Screen

Corresponding with the casing, FRP screen is adopted. The opening ratio is 12% and the length is four (4) m long per piece. The total screen length is longer than the calculated by the following formula.

$$Ls = \frac{\alpha \cdot Q}{10 \cdot A \cdot N \cdot V}$$

where Ls : Length of screen (m)
Q : pumping rate (l/s) (assumed equal to the optimal yield)
A : Surface area of screen 0.66m^2/m
N : Opening ratio 0.12
V : Inflow velocity 0.5cm/s (assumed)
: Safety Factor 3

The dimensions of the wells are summarized as shown in Table 4.2.4.

Table 4.2.4 Dimensions of New Deep Wells

Well No.		1	2	3
Pumping Rate	(m/day) (l/s)	127 (1.5)	138 (1.6)	301 (3.5)
Diameter of Well	(m)	200	200	200
Casing Length	(m)	72	90	18
Screen Length	(m)	16	16	36
Well Depth	(m)	88	106	54
Drilling Diameter	(mm)	300	300	300

4.3 Plan of Water Supply System

The water supply system proposed for the center of Bure would be implemented in two phases: first phase (target year 2005) and second phase (target year 2010).

The water supply system, which is composed of intake facilities, rising mains and distribution facilities, is proposed in the first phase to meet the water demand.

The water supply system, which is composed of additional intake facilities and transmission facilities, is planned in the second phase to meet the water demand at the target year of 2010.

4.3.1 Water Supply System in 2005

(1) Water Source

Additional water source except the existing springs is needed to meet the water demand at the target year of 2005.

There are three potential sites for borehole as stated in chapter 4.2. The groundwater pumped up is transferred to the collecting chamber directly. The production rate planned is summarized as follows.

S1 (existing spring)	164 m^3/day
S2 (existing spring)	173 m^3/day
W1 (proposed well)	127 m^3/day
W2 (proposed well)	138 m^3/day
W3 (proposed well)	301 m^3/day
Total	903 m^3/day

(2) Boosting Facility and Rising Mains

The booster pump with following capacity will be used the above mentioned pump to reservoir.

$Q = 0.96\ m^3/min.,\ H = 90\ m,\ P = 30\ kW$

Diameter of rising mains from the collecting chamber to reservoir will be 150 mm. Dia. of 1,600 m in length.

(3) Reservoir

The existing reservoirs is used, therefore, the additional capacity of the reservoir is required to meet the water demand at the year of 2005, and the required capacity is about 110 m^3 including reserve for fire fighting.

(4) Distribution Network

The distribution network is designed for the peak hour demand and fire fighting case, according to the design criteria.

The layout of the network follows the existing roads. The pipe with Dia. 75 mm is adopted as the minimum dia., and the pipe with dia. 50 mm is automatically adopted for the small distribution zone. Existing galvanized steel pipes will be replaced, if necessary.

The layout of distribution network for the target year of 2005 is prepared and attached in the Appendixes. The main pipelines planned are shown as follows:

Table 4.3.1 Distribution pipelines

DN (mm)	Length (m)
200	620
150	3,040
75	4,220
50	4,290

(5) Disinfection

Disinfection will be performed by the injection system directly into the outlet of the reservoirs. Daily consumption ratio of chemical will be estimated at about 1.1 kg and necessary more than 0.11 PPM at the end of distribution pipe.

(6) Administration Building

In order to manage daily basis waterworks such as operation works, bill collecting, a building is required to be built by the year of 2005. The building is preferable to be built in the center of the town, and it has a store room and warehouse.

4.3.2 Water Supply System in 2010

(1) Borehole

It is impossible to select the locations of the boreholes for the water demand at the target year of 2010 at present because of less data. The locations shall be selected after carrying out the further hydrogeological survey.

(2) Disinfection

Disinfection will be performed by the injection system directly into the reservoirs. Daily consumption ratio of chemical will be estimated at about 1.8 kg and necessary more than 0.11 PPM at the and of distribution pipe.

4.4 Implementation Schedule and Cost Estimation

4.4.1 Executing and Responsible Agencies

The executive agency of this Project is to be the Water, Mine and Energy Bureau of the Amhara National Regional Government, while the Ministry of Water Resources is to be responsible to coordinate and facilitate the implementation of the Project.

WSSD is to be responsible for keeping close coordination with the agencies concerned on the project approval, finance and project implementation. The Project would be required to be of great importance in the coordination of activities among the departments in the Ministry and between the central and regional offices concerned.

Prior to the implementation of the Project, the Project Manager is to be appointed under WSSD, who rests with the day-to-day works. Under the manager, aiming at the smooth implementation, coordination be maintained among such departments/services as Planning & Project, Administration & Finance, Contract Administration, Design and WSSD. The Project Manager be also required to keep close relationship with regional and town offices concerned.

4.4.2 Construction Schedule

The construction works for pipeline and reservoir related to water supply works have been carried out mostly by manual labor in Ethiopia. However, it would be recommended to introduce certain number of construction machines in order to speed up the construction works.

As this Project requires urgent intermediation to counteract the current deteriorating water supply condition, the aforementioned measures shall be employed for the purpose of keeping-up smooth execution of the construction works.

The construction schedule is divided into two stages; namely, 1) preparation of finance including the foreign currency portion and detail design accompanied with tender document, and 2) implementation of the Project. The schedule is proposed in the following, taking into consideration the above two stages and the construction amount.

First stage : Preparation in 1996
Second stage : Implementation after 1996 with reference to the priority among Eleven Centers

4.4.3 Project Construction Cost

The Project cost is estimated with both local currency and foreign currency. The unit price is estimated with reference to the standard unit price specified in Guideline for Preparation of Project, WSSA, July 1991. The unit price in this Project is price-escalated from the guideline prices based on the inflation rate shown in Economic Sensus between 1991 and 1995. WSSD's overhead, design and supervision fees and physical contingency are estimated according to the guideline.

In respect of foreign currency portion, the cost is required for the preparation of construction equipment and machinery, and procurement of such equipment and material as pump and pipe. Also, fuel, cement and other local materials made of imported row material are partly counted into foreign currency portion.

Engineering staff will be required for the detail design work and the implementation of the Project, since the Project is relatively large in the scale comparing to those existing water supply system. Consultant will also be employed by WSSD, MWR and be responsible for the all necessary work to be required and cooperate together with the WSSD's engineers.

Total project costs regarding water supply in years of 2005 and 2010 are summarized in Table 4.4.1.

Table 4.4.1 Total Project Cost of Water Supply in Thousand Birr

Year	F.C.	L.C.	Total
2005	12,088	8,649	20,737
2010			11,239

Note: Transportation Cost for Construction Equipment, Vehicles and Office Equipment are not included.

In this Study, sanitary improvement was also designed and required costs are summarized in Table 4.4.2. The costs are composed of 1) toilet facilities to be constructed in schools, medical institutions and public, 2) vacuum track, 3) refuse disposal track, 4) sludge dumping site, 5) refuse disposing site and 6) refuse collecting bins. Household sanitary facilities such as toilet (including community type) and waste water disposal pit shall be managed by the individuals or otherwise subsidized. Although drainage facilities are important, those are to be managed by Municipality and community participation in coordination with WSS. Therefore, the cost does not include the drainage facilities.

Table 4.4.2 Total Project Cost of Sanitary Facilities in Thousand Birr

Year	Cost
2005	1,699
2010	448

4.5 Financial Analysis

4.5.1 Financial Plan

(1) Estimation of Revenues

(a) Determination of Water Tariff

It was decided that there will be three water prices. One will be applied to house connection owners and non-domestic clients. The second and the last will be applied to yard connection users and public fountain users respectively.

The water tariff was so constructed that house connection owners and non-domestic clients will cross-subsidize yard connection and public fountain users, and yard connection users will, in turn, cross-subsidize public fountain users.

The tariff was determined in such a way that house connection owners, yard connection users and public fountain users will pay 4%, 4% and 2% of their income for water respectively in the target year of 2010.

Eventually, it is recommended that the following tariff will be applied from 1999 onward:

Clients	Water Price (birr/m^3)
1. House Connection Owners and Non-Domestic Clients	3.00
2. Yard Connection Users	2.07
3. Public Fountain Users	0.76

Important information concerned such as average monthly household income, share of households, water consumption per household per month, payment for water supply per household per month and ratio of water payment to income by type of clients and by the target year is shown in Table 4.5.1.

(b) Projection of Revenues

The major income source of water supply services is as every one knows revenue from water charge.

It is calculated by (No. of households by year by type of clients) × (annual water consumption per household by year by type of clients) × (water price by type of clients) × (bill collection rate).

The number of households was estimated based on the service population projection in the other chapter.

Annual water consumption was estimated based on the water demand projection in the other chapter.

Water price is already mentioned above.

The bill collection rate in the future was assumed as 95%.

There is the second revenue source. It is the revenue from technical service charge. This is the installation charge of connections. They say that the charge is 40% of the material and transportation cost actually incurred.

The revenue is calculated by (No. of connections to be newly installed by year) × (average technical service charge per connection).

The number of connections to be newly installed every year is estimated based on the projected number of house/yard connection owners.

According to the field surveys conducted by JICA, the average technical service charge per connection worked out to 195 birr although the charge varies depending on the diameter and length of the pipe, distance, etc.

The third revenue source is the the revenue from meter rent. For every new connection installed a water meter will be rented. The rental fee is 1 birr per month.

There are other revenues such as those from material sales, contract fee, connection fee, road crossing, etc. They are assumed to be 2% of the sum total of the preceding three revenues.

Projected revenues by source are shown in Table 4.5.2.

(2) Estimation of Cost

There are two types of cost. One is capital cost and the other is operation and maintenance (O & M) cost.

Capital cost is required to construct and replace water supply facilities. O & M cost is an recurrent cost daily required for the proper functioning of water supply facilities.

(a) O & M Cost

Seven types of O & M cost can be identified.

The first is electricity cost. It is estimated that 103 birr, 160 birr and 257 birr will be daily required in 2000, 2005 and 2010 respectively.

The second is fuel cost. It will not be required as there will be sufficient electricity so far as Bure is concerned.

The third is disinfection cost. It is estimated that 8 birr, 12 birr and 20 birr will be daily required in 2000, 2005 and 2010 respectively.

The fourth cost is personnel cost. It is estimated that 27, 32 and 42 employees will be required for WSS in 2000, 2005 and 2010 respectively. It is recommended that the average monthly remuneration per employee will be 481 birr. It was worked out based on the standard salaries the authorities are now proposing for each type/position of personnel comprizing WSS.

The fifth is installation cost of connections. It is projected that 62, 112 and 184 connections will be annually newly installed from 1999 to 2004, from 2005 to 2009 and from 2010 onward respectively. Installation cost per connection is estimated at 488 birr on average.

The sixth is the purchase cost of water meters. For each connection to be newly installed one water meter will be required. The purchase price of a water meter widely varies depending on the diameter of the pipe and the country from which it was imported. It was assumed that it will be 276 birr based on the bulk purchase price of Indian imports.

The last is other cost including office supplies, uniform, per diem and travel, postage & telephone, transport, maintenance of office, motor house, etc. , insurance, cleaning items, etc.
It was assumed that the cost will be 10% of the six preceding cost combined.

(b) Capital Cost

Capital cost can be classified into initial cost and replacement cost. The former is required at the time of initial investment and the latter at the time of investment for replacement.

So far as the Project is concerned, replacement cost will be required every 15 years for water purification units only. The average life of other equipment and facilities is assumed to be 30 years, which is the assumed life of the Project.

The summary of the estimated initial cost is as follows:

(Unit : thousand birr)

Item	Foreign Components	Local Components	Total
1. Phase 1			
1) Construction Cost	9,248	4,197	13,445
2) Engineering Cost (12% of 1))	1,613		1,613
3) Contingency (5% of 1) + 2))	543	210	753
Sub-Total	11,404	4,407	15,811
4) Buildings		3,369	3,369
5) WSSD's Management Cost (2% of 1) + 2) + 3) + 4))		384	384
Sub-Total		3,753	3,753
Total	10,654	8,910	19,564
6) Water Purification Units (included in total)	10	15	25
2. Phase 2			
1) Construction Cost			6,541
2) Engineering Cost (10% of 1))			654
3) Contingency (10% of 1) + 2))			720
Total			7,915
Grand-Total			27,479

The Phase 1 Project will start in 1996 and end in 1998, while the Phase 2 Project will start in 2007 and end in 2009. The first year of project implementation is for detail design, and the second and third years are for the construction of facilities. The progress of construction work was assumed to be 50% for 1997/2008 and the remaining 50% for 1998/2009.

4.5.2 Financial Analysis

Financial statements (income statement and fund statement) were projected for 30 years starting in 1996.

In doing so, the following conditions were assumed:

1. External Loan for Initial Cost

   Ratio of Loan : 100%
   Grace Period : 10 years
   Repayment Period : 30 years
   Interest Rate : 1%

2. Governmental Subsidy to WSS

   95% of Initial Cost

It is to be noted that the cost related to the construction of accommodation facilities as well as WSSD's management is not included in the above initial cost. Such cost will be borne by the Ethiopian government and WSS will pay it back on the same repayment terms as in the case of external loan.

Also, it was assumed that te existing corporate income tax will be applied, including 40% tax rate on the before-tax income in case the income is over 50 thousand birr.

Further, inflation was not considered.

The results are shown in Table 4.5.3.

As it shows, WSS will be financially sound and stable in terms of earnings as well as solvency in the years to come except initial years, if all the above mentioned conditions, estimates and assumptions are met.

As representative managerial indicators, the weighted averages of the ratio of revenues to expenditures and the ratio of working capital to revenues for the 30 years from 1996 to 2025 work out to the following:

Revenues/Expenditures = 133.3%
Working Capital/Revenues = 39.8%

Generally, it will be all right if the ratio of revenues to expenditures is equal to or more than 100%, or preferably 110%. Also, it will be all right if the ratio of working capital to revenues is equal to or more than 10%.

It is to be noted that the above values exceed the required levels by a substantial margin.

Table 4.5.1 Water Price and Ratio of Water Payment to Income

Item	1995	2000	2005	2010
1. Average Monthly Household Income (birr)				
1) House Connection Owners	806	900	943	963
2) Yard Connection Users	486	512	464	391
3) Public Fountain Users	160	156	142	124
2. Share of Households (%)				
1) House Connection Owners	3.6	6.3	11.7	20.0
2) Yard Connection Users	27.4	29.5	33.8	40.0
3) Public Fountain Users	51.9	53.1	47.2	35.0
3. Water Consumption/Household/Month (m^3)				
1) House Connection Owners	4.8	11.0	11.8	12.9
2) Yard Connection Users	4.2	6.5	6.9	7.5
3) Public Fountain Users	0.9	2.9	3.1	3.3
4. Water Price (birr/m^3)				
1) House Connection Owners	1.00	3.00	3.00	3.00
2) Yard Connection Users	1.00	2.07	2.07	2.07
3) Public Fountain Users	1.00	0.76	0.76	0.76
5. Payment for Water Supply/Household/Month (birr)				
1) House Connection Owners	4.8	33.0	35.5	38.6
2) Yard Connection Users	4.2	13.5	14.4	15.6
3) Public Fountain Users	0.9	2.2	2.3	2.5
6. Ratio of Water Payment to Income (%)				
1) House Connection Owners	0.6	3.7	3.8	4.0
2) Yard Connection Users	0.9	2.6	3.1	4.0
3) Public Fountain Users	0.6	1.4	1.6	2.0

Source: JICA

Table 4.5.2 Planning of Revenues

(Unit: birr)

Year	H./Y. Connec.	Public Founta.	Non-Domest.	Techni. Servic.	Meter Rent	Other Revenue	Total
1996	34,376	11,357	9,770	1,506	5,188	5,896	68,093
1997	35,064	11,584	9,965	1,506	5,291	6,011	69,422
1998	35,765	11,816	10,165	1,506	5,397	6,128	70,777
1999	118,918	21,952	44,710	12,057	10,805	5,760	214,202
2000	194,340	36,894	72,818	12,057	11,547	6,553	334,208
2001	227,168	38,265	77,811	21,912	12,896	7,561	385,612
2002	259,996	39,635	82,804	21,912	14,244	8,372	426,963
2003	292,824	41,005	87,797	21,912	15,593	9,183	468,314
2004	325,652	42,376	92,790	21,912	16,941	9,993	509,665
2005	358,481	43,746	97,784	21,912	18,290	10,804	551,016
2006	422,054	43,430	104,025	35,930	20,501	12,519	638,459
2007	485,628	43,114	110,267	35,930	22,712	13,953	711,603
2008	549,202	42,797	116,508	35,930	24,923	15,387	784,748
2009	612,776	42,481	122,750	35,930	27,134	16,821	857,892
2010	676,350	42,165	128,991	35,930	29,345	18,256	931,036
2011	676,350	42,165	128,991	0	29,345	17,537	894,388
2012	676,350	42,165	128,991	0	29,345	17,537	894,388
2013	676,350	42,165	128,991	0	29,345	17,537	894,388
2014	676,350	42,165	128,991	0	29,345	17,537	894,388
2015	676,350	42,165	128,991	0	29,345	17,537	894,388
2016	676,350	42,165	128,991	0	29,345	17,537	894,388
2017	676,350	42,165	128,991	0	29,345	17,537	894,388
2018	676,350	42,165	128,991	0	29,345	17,537	894,388
2019	676,350	42,165	128,991	0	29,345	17,537	894,388
2020	676,350	42,165	128,991	0	29,345	17,537	894,388
2021	676,350	42,165	128,991	0	29,345	17,537	894,388
2022	676,350	42,165	128,991	0	29,345	17,537	894,388
2023	676,350	42,165	128,991	0	29,345	17,537	894,388
2024	676,350	42,165	128,991	0	29,345	17,537	894,388
2025	676,350	42,165	128,991	0	29,345	17,537	894,388

Note: H./Y. Connec. = House/Yard Connection
Public Founta. = Public Fountain
Non-Domest. = Non-Domestic
Techni. Servic. = Technical Service

Table 4.5.3(1) Financial Statement

(Unit: thousand birr)

No.	1	2	3	4	5	6	7	8	9	10
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Income Statement										
Revenue	68	69	71	214	334	386	427	468	510	551
Operation and Maintenance	104	106	109	256	268	321	333	344	355	366
Depreciation	0	68	136	136	136	136	136	136	136	136
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	104	174	244	392	404	457	469	480	491	502
Profit before Tax	-36	-105	-174	-178	-70	-72	-42	-11	19	49
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	-36	-105	-174	-178	-70	-72	-42	-11	19	49
Funds Statement										
Profit after Tax	-36	-105	-174	-178	-70	-72	-42	-11	19	49
Loans	85	2229	2229	0	0	0	0	0	0	0
Subsidies	1609	6706	6706	0	0	0	0	0	0	0
Depreciation	0	68	136	136	136	136	136	136	136	136
Sources	1657	8898	8897	-42	66	64	94	124	154	185
Capital Works	1694	7059	7059	0	0	0	0	0	0	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	-36	1839	1839	-42	66	64	94	124	154	185
Applications	1657	8898	8897	-42	66	64	94	124	154	185
Loan Liabilities	86	2338	4613	4659	4706	4753	4801	4849	4897	4946
Cash Balance	-72	1768	3606	3564	3630	3695	3789	3913	4068	4252

Source: JICA

Table 4.5.3(2) Financial Statement

(Unit: thousand birr)

No.	11	12	13	14	15	16	17	18	19	20
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Income Statement										
Revenue	638	712	785	858	931	894	894	894	894	894
Operation and Maintenance	448	469	490	511	533	378	378	378	378	378
Depreciation	136	136	142	148	148	148	148	148	148	148
Payment of Interest	1	26	49	47	44	42	40	37	35	32
Expenditure	585	631	681	706	725	568	565	563	561	558
Profit before Tax	54	81	104	152	206	327	329	331	334	336
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	54	81	104	152	206	327	329	331	334	336
Funds Statement										
Profit after Tax	54	81	104	152	206	327	329	331	334	336
Loans	0	36	180	180	0	0	0	0	0	0
Subsidies	0	683	3418	3418	0	0	0	0	0	0
Depreciation	136	136	142	148	148	148	148	148	148	148
Sources	189	936	3843	3898	354	474	477	479	482	484
Capital Works	0	719	3598	3598	0	0	13	13	0	0
Payment of Principal	4	116	229	231	234	236	238	241	243	246
Working Capital	185	101	16	68	120	238	226	226	238	238
Applications	189	936	3843	3898	354	474	477	479	482	484
Loan Liabilities	4990	4935	4888	4840	4610	4378	4144	3907	3668	3427
Cash Balance	4438	4538	4555	4623	4743	4982	5207	5433	5672	5910

Source: JICA

Table 4.5.3(3) Financial Statement

(Unit: thousand birr)

No.	21	22	23	24	25	26	27	28	29	30
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Income Statement										
Revenue	894	894	894	894	894	894	894	894	894	894
Operation and Maintenance	378	378	378	378	378	378	378	378	378	378
Depreciation	148	148	148	148	148	148	148	148	148	148
Payment of Interest	30	28	27	27	24	21	18	16	13	10
Expenditure	556	554	553	553	550	547	544	541	538	536
Profit before Tax	339	341	341	342	345	347	350	353	356	359
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	339	341	341	342	345	347	350	353	356	359
Funds Statement										
Profit after Tax	339	341	341	342	345	347	350	353	356	359
Loans	0	0	0	0	0	0	0	0	0	0
Subsidies	0	0	0	0	0	0	0	0	0	0
Depreciation	148	148	148	148	148	148	148	148	148	148
Sources	486	489	489	490	493	495	498	501	504	507
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	248	252	264	276	278	281	284	287	290	293
Working Capital	238	236	225	214	214	214	214	214	214	214
Applications	486	489	489	490	493	495	498	501	504	507
Loan Liabilities	3183	2935	2673	2397	2119	1837	1553	1267	977	684
Cash Balance	6148	6385	6610	6824	7038	7252	7466	7680	7894	8109

Source: JICA

Chapter 5 Improvement of Health and Sanitation

5.1 Plan for Sanitary Facilities

The sanitation situation in Bure is very bad. The critical shortage of water supply in the town plays a considerable role in aggravating the sanitation situation. Therefore, any plan of improving the sanitary facilities should go hand-in hand with the improvement of water supply. The waste water production in liters per capita per day was estimated using the water demand data for each type of water supply services.

From the water demand and waste water production as indicated in Table 5.1.1, conventional sewerage system can not be introduced in Bure even by the year 2010.

Therefore, the sanitary technologies envisaged for Bure are on-site technologies such as drainage and waste water disposal pit.

Table 5.1.1 Water Demand in lpcd and Waste Water Production in lpcd for Bure

Item	HC			YC			PF		
	1995	2005	2010	1995	2005	2010	1995	2005	2010
• Water demand (lpcd)	23.6	58	63	20.5	34	37	4.6	15	16
• Waste water generation rate (%)	65	74	75	64	67	68	60	63	63
• Waste water production (lpcd)	15	43	47	13	23	25	3	9	10

5.1.1 Plan of Toilet Facilities

The sanitary technologies planned for Bure are categorized into four major groups:

- Improved Traditional Pit Latrines
- VIP Latrines
- Compost Toilets
- Flush Toilets

These technologies are related to the types of water supply services of house connections (HC), yard Connections (YC) and public fountain (PF). The proposed toilet facilities are considered for residential or domestic households as well as for non-domestic households taking the water supply services of HC, YC and PF into account.

Table 5.1.2 Proposed Sanitation System in Relation to Types of Water Supply Services for Domestic Households

Types of Water Supply Services	Proposed Sanitary System for Domestic Households
1. Traditional Water Sources + Public Fountain (PF)	• Improved traditional pit latrine • VIP latrine, single-pit or double-pit • Soakaway pit for sullage
2. Yard Connection (YC)	• VIP latrine, single-pit or double-pit • Compost latrine • Pour-flush toilet with simple water seal and on-site pit • Pour-flush latrine + soakaway pit • Soakaway pit for sullage
3. House Connection (HC)	• Pour-flush toilet + soakaway pit • Cistern-flush toilet + soakaway pit • Pour-flush or cistern-flush toilet + septic tank • Soakaway pit for sludge

In each category, the first sanitation technology is generally the cheapest and the simplest. Those that can afford more can build the subsequent ones depending on their choices and paying capacity.

For communities, schools, bus, terminals, market areas, health facilities, government offices, hotels, restaurants, bakeries, pastries, bars, tej and tella drinking houses etc. the sanitation technologies proposed are indicated in Table 5.1.3.

Table 5.1.3 Proposed Sanitation Technologies for Communities and Non-domestic Households

Category	Proposed Sanitation System
1. Communities	• VIP community latrine with washbasin
2. Schools & training centers	• VIP collective toilet with washbasin
3. Market & bus terminals	• VIP public toilet with washbasin or shower
4. Government institutions	• VIP latrine with washbasin • Cistern-flush toilet + soakaway pit • Cistern-flush toilet + septic tank
5. Commercials	• VIP latrine with washbasin • Pour-flush or cistern-flush toilet + soakaway pit • Pour-flush or cistern-flush toilet + septic tank
6. Hotels, restaurants, drinking place, etc.	• Collective VIP latrine with washbasin • Pour-flush toilet with washbasin + soakaway pit • Cistern-flush toilet with washbasin + septic tank • Soakaway pit for sullage
7. Hospitals, health centers, clinics	• Collective VIP latrine with washbasin • Pour-flush toilet with washbasin + soakaway pit • Cistern-flush toilet with washbasin + septic tank • Soakaway pit for sullage

5.1.2 Plan of Sullage, Dry Solid Waste and Drainage

(1) Sullage

Sullage is the waste water which does not contain excreta but comes out from each household. Sullage always contains some pathogens though the concentration is much lower than that in sewage. In Bure, sullage is presently being dumped in front of the households or along the streets. This poses a health risk if it is allowed to continue to be dumped everywhere.

The plan considers sullage soakaway pits of various sizes depending on the size and type of households for its disposal. The sullage soakaway pits need to be properly lined with stone, adobe, and other local materials with open joints for the major posts of the depth leaving about 30 cm from the top for pointed lining. If the waste water or sullage is too much for the soakaway pits to handle, then drainage field channels should be used.

(2) Dry Solid Waste

In order to stop the present indiscriminate dumping of refuse and to prevent both environmental pollution and water contamination, four strategic sites just outside the skirt of the town on the north, south, east and west of Bure are proposed for preparing proper refuse dumping sites.

Refuse collecting bins should be placed at strategic locations within the community so that people dump their refuse. Then refuse collecting and disposal truck or animal-drawn cart should empty the bins to transport the refuse to the prepared dumping sites. This work has to be administered by close relationship of the community, the Kebele and the Municipality. The refuse at the dumping site should be burnt under close supervision of the Municipality in coordination with WSS.

(3) Drainage

Two types of drainage are considered here. The first is the use of drainage field channels for the areas where the soakaway pits have become ineffective due to excess of sullage or waste water. The sizes and numbers of the drainage field channels depend on the quantity of waste water to be drained after close follow up of the working of the soakaway pits. The second type of drainage is draining the storm water. Most of the drainage facilities that were prepared during the construction of the main roads have been blocked by outside rubbishes that have been dumped on them. The first action required is to open-up the blocked drainage facilities and maintain them regularly to remain open. This would considerably help to reduce the formation of stagnant water, and thereby reducing or eliminating the sources for breeding of insects and flies. There are roads within Bure that do not have any means of drainage facilities. These roads should have side ditches and cross drainages to drain the water whenever storm (rainfall) occurs.

5.2 Financial Plan for Sanitary Facilities

To estimate both the capital cost of building the sanitary facilities and the annual operation and maintenance cost, based on the 1995 prices, the following assumptions have been made.

- The calculated waste water flows for Bure are too low to justify the installation of conventional sewerage system in Bure. On account of this, the sanitary facilities proposed for Bure are on-site sanitary technologies.
- Those households that do not have any toilet facilities in Bure at present are assumed to have one type of toilet facility by the year 2010.
- Sanitary technologies that are new to the culture of the people living in Bure are to be introduced gradually and with proper prior education as to the benefits and usefulness of the new technologies. Social acceptability of the new technology has to be confirmed prior to its introduction.
- Proposals for the appropriate sanitary technologies are drawn up based on the types of water services rendered in Bure.
- The households in the same water service category can have toilets of the standard they can afford to pay for.

5.2.1 Households

From projected population of Bure for target years of 2005 and 2010, households have been estimated using the family size for each type of water services.

Table 5.2.1 Households in Bure for Target Years of 2005 & 2010 by Type of Water Services

Target Year	Households		
	HC	YC	PF
• 2005	400	1,170	1,630
• 2010	840	1,680	1,470

5.2.2 Estimate of Costs

(1) Capital Costs per Unit

For each type of toilet facility that is considered appropriate for Bure and some equipment required, indicative costs for constructing each type of sanitary facilities and for purchasing the equipment are estimated as follows.

Table 5.2.2 Indicative Cost of a Type of Sanitary Facility or Equipment

Type of Sanitary Facility or Equipment	Indicative Cost of One Facility or Equipment (Birr)
1. Improved traditional pit latrine	1,000
2. VIP toilet, single pit	1,500
3. VIP toilet, double pit	2,000
4. VIP toilet, shared	15,000
5. VIP toilet, community	45,000
6. VIP toilet, collective (e.g. schools)	65,000
7. VIP toilet, public (e.g. market)	95,000
8. Compost latrine	2,500
9. Pour-flush + soakaway pit	3,000
10. Pour-flush + septic tank + soakaway pit	7,500
11. Cistern-flush + soakaway pit	4,000
12. Cistern-flush + septic tank + soakaway pit	8,500
13. Sullage soakaway pit	800
14. Drain field channel	4,000
15. Medium size vacuum truck	250,000
16. Medium size refuse collection and disposal truck	180,000
17. Animal-drawn cart	12,000
18. Refuse collection bin	250
19. Sludge dumping site	10,000
20. Refuse disposing and burning site	6,500

(2) Annual Operating and Maintenance Costs per Unit

The annual operating and maintenance cost is based on the assumption that most of the work is going to be done by labor only. For the equipment both running and maintenance costs are included.

Table 5.2.3 Annual Operating and Maintenance Cost per Unit

Type of Sanitary Facility or Equipment	Annual Operating and Maintenance Cost (Birr)
1. Improved traditional pit latrine	200
2. VIP toilet, single pit	250
3. VIP toilet, double pit	300
4. VIP toilet, shared	400
5. VIP toilet, community	700
6. VIP toilet, collective (e.g. schools)	800
7. VIP toilet, public (e.g. market)	3,000
8. Compost latrine	750
9. Pour-flush + soakaway pit	1,000
10. Pour-flush + septic tank + soakaway pit	1,250
11. Cistern-flush + soakaway pit	1,200
12. Cistern-flush + septic tank + soakaway pit	1,400
13. Sullage soakaway pit	100
14. Drain field channel	800
15. Vacuum truck	7,500
16. Refuse collection and disposal truck	8,500
17. Animal-drawn cart	3,000
18. Refuse collection bin	50
19. Sludge dumping site	2,000
20. Refuse disposing and burning site	2,500

(3) Assumptions for Estimating the number of Toilets to be Implemented in Bure by the Year 2005 and 2010

To find the number of toilets to be implemented in Bure by the year 2005 and 2010, the following assumptions have been made.

- By the year 2005

  - All schools in Bure will have, at least, VIP collective toilets.
  - The Bure Hospital toilet facilities will be rehabilitated; and the clinic and possibly a health center will have VIP collective toilets.
  - Bure market area and bus terminal will have VIP public toilet.
  - 100% of households that have house water supply connections (HC) will have some kind of flush toilet.
  - 75% of the households that have yard water supply connections (YC) will have VIP or higher toilets.
  - 75% of households that use public fountain (PF) as a source of water supply will have improved traditional toilets or VIP toilets.

- By the year 2010

  - 50% of households that have HC water supply will have some kind of flush toilets.
  - 50% of households that have YC will have VIP or higher toilets.
  - 100% of household that use PF will have improved traditional latrine or VIP latrine or higher grade toilets.

- In each category (HC,YC,PF), those that can afford more can have higher standard of toilets of their choices.

- All equipment will be replaced by this time.

(4) Total Capital Cost

Indicative capital costs for sanitary facilities for Bure based on 1995 prices are shown in Table 5.2.4 for the year 2005 and in Table 5.2.5 for the year 2010.

Table 5.2.4 Capital Costs of Sanitary Facilities for Bure for Year 2005

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• VIP collective toilets for schools	12	65,000	780
• VIP collective toilets for clinics and health centers	2	65,000	130
• VIP public toilet for market area and bus terminal	3	95,000	285
• 100% households with HC to have PF toilets	400	7,500	3,000*
• 75% households with YC to have VIP shared toilets or higher toilets	878	15,000	13,170*
• 75% households with PF to have VIP toilets	1,223	2,000	2,446*
• Vacuum truck	1	250,000	250
• Refuse disposal truck	1	180,000	180
• Sludge dumping site	3	10,000	30
• Refuse disposing site	4	6,500	26
• Refuse collecting bins	70	250	18
Total			20,315
Excluding Households' (*)			1,699

Table 5.2.5 Capital Costs of Sanitary Facilities for Bure for the Year 2010

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• 50% of households with HC to have flush toilets	420	7,500	3,150*
• 50% of households with YC to have VIP toilets or higher	840	3,000	2,520*
• 100% households with PF to have ViP toilets	1,470	2,000	2,940*
• Replacement of vacuum truck	1	250,000	250
• Replacement of refuse disposal truck	1	180,000	180
• Replacement of refuse collecting bin	70	250	18
Total			9,058
Excluding Households' (*)			448

(5) Total Operating and Maintenance Cost

Indicative operating and maintenance cost for sanitary facilities for Bure are shown in Tables 5.2.6 and 5.2.7 for the years of 2005 and 2010 each.

Table 5.2.6 Annual Operating & Maintenance Costs for the Year 2005

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• VIP collective toilets for schools	12	800	9.60
• VIP collective toilets for clinics and health centers	2	800	1.60
• VIP public toilet for market area and bus terminal	3	3,000	9.00
• 100% households with HC to have PF toilets	400	1,250	500.00*
• 75% households with YC to have VIP shared or higher toilets	878	400	351.20*
• 75% households with PF to have VIP toilets	1,223	300	366.90*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Sludge dumping site	3	2,000	6.00
• Refuse disposing site	4	2,500	10.00
• Refuse collecting bins	70	50	3.50
Total			1,273.80
Excluding Households' (*)			55.70

Table 5.2.7 Annual Operating & Maintenance Costs by the Year 2010

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• Flush toilets for households with HC	420	1,250	525.00*
• VIP or higher toilets for households with YC	840	1,000	840.00*
• VIP toilets for households using PF	1,470	300	441.00*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Refuse collecting bins	70	50	3.50
Total			1,825.50
Excluding Households' (*)			19.50

(6) Summary of Costs

- Capital Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	20,315	1,699
2010	9,058	448
Total	29,373	2,147

- Annual Operating & Maintenance Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	1,273.80	55.70
2010	1,825.50	19.50
Total	3,099.30	75.20

5.3 Application of Sanitary Education Program

In accordance with the approach mentioned in the Main report, the following recommendations are made specifically for sanitary education in Bure.

Support to existing health education program and widen it's remit to include sanitary education through the Churches and Mosque, perhaps with pamphlets and other materials, and the provision of budget for sanitary education work in the town, through the Sanitarians, will benefit the sanitary education program by increasing effectiveness and the number of people reached. The particular group to target would be low income households (income groups 1-3) in which there are 68% of the female headed households).

Using this table, priorities for sanitary education activities can be set. Changes in sanitary behaviors should be monitored to make sure that the required changes in behaviors and health risk are being made as required. Suggestions of ways to plan and carry out such a program are included in the sanitary education manual produced by this Study.

There is some variation between user groups, particularly PC Users (including all Muslims) have better access and use of latrines, more sanitary solid waste and waste water disposal behaviors and improved handwashing practices but are more likely to have livestock living in their homes. Those poor households have lower access to latrines and waste disposal facilities and have worse handwashing practices and poorer management of children's excreta.

However the summary of indicator behaviors is reasonably representative for all respondents of the questionnaire and suggests areas where sanitary improvements are required. The highest priority area are the use of piped water for drinking always, the burning or burial of solid waste and the sanitary disposal of wastewater. The middle-high priority areas are fly control and the sanitary disposal of children's excreta. The middle-low priority areas are keeping the water scoop and kitchen utensils off the floor,

handwashing with soap/ash after defecation or after handling children's excreta, keeping animals out of the house and access to and use of a latrine by all family members. Other behaviors in the chart are reasonable.

Table 5.3.1 Sanitary Education Priorities in Bure

Priority level	Type of Behavior	Blocks to Improved Practice
High	Piped water used always	Piped water not always available in sufficient quantities (WSS role) and not available when required by people (WSS role) at sites convenient for collection (WSS role).
High	Solid waste disposal in covered pits or burned	Sites not allocated for public waste disposal sites or not managed strictly (Municipality/ Woreda) Individuals (women) must be informed of where (Municipality/ Woreda) and how to dispose of waste (CPP/ all)
High	Waste water disposal in pits, drains or vegetable gardens	Drainage insufficient and disposal into drains not strictly managed (Municipality/Woreda) Individuals (women) must be informed of where to dispose waste water (Municipality/Woreda) and shown safe disposal techniques (CPP/all)
Medium-High	Fly Control	Associated with climate but also related to solid and liquid waste disposal and excreta disposal (Municipality/Woreda /All role) Behaviors like covering of food and water pots during storage should be maintained (CPP/All)
Medium-High	Sanitary disposal of children's excreta	Small children should be encouraged to use the latrine as soon as they are able (all family members) Clearing up of children's excreta (women and girls role) must be encouraged and status of latrine users promoted (CPP/all))
Medium-High	Water scoop and kitchen utensils kept off the floor	Domestic hygiene (women) although facilitated by shelf or similar available in kitchen to keep utensils on (women/ men) Construction of such shelves to be promoted (CPP)
Medium-Low	Handwashing with soap after defecation	Personal hygiene (all) made more easy by making access to water and soap/ash nearer to the latrine (women's role) and by improving the status of the improved behavior (all)
Medium-Low	Handwashing with soap after handling children's stools	Personal hygiene (women/boys/girls roles) made easier by improving access to water and soap/ ash nearer to latrine (women) and improving the status of such behavior (all)
Medium-Low	Not keeping animals in the house	Small Animals (female role) and larger animals (male role) to be kept outside where possible. Awareness raising of the increased risks of diarrhoeal disease from animal excreta is required (CPP) Lack of land/shelter for animals may be the issue (all)
Medium-Low	Latrine coverage for all households	Latrines to be built and maintained (Public-Municipality/Woreda) and (Community/private latrines-WSS/CPP/All made easier with examples of low cost latrines and loans (WSS))
Medium-Low	Latrine use by all members of household	Where there is a latrine, not all (children) of the household members use it. Use by all family members should be encouraged and status of latrine users promoted (CPP/all)

Chapter 6 Reinforcement of Organization

It is advised to refer to Table 6.1.1 and Figure 6.1.1 when you read this section.

6.1 Comprehensive Organization and Management

The production of water will increase markedly under the proposed plan from 200 m^3/day in 1995 to 502 m^3/day in 2000, 782 m^3/day in 2005 and 1,254 m^3/day in 2010.

In line with it, the organizational structure will be enlarged, new functions will be added and the number of employees will be increased.

Basically the number of employees in the target years was estimated dividing water production by water production per employee. In estimating water production per employee, labor efficiency resulting from a greater production was assumed. It is proposed that sanitation functions be introduced in the organization of WSS from 2000 on. It means that more manpower will be required.

In adding sanitation functions to WSS the full name of WSS will be changed to Water Supply and Sanitation Service. But, the abbreviated name will be WSS as has been the case.

Considering the above factors, it is proposed that the number of employees will increase from 22 in 1995 to 27 in 2000, 32 in 2005 and 42 in 2010.

The organizational structure will get enlarged and more diversified. The ultimate organizational structure of WSS is shown in Figure 6.1.1.

As it shows, the organizational structure of WSS will be basically composed of 7 elements: Manager, Internal Audit, Customer Services, Administration Service, Financial Service, Technical Service and Sanitary Service. These are a skeletal structure or fundamental requirements of water supply and sanitation services. The functions of the last four big Services will get more diversified as years go by in accordance with greater water production.

6.2 Organization and Management of Water Supply

The number of personnel for water supply functions of WSS will be 25, 29 and 38 in 2000, 2005 and 2010 respectively.

Personnel for Administration, Financial and Technical Services will be basically distributed in such a way that their respective shares will be 30%, 35% and 35%.

A brief explanation on the ultimate organizational structure and functions will be given below:

The objectives of water supply functions of WSS are to supply sufficient piped water on one hand and to financially stand on its own feet. In this regard Customer Services and Internal Audit are typical functions of WSS. Besides them there will be three major Services.

Administration Service is composed of General Administration. Personnel, Storage and Legal Sections. General Administration Section will be in charge of secretarial/clerical work. Guards and sweepers also belong to this section. Personnel Section will be in charge of recruitment, assignment and training of personnel, and remuneration. Storage and purchasing of materials and supplies will be done in Storage Section. Such matters as complaints and penalties can be taken care of by Legal Section.

Financial Service controls Budgeting, Accounting, Financial Management and Operation Sections. Annual and monthly budget of income and expenditures will be prepared in Budgeting Section. Monthly and annual accounting of expenditures and income will be performed in Accounting Section. Financial Management Section makes analysis and evaluation of financial performances. Operation Section is in charge of meter reading, billing and collection, and cash water selling.

Technical Service covers Technical Records, Operation and Maintenance, Inspection and Work Sections, and Workshop. Records of equipment and supplies such as acquired dates, number, plans, dimension, breakdowns and repairs will be kept in Technical Records Section. Operation and maintenance of pumping stations, reservoirs, pipelines, public fountains, etc. will be taken care of by the section of the same name. Inspection of the above-mentioned facilities will be regularly done by the section of the same name. Repairing and manufacturing belong to Workshop. Works Section is in charge of rehabilitation/replacement/construction of facilities.

The number of personnel to be assigned by position/function in 2000, 2005 and 2010 is shown in the latter half of Table 6.1.1.

6.3 Organization and Management of Sanitation

The number of personnel for sanitation functions of WSS will be 2, 3 and 4 in 2000, 2005 and 2010 respectively.

A brief explanation on the ultimate organizational structure and functions will be given below:

An independent department called Sanitation Service will be introduced. The Service will be comprized of Public Relations, Loan Service and Maintenance Sections.

Public Relations Section will be in charge of the provision of information and public relations services to help people to install septic tank toilets and dry pit latrines. Loan Service Section will provide loan/subsidy to clients for the installation of septic tank toilets and keep related records. Maintenance Section will have a vacuum truck to regularly empty toilets and will regularly clean and maintain drainages.

The number of personnel to be assigned by position/function in 2000, 2005 and 2010 is shown in the latter half of Table 6.1.1.

Table 6.1.1 Personnel Requirements

1. Total No. of Personnel

Item	1995	2000	2005	2010
1. Total Production of Water (m^3/day)	200	502	782	1,254
2. Water Production per Worker (m^3/day/worker)	9.1	20	30	40
3. Coefficient	1	1	1.1	1.2
4. No. of Personnel	22	25	29	38
5. Additional Personnel for Sanitation	0	2	3	4
6. Final No. of Personnel	22	27	32	42

2. Breakdown of Personnel by Position/Function

Positions/Functions	1995	2000	2005	2010
1. Manager	1	1	1	1
2. Customer Services	0	0	0	1
3. Internal Audit	0	0	1	1
4. Administration Service				
1) Head	1	1	1	1
2) General Administration Section				
Secretaries/Typists/Clerks	2	1	1	1
Guards	4	4	5	6
Sweepers/Janitors	1	1	0	0
Drivers	0	0	0	1
Sub-Total	7	6	6	8
3) Personnel Section				
Recruitment and Assignment	0	0	0	1
Training	0	0	0	0
Remuneration	0	0	0	0
Sub-Total	0	0	0	1
4) Storage Section				
Store Keepers	1	1	1	1
Purchase of Materials/Supplies	0	0	0	0
Sub-Total	1	1	1	1
5) Legal Section	0	0	0	0
Total	9	8	8	11

2. Breakdown of Personnel by Position/Function (Continued)

Positions/Functions	1995	2000	2005	2010
5. Financial Service				
1) Head	1	1	1	1
2) Budgeting Section	0	0	0	1
3) Accounting Section				
Accountants	1	1	1	1
Cashiers/Treasurers	1	1	1	1
Sub-Total	2	2	2	2
4) Financial Management Section				
Financial Analysts	0	0	0	1
5) Operation Section				
Meter Readers	1	1	1	1
Bill Distributors/Collectors	1	1	1	1
Water Sellers	4	5	5	5
Sub-Total	6	7	7	7
Total	9	10	10	12
6. Technical Service				
1) Head	0	0	1	1
2) Technical Records Section	0	0	0	1
3) Operation and Maintenance Section				
Mechanics	0	0	0	1
Electricians	0	1	1	2
Motor Operators	1	2	4	4
Plumbers	2	2	2	2
Sub-Total	3	5	7	9
4) Inspection Section				
Water Meter Technicians	0	1	1	1
Leakage Detectors	0	0	0	0
Water Quality Analysts	0	0	0	0
Sub-Total	0	1	1	1
5) Workshop	0	0	0	0
6) Works Section				
Contracting	0	0	0	0
Designing/Drafting	0	0	0	0
Sub-Total	0	0	0	0
Total	3	6	9	12
7. Sanitary Service				
1) Public Relations Section	0	1	1	1
2) Loan Service Section	0	1	1	1

2. Breakdown of Personnel by Position/Function (Continued)

Positions/Functions	1995	2000	2005	2010
3) Maintenance Section				
Technicians	0	0	0	1
Drivers	0	0	1	1
Sub-Total	0	0	1	2
Total	0	2	3	4
Grand-Total	22	27	32	42

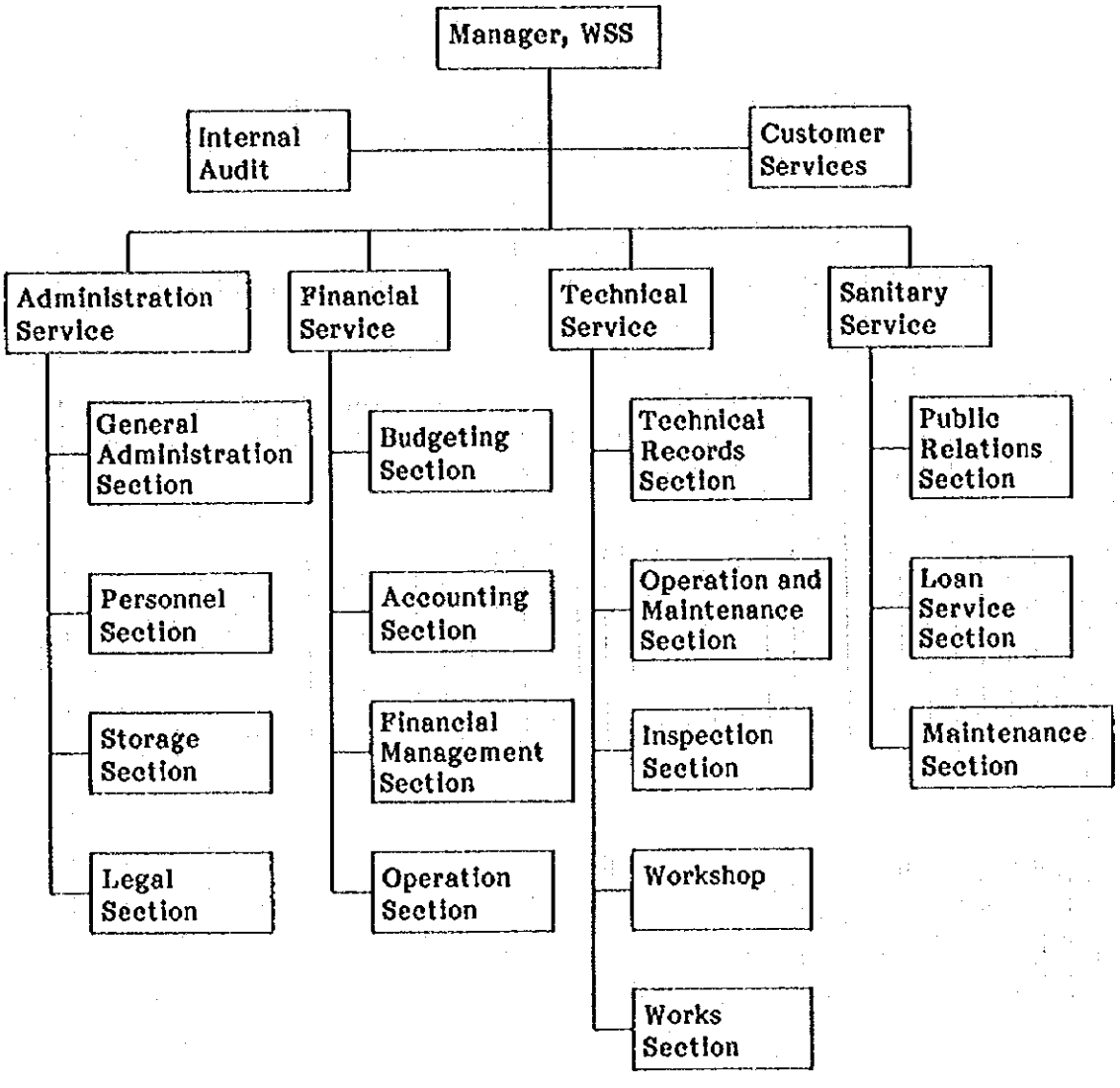


Figure 6.1.1 Proposed Model Organization Set-up of WSS

6.4 Community Building / Participation and WID

In addition to the recommendations outlined in the Main Report, the following are more specific to Bure. Based on the findings of the field survey the following recommendations have been suggested for implementation:

- Construct additional public fountains in areas where there are none using community labor and supporting a community management. Also provide private connections with adequate service time to those who can afford them.

- Public latrine (not pour flush) to be reopened and expanded to include an income generating public shower in the center of town to finance the cleaning and maintenance of the facility and possibly to finance other community initiatives.

- Community latrines to be constructed mostly with water for handwashing in areas where people are living in rented Kebele housing with priorities given to poorest elements of the community, these can be community managed with support from the Authorities.

- Support existing health education program and widen it's remit to include sanitary education through the Churches and Mosque, perhaps with pamphlets and other materials.

- Provision of budget for sanitary education work in the town, through the Sanitarians. Work alongside the sanitarians developing a non-didactic developmental approach to sanitary education.