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JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF WATER RESOURCES

No. 22

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

FEASIBILITY REPORT
NEFAS MEWCHA

(Volume II-VII)

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FEBRUARY, 1996

SANYU CONSULTANTS INC.
KYOWA ENGINEERING CONSULTANTS CO., LTD.

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GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
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PREFACE

This is the Feasibility Study Report for Nefas Mewcha 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.

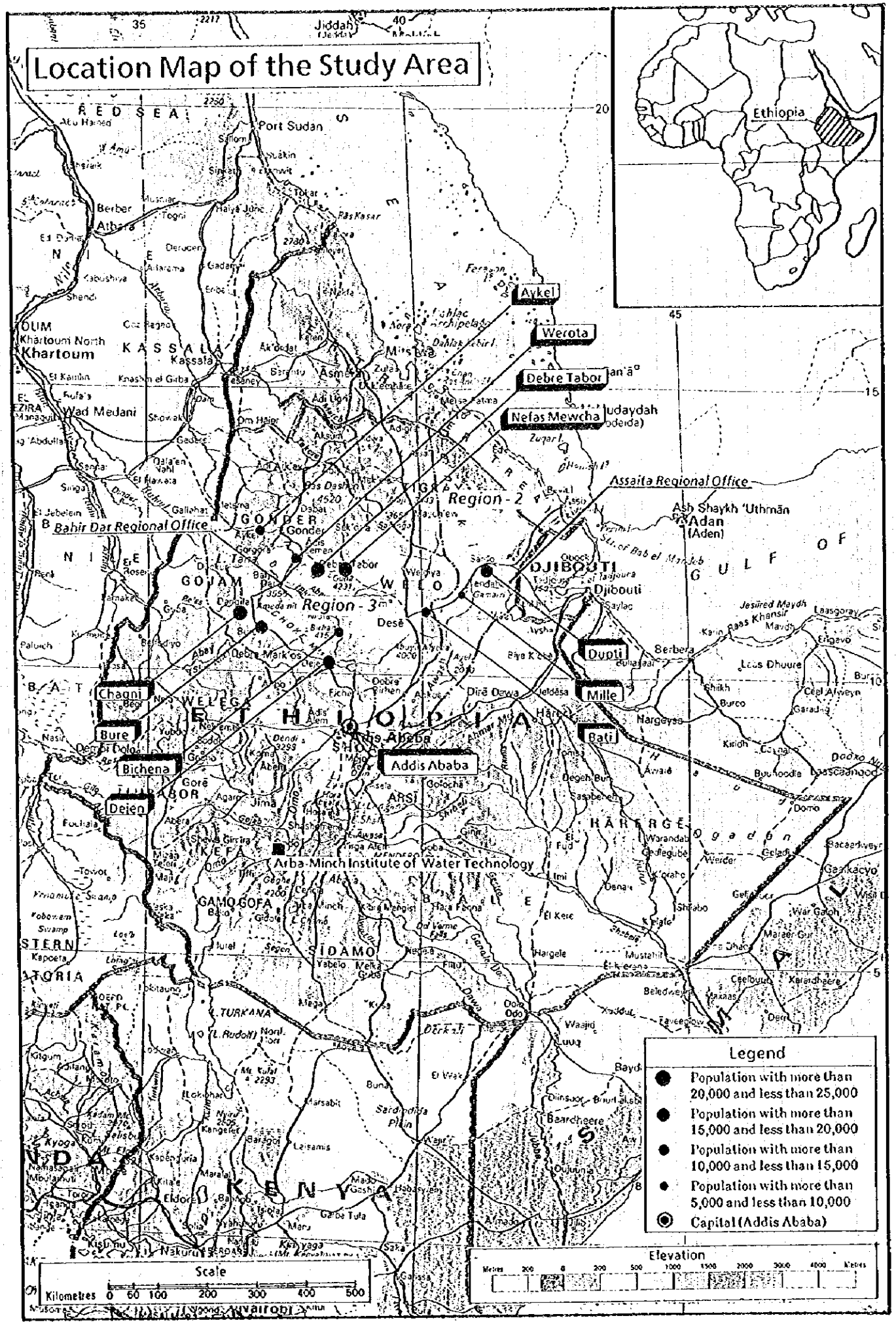
The major objectives of this Study are 1) to conduct a feasibility study on the water supply system in order to improve living condition of the population in the Study area by enhancing the level of the water supply services in terms of water quantity, water quality and its accessibility, 2) to formulate 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
Aykel
Werota
Debre Tabor
Nefas Mewcha
Assaita Regional Office
Region - 2
Bahir Dar Regional Office
Region - 3
Addis Ababa
Arba-Minch Institute of Water Technology
Dupti
Mille
Bati
Chagni
Bure
Bichena
Deien
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)
Scale
Kilometres 0 60 100 200 300 400 500
Elevation

General Description of Current Condition in Nefas Mewcha

Items	Description
Administration	Amhara Region, South Gonder, No. of Kebele : 2
Residents	Total population : 13,726 (2.3 persons/ha) Average family size : 5.9 persons Amhara : 100% Christians : 94% (6 churches) : % Moslems : 6% (1 mosque) : %
Educational Conditions	Kinder garden / Elementary school / Junior & Senior high s. No. of school: 2 / 2 / 1 No. of teachers: 2 / 88 / 43 No. of students: 144 / 2489 / 1110
Medical Conditions	Hospital : - Doctor : 2 Health center : 1 Nurse : 6 Health clinic : -
Economic Conditions	Hotels/restaurants : 209 Shops : 629 Cottage industry : 22 : Average monthly household income : 202 birr
Water Supply Condition	The source of WSS : Borehole (1) Major other sources : Spring Domestic consumption : 59.9 cum/day (4.7 lpcd) Other consumption : 5.7 cum/day (total 65.6) Water service coverage : 93% House connection : 38.1 lpcd (0%, 1.0 birr/cum) Yard connection : 16.6 lpcd (17%, 1.0 birr/cum) Neighbors : 8.0 lpcd (4%, 1.0(2.0) birr/cum) Public fountain : 1.6 lpcd (71%, 1.0(1.3) birr/cum)
Sanitary Condition	Septic toilet : - /100HH Dry pit toilet : 50/100HH Community toilet : 2/100HH Open field : 46/100HH 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 : 60% ORS awareness : 40% Sanitary behaviors score : 914/1600 (57%) Needs : Adequate Water, Improved Sanitation
Remarks	1. Water charge in bracket is actually paid. 2. HH means "household". 3. ORS means Oral Rehydration Solution. 4. Little faecal contamination found probably due to low temperature.

Project Description of Nefas Mewcha

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 13,726 (7.0%) 19,251 (6.5%) 26,376 (6.0%) 35,297
Water Demand Projected in cum/day	in 1995* 2000 2005 2010 Domestic : 60 358 600 1,019 Non Domestic : 6 167 256 385 Losses : 27 58 117 248 Total : 93 583 973 1,652
Dimensions of Water Supply System	Target Service Coverage: 100%(93% at present) Target Year of 2005 Deep Wells : 4 (400m) Rising Main : ϕ150(3.72km), ϕ100(0.69km), ϕ75(1.59km), ϕ50(3.40km) Booster of Rising : ϕ150mm,Q=0.59m^3/min,H=100m ϕ75mm,Q=0.23m^3/min,H=100m Reservoir : 260m^3(130×2) Distribution : ϕ250(300m), ϕ200(378m), ϕ150(3,005m), ϕ75(2,635m), ϕ50(10,800m) Booster of Dist'n : ϕ250mm,Q=1.3m^3/min,H=15m Target Year of 2010 Deep Wells : 3 (306m) Rising Main : ϕ100(2.30km)
Water Tariff Structure & Accounting System	Introduction of Progressive Water Tariff** HC: 3.50 birr/m^3, YC: 2.31 birr/m^3, PF: 0.82 birr/m^3 Introduction of Double Accounting System
Plan of Sanitary Facilities Improvement	Construction of 4 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 35 in 2005 and 45 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 Nefas Mewcha, water service coverage is 93 %, however the water consumption per capita per day is extremely low with the amount of 4.7 lpcd in average. Water quality of the source is acceptable with reference to WHO drinking water guideline in terms of both physico-chemical and biological aspects.

Toilet coverage is 52 % only, and 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). Nefas Mewcha is the one, located in Amhara Region, among the Eleven Centers along with Dupti, Mille, Bati, Debre Tabor, Aykel, Werota, Chagni, Bure, 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. Nefas Mewcha 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

Nefas Mewcha is located in the mountain chain of Mount Guna and the area is about 3,000 m.asl, being surrounded by deep gorges of Tekeze river to the north and Beshilo river, a tributary of the Abay to the south. Rivers around the town are Zanti, Zoga, Zenovo and Yegul. The area is entirely occupied by basalts and their debrises. There is a meteorological station of NMSA in the town but no river gauging station around the town. See Figure 2.1.1 for the locations and the rivers around Nefas Mewcha.

Table 2.1.1 shows the long term monthly mean values of precipitation, potential evapotranspiration and air temperature 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)	11.2	30.3	544	59.4	67.3	49.1	296.1	349.4	119.2	55.7	35.4	35.9	1,163.4
ETo(mm)	147	152	149	146	143	144	143	144	143	142	142	141	1,736
A.Temp.(°C)	11.7	11.9	13.8	14.4	14.6	14.3	12.4	11.4	12.1	12.6	12.3	10.9	12.8

Note: * = Estimated Based on the data of Debre Tabor

The distribution of monthly precipitation throughout a year shows one weakly pronounced rainy season in April and May and one strongly pronounced rainy season in July and August. The annual precipitation amounts to 1,163.4 mm.

Since the record of potential evapotranspiration is not available, the data is prepared being based on the distribution map of potential evapotranspiration obtained from NMSA and the data of Debre Tabor. It does not vary very much, ranging from 141 mm in December to 152 mm in February. The monthly mean air temperature reflects its cool climate. It ranges from 10.9°C in December to 14.6°C in May.

In order to assess ground water recharge of the area, the water balance sheet i.e. Table 2.1.2 is prepared assuming the runoff to be 40% of the precipitation and the reference crop evapotranspiration to be 70% of the potential evapotranspiration. The precipitation data is prepared from the four (4) year records between 1987 and 1992. The potential evapotranspiration is assumed to be same as the long term mean values.

Table 2.1.2 Water Balance Sheet of the Ground Water Recharge Area, Nefas Mewcha

Unit : mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	11.1	30.3	54.4	59.4	67.3	49.1	296.1	349.4	119.2	73.3	45.2	38.4	1,193.2
Q	4.4	12.1	21.7	23.8	26.9	19.6	118.5	183.5	47.7	29.3	18.1	15.3	520.9
P-Q	6.7	18.2	32.7	35.6	40.4	29.5	177.6	165.9	71.5	44.0	27.1	23.1	672.3
ETo	139	143	141	138	135	136	135	136	135	134	134	136	1,736
ETcrop	97.3	100.1	98.7	97.1	94.5	95.2	94.5	95.2	94.5	93.8	93.8	95.2	1,215.2
ETa	6.7	18.2	32.7	35.6	40.4	29.5	94.5	95.2	77.5	44.0	27.1	23.1	518.5
ΔS	0	0	0	0	0	0	83.1	70.7	0	0	0	0	153.8

Note: P = Precipitation
Q = Runoff
ETo = Potential Evapotranspiration
ETcrop = Reference Crop Evapotranspiration
ETa = Actual Evapotranspiration
ΔS = Recharge

According to this sheet, the recharge takes place only in July and August, which amounts to 153.8 mm in an average year. The proposed sites for new wells are mostly located in the watersheds of Zenovo river and Yegul river. Zenovo river has a watershed area of 5.0 km^2 at Doromeda and Yegul river has 9.5 km^2 at Kabaromeda. Since these rivers have relatively small watershed areas, it must be checked if there is a sufficient recharge for the wells.

Yearly water balance sheets were prepared for four (4) years between 1987 and 1992 as shown in Appendices. The recharge of each year is shown in Table 2.1.3.

Table 2.1.3 Monthly Recharge Estimated by Means of Surface Water Balance Analysis

Unit : mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1987	0	0	0	0	0	0	0	75.1	0	0	0	0	75.1
1988	0	0	0	0	0	0	176.6	48.2	0	0	0	0	224.8
1989	0	0	0	0	0	0	64.7	15.5	—	—	—	—	80.2
1992	0	0	0	0	0	0	134.5	318.9	0	0	0	0	460.6

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 75.8 mm and 51.6 mm respectively.

For the watershed area of Zenovo river in quantity wise:

5-year recharge $0.0758 \times 5.0 \times 10^6 = 0.379 \times 10^6$ m^3/year
10-year recharge $0.0516 \times 5.0 \times 10^6 = 0.258 \times 10^6$ m^3/year

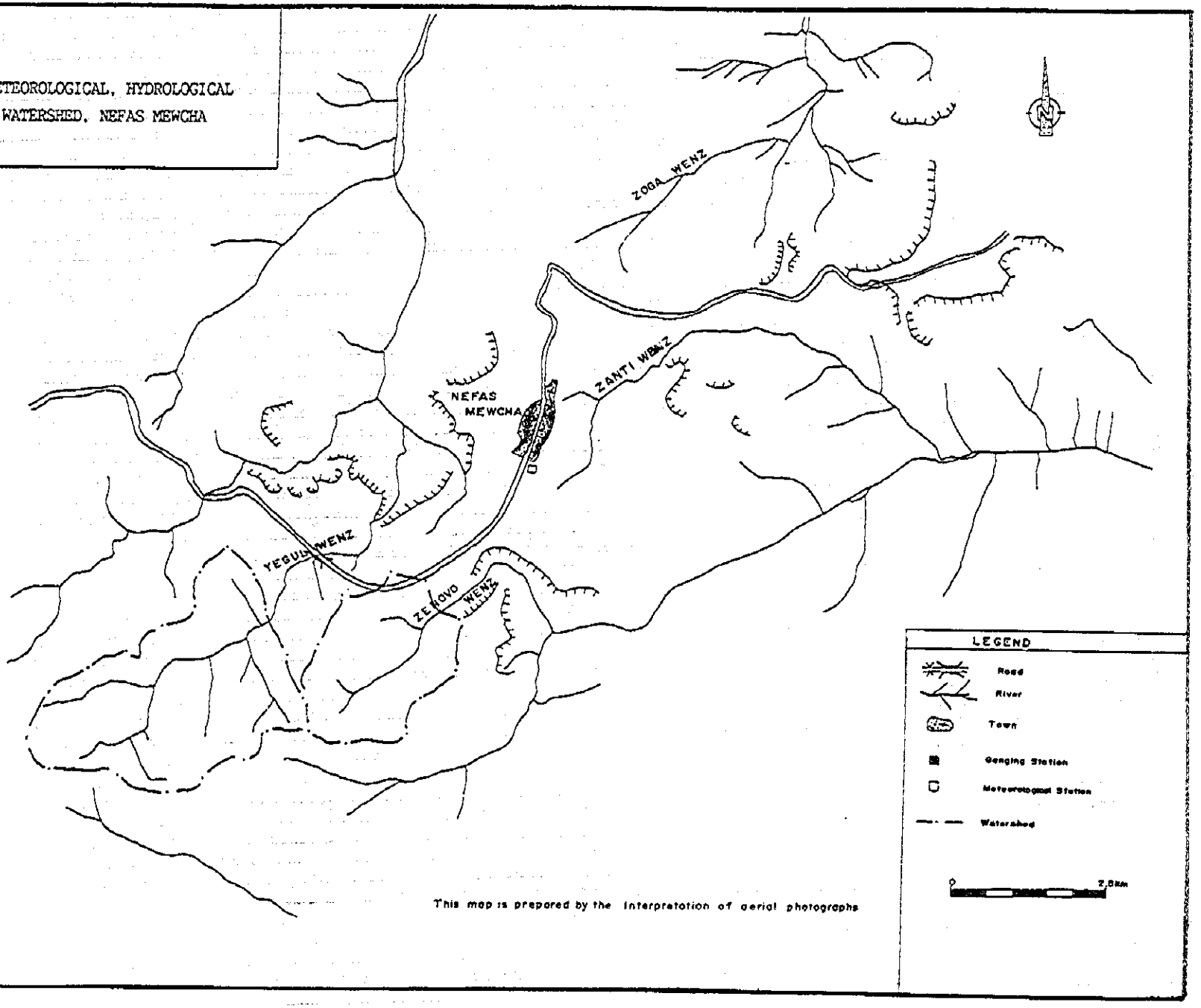
These are equivalent to 1,038 m^3/day and 707 m^3/day respectively.

For the watershed area of Yegul river:

5-year recharge $0.0758 \times 9.5 \times 10^6 = 0.720 \times 10^6$ m^3/year
10-year recharge $0.0516 \times 9.5 \times 10^6 = 0.490 \times 10^6$ m^3/year

These are equivalent to 1,973 m^3/day and 1,342 m^3/day respectively.

Fig. 2.1.1
LOCATIONS OF METEOROLOGICAL, HYDROLOGICAL STATIONS AND WATERSHED, NEFAS MEWCHA



2.2 Hydrogeology

2.2.1 Geology

Nefas Mewcha is situated on the flat narrow plateau which trends northeastward from the foot of Mt. Guna. It is surrounded by deep cut gorges in all direction except in the southwest. The narrow plateau and the foot area are dominated by alkaline basalt which belongs to Ashangi Group of paleocene-miocene. Massive basalt and fresh basalt with columnar joints crop out on the cutting wall along the Werota - Weldiya highway. It is weathered on the top of the hill.

The undulating surface of the plateau is covered with clayey soil originating from decomposition of the weathered basalt. Alluvial deposits which are composed of sand and gravels with fine particles predominate the bottom of the gorge.

2.2.2 Hydrogeology

(1) Groundwater

Ground water potential of Nefas Mewcha is no more encouraging than the condition at Debre Tabor, because the area is situated on the plateau dominated by basalt and exploitation of the aquifers in basalt layers is not easy. The primary permeability of volcanic rocks is low but it could develop extensive secondary porosity along the fault and fracture openings. The occurrence of ground water in basalt layers is associated and controlled by tectonic activity. Actually, according to the borehole logs and drilling records, water was struck at the highly weathered basalt layers which are described as clay, sand or gravels intercalated with weathered basalt.

Six points have been drilled in this area but three of them, Borehole No.1, No.3, No.4, were dry boreholes. On the other hand, water was struck at Borehole No.1c, which was located near Borehole No.1, but this borehole was abandoned because of the accident that the drilling bit stuck down into the hole (from verbal information). Borehole No.2 which was drilled at 200 m upstream side from the No.1 has been productive. Hydrogeological characteristics of this borehole are shown as follows.

Borehole Depth	67.0 m
Static Water Level	4.2 m
Safe Yield	5.0 l/s
Transmissibility	3.47 x 10-4 m^2/s

Borehole No.3 was drilled at about 500 m upstream side from No.2 but no data was kept due to the dry hole. Borehole No.4 which was located at the about 4 km south, in Doromeda Village, was drilled by EWWCA in 1993 and was dry. Borehole No.5 which is located at about 7 km southwestward from the town, near Kabaromeda Village, was drilled by EWWCA in 1992, but it has not been productive yet, because the pump is not installed and the generator is also not prepared. Pumping tests was carried out in 1994 but coefficients for the aquifer has not been calculated yet.

(2) Other Water Source

Two spring points are observed along the Zenti River which drains out to the east side of the town. Another spring is in the small valley behind the new prison. All the springs are dry during extended dry season.

No perennial river flows surrounding the town but the nearest perennial river is the Gobgob River at about 10 km west of the town and drains to the deep cut gorge at the west side of the town. The use of this river as a source would need long pipeline and involve treatment so that it would be very costly.

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 is only one (1) borehole which is currently serving to the population of Nefas Mewcha. The analyzed chemical constituents are within the acceptable range set by the WHO guideline.

A relatively well protected spring named Zenti, from which many people fetch water, was also undertaken for the test, and the result shows to be fit for drinking water.

There is another borehole, which is located about seven (7) km south-west of Nefas Mewcha and has not started functioning yet. The chemical constituents are found within the acceptable range except turbidity and color. The turbidity and color could be removed after the pumping-up is started because the water is presently stagnant.

3.1.2 Bacteriological Aspects

Bacteriological test carried out for 32 samples shows fairly good result free from faecal coliform which is an indicator of faecal contamination. No coliform was detected for the samples collected from the source as well as its outlets such as public fountains and private connections. The protected spring (Zenti) had been tested twice, both of which showed no faecal coliform. Likewise, water fetched from those sources and stored in household containers showed no coliforms with some exceptions. However, another spring located about 300m downstream from the protected spring was found with full contamination of faecal coliforms. The unprotected spring was observed with unhygienic condition and could be easily contaminated, because of accessibility of cattle and to which sewage was drained.

The outcome based on above suggests that bacteria especially the thermophilic one cannot be well developed in the distribution lines and containers under such low temperature caused by high altitude with about 3,000m (water in a clay pot showed 17-C dated June 21, 1995), if the water source is properly protected from unhygienic condition and free from the bacteria.

3.2 Current Water Consumption and Demand

3.2.1 current Water Production and Consumption

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

Production	72,640 m^3
Consumption	51,246 m^3
Losses	about 29 %

3.2.2 Current Water Consumption

According to the water consumption census conducted by the Team, the total population served by the water supply is about 12,700, accounting for 93% of the total population. Domestic, institutional, commercial and industrial consumptions 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	2894	12705	(100)	59.9	(4.7)	298.6	(23.5)
House Connection	7	41	(0.3)	1.6	(38.1)	1.6	(38.1)
Yard Connection	348	2288	(18.0)	37.9	(16.6)	63.6	(27.8)
Public Fountain	2319	9786	(77.0)	15.7	(1.6)	218.2	(22.3)
Neighbors	220	590	(4.6)	4.7	(8.0)	15.2	(25.8)
Institutional	13			3.1			
Commercial	363			2.3			
Industrial	25			0.3			
Total	3295			65.6			

There are only nine (9) customers with house connections. Seven (7) of them are private customers and five (5) use water for their businesses as well as domestic purposes. The domestic lpcd of the house connection customers is calculated at 38.1 from the census data. From this lpcd and the population served accounting at 41, the domestic consumption is estimated at 1.6 m^3/day.

There are two (2) institutional customers; namely, the army camp and the Commercial Bank, whose consumption is 1.1m3/day in total. There are five (5) commercial customers, i.e., two (2) hotels (lodgings) and three (3) coffee bars. Their commercial consumption is, however, unable to calculate because of the high average domestic lpcd. There is no industrial customer with house connections.

There are 355 customers with yard connections. Almost all are private customers and one-third of them use water for their businesses as well as domestic purposes.

The domestic lpcd of the yard connection customers is calculated at 16.6 from the census data. From this lpcd and the population served accounting at 2,288, the domestic consumption is estimated at 37.9 m^3/day. There are seven institutional customers and their consumption is 2.0 m^3/day. The large consumers are two (2) elementary schools whose consumptions are 1.3 m^3/day in total.

There are 109 commercial customers whose businesses are hotels (lodgings), coffee bars, eateries, breweries (Tej and Tela houses), tea rooms shops, etc. Their commercial consumption is estimated at 2.2 m^3/day, excluding their domestic consumption estimated at 17.2 lpcd. There are three (3) houses presently being built whose consumption, excluding their domestic consumption is sorted to industrial. Their industrial consumption is 0.3 m^3/day.

Majority of water users are public fountain users which account for 77% of the total population served. There are 230 households engaged in small businesses such as breweries (Tej, Tela and Araki houses), tea rooms, eateries, shops, grain stores, grain mills and even hotel (lodging). Since the lpcd of public fountain is as low as 1.6, their consumption for businesses is considered negligible. This lpcd is one of the lowest among the 11 centers. There is only two institutional users, however, their consumption is minimal.

Those who borrow and buy water from neighbors (vendors) are accounted at 220 households and two institutions. The domestic lpcd is calculated at 8.0 from the census data. From the lpcd and the population served accounted at 590, the domestic consumption is estimated at 4.7 m^3/day. The three (3) institutions are the army camp, the Weroda Finance Dept. Office and the police station. Their consumption is, however, minimal. There are 19 households engaged in small businesses such as breweries (Tej and Tela houses), shops, etc. Their commercial consumption is minimal.

3.2.3 Current Water Demand

There water required by the users of different mode of services for different domestic purposes was surveyed. In the 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 in any businesses either.

Most of the samples are located in the center of the town in Kebele 01 where piped water is relatively available. For the samples of TSU, the area near the borehole is selected, where there is a spring.

The survey result seems very reasonable varying from 21.0 lpcd of TSU to 30.1 lpcd of house connection users. In comparison with the lpcd of demand and current consumption, the water supply is satisfactory for the domestic demand of house connection users but not for the other users.

In order to calculate the domestic day demand, the lpcd of current consumption is applied for house connection users and the lpcd of demand surveyed is respectively applied for the other users.

The domestic demand of the users with different mode of services is shown in Table 3.2.2.

Table 3.2.1 Water Production and Consumption in Nefas Mewcha

Consumption (m3)

	IC	PF1	PF2	PF4	PF5	PF6	PF7	PF8	PF9	PF11	PF12	PF13	PF14	PF15	PF16	Sub Total	Grand Total
Jul-93	1,356	21	37	42	31	35	50	32	17	40	38	52	11	12	21	439	1,795
Aug-93	1,163	26	39	64	24	38	58	21	27	41	58	20	16	17	2	451	1,614
Sep-93	1,410	67	34	88	29	75	102	51	37	81	60	35	17	23	9	708	2,118
Oct-93	2,072	77	15	50	29	96	125	34	50	71	127	50	22	17		763	2,835
Nov-93	2,017	79	43	104	45	103	93	50	61	97	87	48	19	17	19	865	2,882
Dec-93	1,982	42	41	87	42	87	81	59	52	75	98	46	13	5	19	747	2,729
Jan-94	2,016	61	41	98	47	95	97	87	33	76	108	49	13	4	19	828	2,844
Feb-94	2,238	55	43	91	78	70	72	48	78	50	58	17	10	10	20	700	2,938
Mar-94	1,979	53	56	43	37	82	44	26	26	35	28	51	2	27	4	514	2,493
Apr-94	2,143	4	16		11		15	4	11		50			12		123	2,266
May-94	2,083	24	36	30	2	37	27	4	6	14	8	15		1	2	206	2,289
Jun-94	1,414	71	27	66	8	66	8		26	36	37	35		3	6	389	1,803
Jul-94	1,399	6	31	46	23			14	24	37	59	12			9	261	1,660
Aug-94	1,440	52	38	86	29	62	10	39	45	69	66	41		7		544	1,984
Sep-94	1,931	74	55	61	14	55	57	28	38	81	62	74		12	60	671	2,602
Oct-94	2,079	71	47	60	25	30	103	47	52	116	90	57	17		21	736	2,815
Nov-94	1,766	45	45	51	32		121	3	58	99	11	15			31	511	2,277
Dec-94	2,190	19	42	78	48		43		79	73	60	31			19	492	2,682
Jan-95	1,640	63	12	63	45		60		53	42	2	14			22	366	2,006
Feb-95	1,640	32		70	25	31	56		30	94	48	91			16	493	2,133
Mar-95	2,153	65		61	53	18	27		40	44	40	58	13		5	424	2,577
Apr-95	1,486	69		40	104	21	36		35	26	22	49	11		5	418	1,904
Total	39,597															11,649	51,246
Average																	2,329
Maximum																	2,938

Production (m3)

Well No.1
2,296
1,218
2,575
2,997
2,958
2,887
3,234
4,609
5,078
4,802
4,107
4,119
3,528
3,073
2,049
2,755
2,792
2,947
3,031
3,717
3,154
4,714
72,640
3,302

Unaccourted loss

(m3)	(%)
501	21
-396	-32
457	17
162	5
76	2
158	5
390	12
1,671	36
2,585	50
2,536	52
1,818	44
2,316	56
1,868	52
1,089	35
-553	-26
-60	-2
515	18
265	8
1,025	33
1,584	42
577	18
2,810	59
21,394	29

*recorded in Ethiopian calendor

IC: Individual Connection

PF: Public Fountain

3.3 Water Supply Facilities Condition

3.3.1 General

Water source in this town is groundwater, and the water supply is served by the piped water system. The existing water supply system is composed of one borehole, one transmission pipeline and distribution facilities. The schematic existing water supply system is shown in the Figure 3.3.1.

3.3.2 Water Source

The existing submersible pump is driven by the on-site generator, and existing generator is Indian-made with a capacity of 30 KVA.

The existing borehole is equipped with a check valve and flow meter, and the flow meter showed that the pumping rate is about 3.3 l/s. No information on the existing submersible pump is available, because pump investigation was not carried out due to the difficulties of taking out the pump from the borehole.

It is reported that the submersible pump is operated three times a day: 6:00AM-12:00AM, 2:00PM-5:00PM, and 7:00PM-12:00PM in order to cool down the generator.

3.3.3 Transmission and Distribution Facilities

Water is supplied directly to the town from the borehole. The existing reservoir is made of masonry and cylinder type with a capacity of 70m^3. No measurement appurtenance was provided.

The distribution network is branched system with galvanized steel pipes. The diameters of the pipes range from DN 20 to DN 100. The lengths of pipelines are summarized as follows:

Table 3.3.1 Existing Pipeline Data

Diameter (mm)	Length (m)	Material
25	340	G.S.
40	1540	-do-
50	1680	-do-
65	150	-do-
80	270	-do-
100	1090	-do-

3.3.4 Service Level

Water service level is divided into two modes: individual connection and public fountain. There are 332 individual connections, and it is subdivided into 3: private (377), commercial (3), governmental institution (9), and public institution (7). Individual connection is about 77% of the total consumption, and public fountain about 23%.

According to the WSS's staff, about 150 customers request WSS to make a house connection annually. Out of this number, about 30 customers are made to connect annually.

There are 16 public fountains, and 14 operational public fountains. The public fountain was usually opened three times a day: 6:00AM-8:00AM, 9:00AM-12:00PM, and 3:00PM-6:00PM, but the public fountain to be opened on rotation basis due to lack of P.F. Attendant. 4 or 6 faucets per public fountain were being provided.

3.3.5 Disinfection

There is no disinfection facility in the existing water supply system. It is reported that the clinic provides chlorine tablet twice a year free of charge and the tablet is added in the service reservoir. According to the staff, it is difficult to purchase chemical for disinfection due to the financial constraint.

3.3.6 O & M

Nefas Mewcha is classified as urban town, and the waterworks is under the control of the Regional Office in Amhara Region. Any regular check up for the maintenance was not made except yearly inspection tour by the regional office.

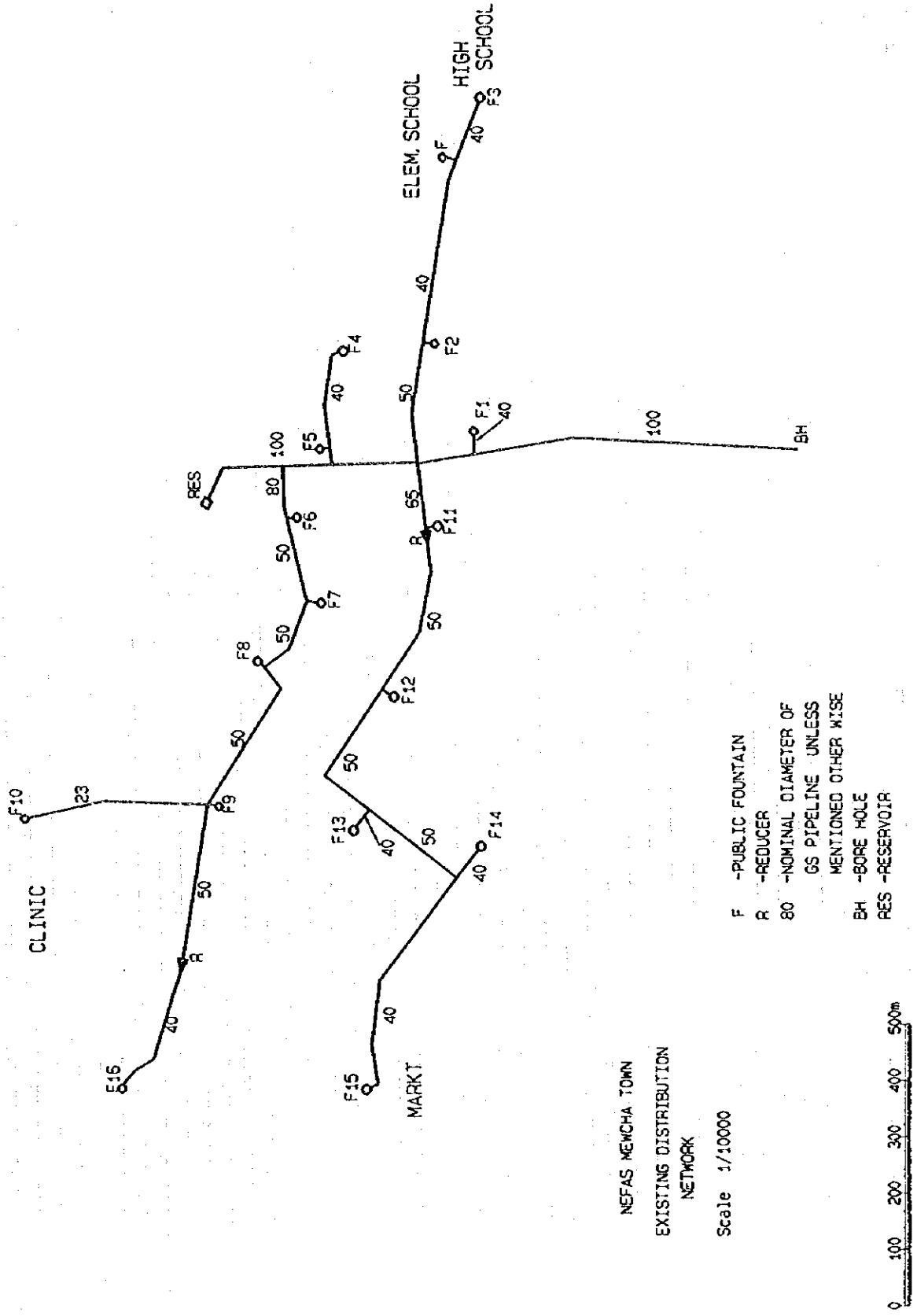


Figure 3.3.1 Schematic layout of Existing Facilities (No scale)

3.4 Sanitary Facilities Condition

3.4.1 Toilet Facilities

Sanitation is very poor in Nefas Mewcha. The toilet facilities that the people mostly use are dry pit latrines and open area. There is no public toilet in the town. The people at the bus terminal and at the big Saturday Market use open-field for disposing their body wastes.

The 1984 Population and Housing Census with an updated data of 1993 has carried out a sanitation survey of the whole town. The results of the survey are indicated in Table 3.4.1.

Table 3.4.1 Distribution of Housing Units by Type of Toilet Facilities in Nefas Mewcha

Number and percentage	Type of Toilet Facility						Total
	Flush		Dry pit		None i.e. (open-) field	Other	
	Private	Shared	Private	Shared			
• Number	1	-	234	144	827	32	1,249
• Percentage (%)	0.9	-	18.7	11.5	66.2	2.7	100.0

Table 3.4.1 indicates that 66% of households in Nefas Mewcha do not have toilet facilities; while 30% of the households have traditional pit latrines, and only about 1% of the households have flush toilets.

The survey of 100 households carried out by the Team reveals the following results regarding toilet facilities.

Table 3.4.2 Distribution of Households by Type of Toilet Facilities Used

Percentage	Type of Toilet Facility					
	Septic Tank	Dry Pit Latrine	Community Toilet	Open field	Other	Total
%	-	50	2	46	2	100

Table 3.4.2 shows that out of 100 households 52 of them use dry pit latrines and 46 of them use open-field. There is no single household out of these hundred households that has flush toilets.

When the pit latrines fill-up, usually in 2-3 years, the owners dig new ones of they have space. Those who can afford to pay and can arrange a vacuum truck from Bahir Dar or Gonder, which is usually difficult to get due to shortage, can have their pit latrines emptied. There is no properly prepared and reserved site for dumping the sludge. But the Town dumps the sluge about 2 km outside the edge of the town along the Weldiya Road. The farmers on whose land sometimes the sludge is being dumped seem to take advantage of the sludge as a fertilizer. But they allow this dump during the dry season only.

From the Population and Housing Census of 1984, it has been noted that 94% of the walls of housing units in Nefas Mewcha are built out of wood and mud, 91% of their roofs out of corrugated iron sheets and 85% of the flooring out of earth and mud. The physical structures of the toilet facilities follow, more or less, the same pattern except for the flooring of the toilet facilities which are mostly cement/concrete or line-up sticks.

3.4.2 Other Sanitary Facilities

Most of the dry solid wastes are dumped along the streets, in open area nearby and near households. The survey of 100 households regarding disposal of dry solid wastes has indicated the following as shown in Table 3.4.3.

Table 3.4.3 Response to Disposal of Dry Solid Waste of 100 Households

Percentage	Way of Disposal of Refuse				
	Thrown Anywhere	In Open Pit	In Covered Pit	Burnt	Total
%	62	24	3	11	100

As it can be seen from Table 3.4.3, 62% of the households dump their refuse anywhere, 24% dump in open pit, and only 11% burn. This situation has created environmental pollution, water contamination and health hazards.

The same survey of the 100 households has revealed the following for sullage disposal.

Table 3.4.4 Response to Disposal of Sullage of 100 Households

Percentage	Way of Sullage Disposal				
	Anywhere	Pit	Drain	Vegetable Garden	Total
%	81	15	3	1	100

Out of the hundred households, 81 of them dump their sullage anywhere. Mostly this is done in front of the households, along streets and nearby open area. 15% of the households dump sullage in pits, 3% in the drains and 1% in vegetable gardens. Because of indiscriminate dumping of most of the sullage anywhere, the environmental pollution and water contamination are high resulting in considerable health hazards.

Nefas Mewcha does not have abattoir. The town people slaughter their meat animals everywhere and throw the waste matter nearby making the area unhygienic.

In general, the sanitation condition in Nefas Mewcha is very bad.

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 Nefas Mewcha is 19, which is on the large side 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					
Archives clerk	1	0	1	0	0
Clerk	0	1	0	1	0
Store keeper	1	0	1	0	0
Guards	4	0	4	0	0
Sub-total	6	1	6	1	0
3. Finance					
Accountant	1	0	1	0	0
Cashier	1	0	0	1	0
Meter reader	0	1	1	0	0
Water sellers	2	3	5	0	0
Sub-total	4	4	7	1	0
4. Technical					
Motor operator	1	0	1	0	0
Plumber	1	0	1	0	0
Astt. plumber	1	0	1	0	0
Sub-total	3	0	3	0	0
Total	14	5	17	2	0

As the table shows, out of the total 17 persons or 89% are permanent workers and 2 or 11% are contract workers. Female workers are 5 in number or 26%. It is nearly equal to 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 37%, 42% and 21%. On the other hand, their 11 town averages are 37%, 41% and 22%. It means that the broad functional composition of personnel is almost the same as that of the 11 town average.

Annual water production per worker, which is the broadest labor productivity indicator is calculated at 2,222 m^3. It is on the low side. The monthly remuneration per worker is 153 birr, which is on the low side.

It follows from the above that although both functional composition of personnel and the participation rate of the female workers are just standard ones, but the size of workforce itself might not be commensurate with the level of water production.

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 42,216 m^3 and 31,206 m^3 respectively. Leakage ratio works out to 26.1%, which is the highest among the 11 towns concerned. The daily water consumption as divided by population comes to 6.2 liter. This is at a medium level.

Income for the last year was 56,457 birr. The major sources of income are house connections (48.6%), public fountains (19.8%), and service charge (13.8%). Income per m^3 of water consumed works out to 1.81 birr, which is on the high side. Bill collection rate is 91.7%, which is rather on the high side.

Expenditures for the same year were 79,567 birr. Major items of expenditures were fuel (42.7%), salaries (18.9%), fittings and water meters (11.6%) and uniform (8.0%). Expenditures per m^3 of water produced work out to 1.88 birr, which is on the high side. The income-expenditure ratio comes to 71.0%. This is on the low side.

The number of personnel is 19. It is on the large side among the 11 towns. Annual water production per worker is calculated at 2,222 m^3, which is on the low side. Annual income per worker is 2,971 birr, which is one of the lowest. Expenditures per worker are 4,188 birr, which is at a medium level. Average monthly salaries are 153 birr. It is on the low side.

It follows from the above that the financial status of WSS is not good mainly due to a high level of expenditures (fuel is responsible) and a comparatively large workforce.

3.7 Social Background and People's Awareness

3.7.1 Population and Social Composition

At the time of the field survey, the population of Nefas Mewcha was 13,726, divided into two Kebeles. 01 Kebele is slightly smaller than 02 Kebele. According to the responses to the household survey, the population were all Amhara (100%), most (92%) practice Christianity and most of the rest practice Islam. The land ownership of respondents was 57% and the number of female headed households was relatively low at 30%. There is high unemployment in the town with only a small amount of commerce and petty trading. The rural area suffered a poor harvest in 1994 and food distributions were taking place from the town on a food for work basis. Up until the time of the field survey the town people had not been included in these food distributions which was a serious complaint of many groups.

3.7.2 Sanitary Condition

Most private connection users had latrines while some public fountain users had latrines. Half of the households in the survey did not have latrines and practiced open defecation, especially the poor and those in rented housing. They did not have latrines due to lack of affordability and lack of land rather than a lack of awareness or demand.

Community latrines with community management might work and groups were interested in this idea. All groups thought that they would be able to keep the latrines clean and preferred to have the facility split by sex rather than by groups of families. No groups wanted pour flush latrines, and not all groups could afford to consider having water in the latrines due to problems over payment for that water charge. Other groups suggested a monthly payment paid by the community with subsidies for those who could least afford this cost. None of the groups felt they would be able to finance the desludging of the latrines once they were filled up. Most people were willing to provide labor for sanitary improvements in the town while 15% of respondents requested sanitary education and community control as part of any sanitation program.

3.7.3 Water Situation

At the time of the field survey, water was in short supply in the town. The system was functioning but taps are only open one day in four, and then only for a limited time. This is the same for public fountains as for private connections. Logistical and management problems over fuel reduced the operating time still further on occasions. At times like these the town people have had to go to springs to fetch water. Water collection and laundry was the task of women, although some young girls and boys also collected water. Occasionally men would accompany women to springs particularly if collecting during the evening.

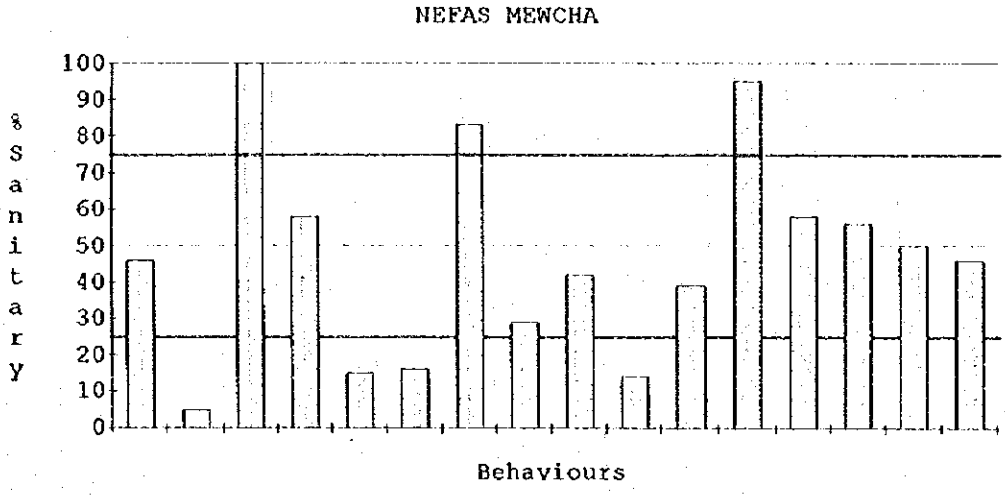
The price of water was the same for all of the people we spoke with at 10 cents for 4 clay pots from public fountains. On average private connection users pay 5 Birr per month and hotels pay an average of 15 Birr each month. All of the people we spoke with were prepared to pay more money for a better water supply service. The main requirement was for longer water point service time. There were probably enough public fountains to satisfy demand if they functioned for two hours every day. Additional public fountains were required at the edge of town where distance was felt to be too great to the public fountains. In these areas people expressed an interest in community management of the water points. Additional private connections were not regarded as priorities in Nefas Mewcha.

3.7.4 Health Indicators

The town had a Health Center which served the whole Woreda. Among the staff there were two sanitarians. The sanitation program had serious problems due to a lack of budget and a lack of coordination with relevant authorities. Intestinal Parasites were the most common reason for presenting at the health center. Scabies, diarrhea and conjunctivitis were among the most common diseases in 1994/5. The health center has had a monthly program including sessions at the outpatients clinic, prison and schools.

The town population had a relatively high level of sanitary awareness compared with other towns in the study. The responses to the household survey indicate that 61% of households were aware of the cause of diarrhea and 42% were able to prepare ORS correctly. It also had reported the highest number of men and women attending health education sessions in the town. Sessions included the use of different methods from charts and posters to short lectures. The health center staff felt that their program was improving the attitudes of the people towards health. The school has only had inputs from the health center for their Anti-AIDS program.

The sanitary behaviors recorded by the household survey are middling as compared to other towns in the Study. They are recorded in Figure 3.7.1.



No.	SANITARY BEHAVIOURS	%Sanitary
1	Access to piped water	93
2	Use piped water supply always	5
3	Covered water container	99
4	Water scoop kept off the floor	68
5	Handwashing with soap after defecating	28
6	" after handling childrens stools*	35
7	Covering cooked food during storage	100
8	Not eating unwashed raw fruit and vegetables	93
9	Kitchen utensils stored off the floor	70
10	Rubbish burried or burned	14
11	Wastewater disposed in pit/drain/veg. garden	19
12	No animals kept in the house	87
13	Home not infested with flies	67
14	Latrine in use by household	57
15	Latrine in use by all household members	47
16	Infant's excreta disposed of in latrine*	32
TOTAL SCORE FOR SANITARY BEHAVIOURS		914

*As proportion of households with young children

Figure 3.7.1 Indicator Sanitary Behaviours

This summary of indicator behaviors suggests areas where sanitary improvements would be required. The highest priority areas are the use of piped water always, the burning or burial of solid waste and sanitary disposal of wastewater. The middle-high priorities are handwashing with soap after defecation and after handling children's stools, and the use of latrines by all family members including disposal of children's excreta in a latrine. The middle-low priorities are keeping water scoops and kitchen utensils off the floor, fly control and access/use of latrines by household.

There is the largest variation in this score between different water user's groups, religions and income groups (See Figure 3.7.2).

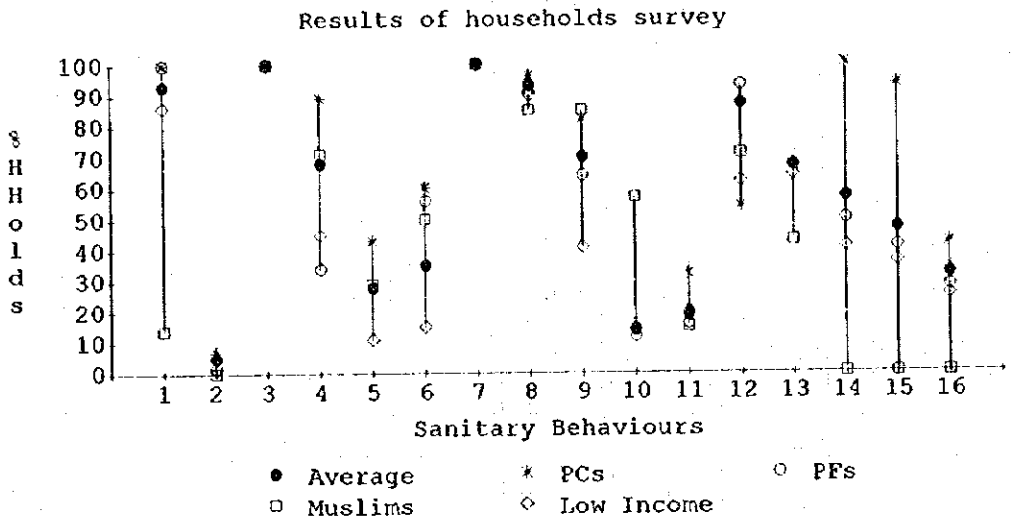


Figure 3.7.2 Differences in Sanitary Scores

Muslims seem to have very limited access to piped water supply and no access to latrines but have better solid waste disposal practices. Low income groups have poorer practices particularly in hand washing and management of children's excreta.

3.7.5 Education

Nefas Mewcha had two elementary schools and one secondary school. The percentage of female staff in the questionnaire survey was 50% at the elementary schools and only 9% at the secondary school. There were 1157 pupils at the secondary school, some pupils attending in the morning and the others attending in the afternoon. In all classes there were more boys than girls and this trend is greater at the higher levels. Girls tend to drop out from school more and perform less well in general, although there were some exceptions. The school had a Health/Anti-AIDS and Red Cross Club, led by the biological science teachers.

There were no water facilities at the school. There was a latrine with one side for boys and one for girls. However, the girls do not use the latrine due to bullying from the boys. A latrine for girls in a different part of the school compound would be more appropriate.

3.7.6 Religious Institutions

Most of the population were attending either the Church or the Mosque. The Priest at Selassie Church confirmed that water and sanitation was a long term problem in the town. Even at the church, the private connection seldom worked and they had no latrines. The Priest felt that community latrines would be a good option and would like to assist with any sanitary education program. As part of the teaching sessions at the church, they would be willing to include health and sanitation related topics. The Church would require assistance in this matter from the staff of the Health Center.

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 19 governmental organizations excluding schools dealing with general administration, finance, education, health, water supply and sanitation, communications, police, justice, water resources development, agriculture, electricity supply, relief, meteorology and municipal affairs.

The number of government employees is 541. It is on the large side among the 11 towns. The number of them per 1,000 population works out to 39, which is on the high side. Their average monthly salaries are 297 birr, which is the second lowest, next to 292 birr in Bure.

This town has two Kebele. There are three NGO's, two of which are relief-related.

3.8.2 Population

The population of the town is estimated at 13,726 based on the results of the cartographic census conducted by Central Statistical Authority in 1993. It is on the small side among the 11 towns. Ethnically, Amhara occupy a virtually 100 percent of population with a handful of Tigre. Religion-wise, 94% of the population is Christians and 6% Moslems. There are 6 churches and 1 mosque.

This is an Amhara and Christian town.

The average family size is 5.9 persons. This is on the small side among the towns concerned. The area of the town is 648 ha. It is on the large side. The population density is calculated at 21.2 persons/ha. This is on the low side.

3.8.3 Educational Conditions

There are 2 kindergartens, 2 elementary schools, and 1 junior and senior high school. The total number of pupils/students is 3,743. It is medium among the 11 towns. The number of pupils/students per 100 population is calculated at 27, which is on the high side.

Literacy ratio and primary school enrollment ratio were 70.2% and 58.5% respectively according to the 1984 population census. The former is on the high side, but the latter is on the low side.

3.8.4 Medical Conditions

There are 1 health center and 2 private pharmacies. The total number of medical personnel in the health center comes to 43, which is the second largest, next to 81 in Debre Tabor among the 11 towns. It means that there are 3.1 medical personnel for every 1,000 population. It is also at the second highest level, next to 3.2 in Debre Tabor.

The types of diseases people suffer most are water-borne and sanitation-related diseases such as intestinal parasitism, diarrheal diseases, scabies and conjunctivitis, and respiratory tract infections such as pneumonia and upper respiratory tract infection. The number of top ten disease cases treated in the medical institutions in 1993/94 was 22,002, which is the largest 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 48.1%, which is at the highest level.

Under 5 mortality rate and life expectancy were 195.8/1,000 and 49.0 years respectively according to the 1984 population census. The former is the second highest, next to 213/1,000 in Dupti and the latter is the second lowest, next to 47 in Dupti.

It follows from the above that although medical environment is one of the best among the 11 towns, people suffer from diseases and ill health more than those in other towns. There might be climatic and economic causes behind it.

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

3.8.5 Economic Conditions

The number of hotels and restaurants is 209 (24.3%), that of shops 629 (73.1%) and that of cottage industry 22 (2.6%), adding up to 860 (100.0%). This total number of commercial/industrial establishments is on the large side among the 11 towns (No. 3). The total number per 1,000 population comes to 63, which is on the high side (No. 3). The number of hotels and restaurants per 1,000 population is 15, which is also on the high side (No.4).

The above tells that Nefas Mewcha is characterized as a relatively big commercial town.

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

Major marketable items are agricultural products such as tef, barley, wheat and beans, livestock such as oxes, cows, sheep, horses, mules and donkeys, household items, etc. Goats and camels are not available.

Saturday is the market day on which 80,000 people are said to converge to the town.

The average monthly household income is 202.3 birr. This is the lowest among the 11.

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 50 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 on-site generator by EELPA, and the existing water supply facilities is also operated by the on-site generators. Hydroelectric power is scheduled to supply by 2005 Thus, the future water supply facilities at the target year of 2005 and 2010 will be also operated by the hydroelectric power.

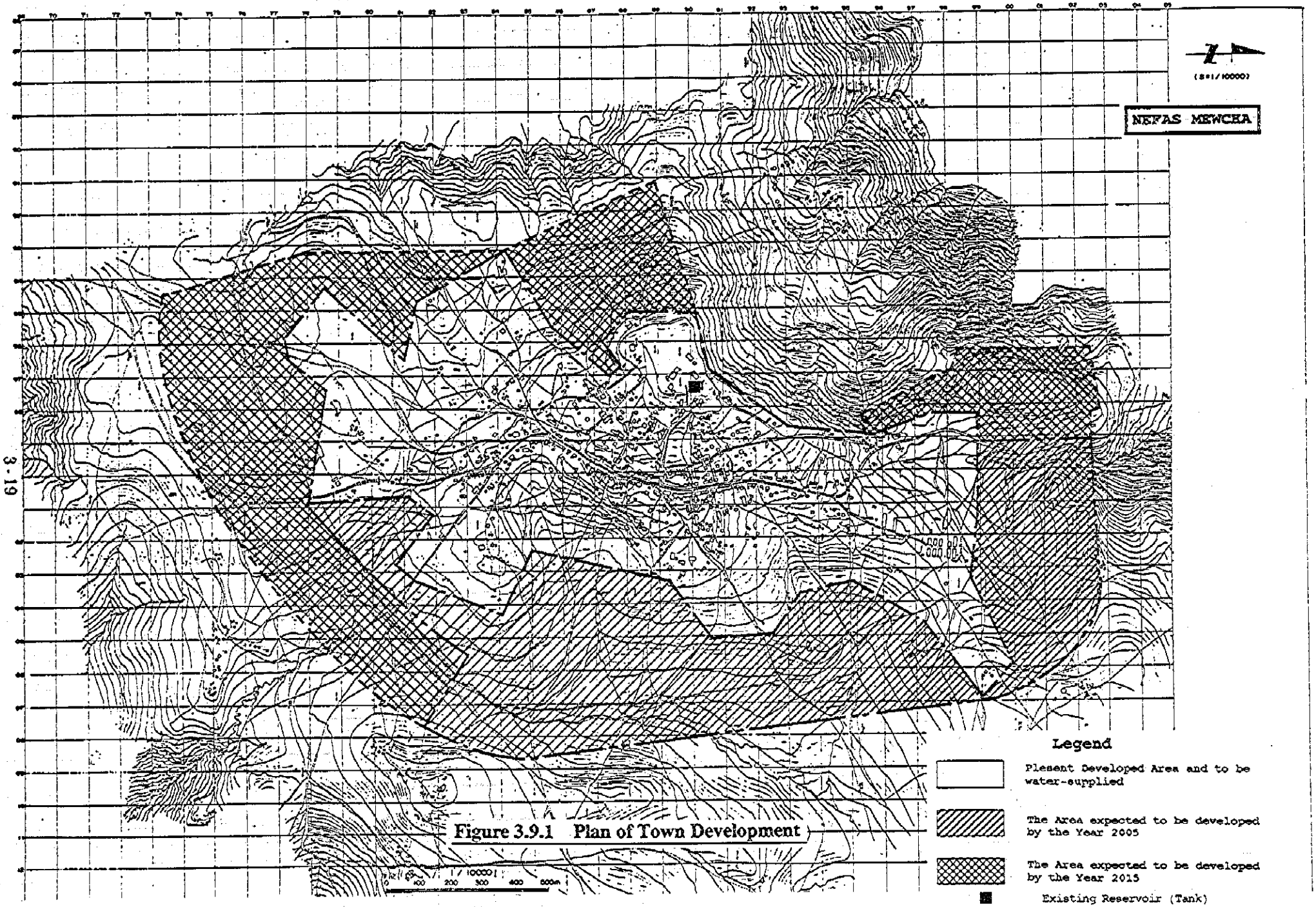


Figure 3.9.1 Plan of Town Development

Chapter 4 Plan of Water Supply System

4.1 Water Demand Projection

4.1.1 Population Projection

The population of Nefas Mewcha was 6,323 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 2,820. Similarly, 1972 and 1973 population was 2,510 and 2,660 respectively. When one adopts CSA estimates, the average annual population growth rate during the 10 years 1974 to 1984 is calculated at 8.41%.

Since 1984 also CSA published its own estimates of population. According to them population of the town in 1992 and 1993 was 11,487 and 12,239 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 11,922 in 1993. When one uses the figures, the average annual population growth rate during the 9 years from 1984 to 1993 works out to 7.30%. 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 Nefas Mewcha. Therefore, the team projected the 1995 population using the 1984 to 1993 average annual growth rate. It came to 13,726.

Weroda people consider that economic growth of the town hinges upon industrial development such as blanket, glass, oil and cement factories. Industrial development in turn depends upon the availability of infrastructure such as water and power. Regarding power, the Fincha - Adigrat Hydro-Electric Power Project connecting Southwest and North via Nefas Mewcha is now at the tendering stage.

As the average annual population growth rate 1995 to 2000 7.0% 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 6.5% and 6.0% respectively.

As a result the projected population of the town for 2000, 2005 and 2010 works out to 19,251, 26,376 and 35,297 respectively (Refer to Table 4.1.1).

Table 4.1.1 Population of Nefas Mewcha

1. Past Population

1974 Estimates by CSA	1984 Population Census	Average Annual Growth Rate 1974 to 1984
2,820	6,323	8.41%
1984 Population Census	**1993 Cartographic Census**	**Average Annual Growth Rate 1984 to 1993**
6,323	11,922	7.30%

2. Population Projection

1995	2000	Average Annual Growth Rate 1995 to 2000
13,726	19,251	7.0%
2000	2005	Average Annual Growth Rate 2000 to 2005
19,251	26,376	6.5%
2005	2010	Average Annual Growth Rate 2005 to 2010
26,376	35,297	6.0%

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.

The house connection and yard connection are estimated, based on the ratio of the households who are payable for the mode-wise water charge. Target ratio of the sum of house connection and yard connection at the year of 2010 is 44%, and 14% of these ratio is house connection.

The ratio of the population served by the piped water at the target year of 2010 is 100%, considering the current ratio.

Table 4.1.2 Population Forecast by Service Modes

	Population (%)							
	1995		2000		2005		2010	
House Connection	41	(0.3)	501	(2.6)	1,899	(7.2)	4,942	(14.0)
Yard Connection	2,878	(21.0)	4,331	(22.5)	6,725	(25.5)	10,589	(30.0)
Public Fountain	9,786	(71.3)	13,738	(71.4)	17,411	(66.0)	19,766	(56.0)
Sub total	12,705	(92.6)	18,570	(96.5)	26,035	(98.7)	35,297	(100.0)
TSU	1,021	(7.4)	681	(3.5)	341	(1.3)	0	(0.0)
Total	13,726	(100.0)	19,251	(100.0)	26,376	(100.0)	35,297	(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 900mm).

It will be possible to supply the above ratio, providing that the construction for first stage is completed in the year of 2000. Thus, water consumption ratio will increase according to the completion of next stage. 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	
House Connection	1.6	38.1	27.1	54	110	58	311	63
Yard Connection	42.6	14.8	138.6	32	229	34	392	37
Public Fountain	15.7	1.6	192.3	14	261	15	316	16
Total	59.8		358.0		600		1,019	
Average	19.9	4.7	119.3	19	200	23	340	29

(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	3743	18.7	
Hospital	20 l/staff	46	0.9	
Hotel	100 l/bed	624	62.4	6 beds/place × 104 places = 624 beds
Bar...	200 l/bar	105	21.0	
Mosque	5 l/visitor	200	1.0	200 visitors/place × 1 place = 200
Offices	5 l/person	541	2.7	
Total			106.7	

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	18.7	26.2	35.9	48.0	Population growth rate
Hospital	0.9	1.3	1.8	2.4	-do-
Hotel	62.4	100.5	158.2	243.4	Population growth rate +3%
Bar, Tea shop	21.0	33.8	53.2	81.9	-do-
Mosques	1.0	1.4	1.9	2.5	Population growth rate
Offices	2.7	3.8	5.2	7.0	-do-
Total	107	167	256	385	

(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	60	358	600	1,019
Non Domestic	6	167	256	385
Losses	27	58	117	248
Total	93	583	973	1,652

* Actual consumption

(4) Maximum Day Demand and Peak Day Demand

The factor 1.2 is adopted for the projection of maximum day demand, and 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)		93	583	973	1,652
Maximum Day Demand (m^3/day)	1.2	112	700	1,168	1,982
Peak Day Demand (m^3/hour)	1.6	7	47	78	132

4.2 Water Resources Development

4.2.1 Evaluation of Water Resources

Nefas Mewcha has the annual precipitation of 1,163.4 mm and the annual ground water recharge of 153.8 mm in an average year. In the area, perennial rivers are located far from the town in the deep gorges. The use of these rivers as sources of the water supply would require long pipeline, number of booster pumping stations and treatment plant. It would be very costly in terms of the construction and the O & M. Springs yield little and dry up in the dry seasons, so that they are not feasible.

The WSS has a well under operation in the valley of Zanti river in the vicinity of the town. The safe yield is reported at 5.0 l/s (432 m^3/day) by the driller. On the other hand, watershed area of the valley is 2.2 km^2 at the escarpment and 5-year annual recharge of dry years is estimated at 75.8 mm which is equivalent to 457 m^3/day. If the well is pumped at the rate of the safe yield, there is no more water for an additional well in the valley. Therefore, it is necessary to look at other valleys.

The geology is basalts of Ashangi group which is dissected by linearments according to the aerial photograph interpretation. The primary permeability of basalts 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 in total as shown in Drawing including the existing operational well. Five (5) points are located in the Zenti basin, three (3) in the south of the town, six (6) in the Zenovo basin and four (4) in the Yegul basin. As a result of VES interpretation, apparent resistivity values range from 10 to 50 ohm-m. These values indicate that basalt is highly weathered at each point being affected by the fault or fractured zone. The apparent resistivity curves of the existing borehole points show bumpy shapes with values ranging from 10 to 20 ohm-m. VES Station No.4, No.7, No.8, No.10 and No.17 have resistivity curves that show bumpy shapes with values ranging from 10 to 20 ohm-m. Station No.3 and No.14 also show good curves similar to the existing borehole points.

Considering the lineation and the result of VES, borehole sites are selected at Station No.1, No.3, No.7, No.8 and No.14 and the points where linearments intersect i.e. No.19 and No.20 totally seven (7) points. The results of VES are shown in Appendices. Station No.1 and No.3 are located along Yegui river and No.7, No.8 and No.19 are along Zenovo river. Station No.20 is located to the southwest of the town in one of the tributaries of the Yegui. Station No.14 is located in the valley of Zanti river near the escarpment.

Since the watershed area for No.20 is small i.e. 1.25 km^2, the 5-year annual recharge of dry years is checked. It is estimated to be equivalent to 260 m^3/day.

4.2.2 Strategy of Water Resources Development

The characteristics of the major aquifers of the operational well and the proposed well sites are shown in Table 4.2.1.

Table 4.2.1 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.12	10 - 32 49 - 58	Intercalation of Gravel and Basalt Weathered Basalt	31	1	WSS No.1
2	VES St.8	1 - 100※	Weathered and Fractured Basalt	25	1	New Well
3	St.19	1 - 100※	Weathered and Fractured Basalt	25	1	-Ditto-
4	VES St.14	20 - 45 74 - 100※	Slightly Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	19	1	-Ditto-
5	St.20	1 - 85※	Weathered and Fractured Basalt	21	1	-Ditto-
6	VES St.1	4.5 - 100※	Weathered and Fractured Basalt	24	1	-Ditto-
7	VES St.3	4.6 - 100※	Weathered and Fractured Basalt	24	1	-Ditto-
8	VES St.7	30 - 50 50 - 100※	Slightly Weathered and Fractured Basalt Highly Weathered and Fractured Basalt	17.5	1	-Ditto-

Note: ※ = The aquifer bottom is probably deeper than the figure.

The depths of the major aquifers of WSS No.1 are obtained from the geological log of Borehole No.2. The others are detected by the geoelectrical survey. Excluding the existing borehole, the thickness of major aquifers is reduced into a quater because a part of basalts are highly weathered and may become claylsh. For the sites where the geoelectrical survey was not done, the data of their adjacent sites is referred.

The permeabilities are assumed 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 20 m and the diameters of wells to be 200 mm.

Table 4.2.2 Optimal Yields and Water Levels of the Wells

Well No.	Optimal Yield (m^3/day)	Static Water Level (GL-m)	Dynamic Water Level (GL-m)	Remarks
1	94	4.2	24.2	WSS BH No.1
2	303	4	24	New Well for Year 2005
3	314	0	20	-Ditto-
4	230	2	22	-Ditto-
5	254	4	24	-Ditto-
6	291	4.5	24.5	New Well for Year 2010
7	291	0	20	-Ditto-
8	212	4	24	-Ditto-

The optimum yield of Well No.1 to Well No.5 totaling to 1,195 m^3/day covers the demands of year 2005. The total yield of all the wells will cover the demands of year 2010. It is recommended to drill Well No.2 to No.5 before 2005 because they are located nearer to the town. Test boring is required in this area because of same dry wells as described in 2.2.

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 borehole is not straight.

The diameter of casing is decided at 200 mm, taking into consideration the outer diameter of the submersible pump (standard 80 - 140 mm) 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 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 0.66 m^2/m for 200 mm diameter
- N: Opening ratio 0.12
- V: Inflow velocity 0.5 cm/s (assumed)
- α: Safety factor 3

The dimensions of the wells are summarized as shown in Table 4.2.3.

Table 4.2.3 Dimensions of New Deep Wells

Well No.		2	3	4	5	6	7	8
Pumping Rate	(m^3/day)	303	314	230	254	291	291	212
	(l/s)	(3.5)	(3.6)	(2.7)	(2.9)	(3.4)	(3.4)	(2.5)
Diameter of Well	(mm)	200	200	200	200	200	200	200
Casing Length	(m)	66	78	78	54	66	66	78
Screen Length	(m)	36	28	28	32	36	36	28
Well Depth	(m)	102	106	106	86	102	102	106
Drilling Diameter	(mm)	300	300	300	300	300	300	300

4.3 Plan of Water Supply System

The water supply system proposed for the center of Bati 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.

4.3.1 Water Supply System in 2005

(1) Boreholes

There are seven potential sites for borehole as stated in chapter 4.2, and four of these proposed sites will be constructed in the first phase. The groundwater pumped up is transferred to the reservoir directly and by boosting pump. The production rate planned is summarized as follows.

W1 (Existing Well)	94 m^3/day
W2 (proposed)	303 m^3/day
W3 (proposed)	314 m^3/day
W4 (proposed)	230 m^3/day
W5 (proposed)	254 m^3/day
Total	1,195 m^3/day

(2) Borehole Pumps

Each borehole will be equipped with a submersible motor pump. The characteristics of the pumps to be installed are assumed as follows:

W1	Q = 0.07 m^3/min., H = 40 m, P = 3 kW
W2 ~ W5	Q = 0.21 m^3/min., H = 120 m, P = 5 kW

(3) Booster Pump and Rising Mains

The booster pump with following capacity will be installed to transfer the water to reservoir. And the collecting chamber with the capacity of 15m^3 will be constructed as well.

BP.1 Q = 0.59 m^3/min., H = 100 m, Dia. = 150 mm, P = 3 kW
BP.2 Q = 0.23 m^3/min., H = 100 m, Dia. = 75 mm, P = 18.5 kW

The diameters of rising mains will range from 75 mm to 150 mm. The total length is 9,400 m.

(4) Reservoir

The existing reservoirs is replaced to new reservoirs due to the lack of capacity. The capacity of the reservoir is required to meet the water demand at the year of 2005, and the required capacity is about 260 m^3 including reserve for fire fighting.

(5) 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 Drawings. The main pipelines planned are shown as follows:

Table 4.3.1 Distribution pipelines

DN (mm)	Length (m)
150	7,040
75	520
50	10,800

(6) 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 1.4 kg and necessary more than 0.11 PPM at the end of distribution pipe..

4.3.2 Water Supply System in 2010

(1) Boreholes

By the target year of 2010, the following boreholes will be constructed additionally.

W6 (proposed)	291 m^3/day
W7 (proposed)	291 m^3/day
W8 (proposed)	212 m^3/day
Total	794 m^3/day

(2) Borehole Pumps

The following submersible motor pumps will be installed additionally, as well.

W6 ~ W8 (proposed) Q = 0.21 l/min., H = 100 m

(3) Distribution Network

The layout of distribution network for the year of 2010 is not prepared in this Study. It is needed to revise the current master plan of town planing to match up to current situation. It is, therefore, preferable to design a layout plan after revision of master plan.

(4) Disinfection

Disinfection will be performed by the injection system directly into the reservoirs. Daily consumption ratio of chemical will be estimated at about 2.3 kg and necessary more than 0.11 PPM at the end 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 the 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	14,806	7,683	22,489
2010			11,789

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	2,063
2010	450

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	3.50
2. Yard Connection Users	2.31
3. Public Fountain Users	0.82

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 127 birr, 212 birr and 360 birr will be daily required in 2000, 2005 and 2010 respectively.

The second is fuel cost. It is projected that it will not be required for pumps so far as Nefas Mewcha is concerned.

The third is disinfection cost. It is estimated that 9 birr, 15 birr and 25 birr will be daily required in 2000, 2005 and 2010 respectively.

The fourth cost is personnel cost. It is estimated that 31, 35 and 45 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 55, 108 and 197 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	11,356	4,870	16,226
2) Engineering Cost (12% of 1))	1,947		1,947
3) Contingency (5% of 1) + 2))	665	244	909
Sub-Total	13,968	5,114	19,082
4) Buildings		1,719	1,719
5) WSSD's Management Cost (2% of 1) + 2) + 3) + 4))		416	416
Sub-Total		2,135	2,135
Total	13,968	7,249	21,217
6) Water Purification Units (included in total)	10	15	25
2. Phase 2			
1) Construction Cost			6,861
2) Engineering Cost (10% of 1))			686
3) Contingency (10% of 1) + 2))			755
Total			8,302
Grand-Total			29,519

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

   75% 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 the existing corporate income tax system 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 = 146.4%
Working Capital/Revenues = 35.2%

Generally, it will be all right if the ratio of revenues to expenditures is equal to or more than 100%, or preferable 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 thick 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	-	942	992	977
2) Yard Connection Users	539	514	474	377
3) Public Fountain Users	122	123	119	116
2. Share of Households (%)				
1) House Connection Owners	0.3	2.6	7.2	14.0
2) Yard Connection Users	21.0	22.5	25.5	30.0
3) Public Fountain Users	71.3	71.4	66.0	56.0
3. Water Consumption/Household/Month (m^3)				
1) House Connection Owners	6.7	9.6	10.3	11.2
2) Yard Connection Users	2.6	5.7	6.0	6.5
3) Public Fountain Users	0.3	2.5	2.7	2.8
4. Water Price (birr/m^3)				
1) House Connection Owners	1.00	3.50	3.50	3.50
2) Yard Connection Users	1.00	2.31	2.31	2.31
3) Public Fountain Users	1.00	0.82	0.82	0.82
5. Payment for Water Supply/Household/Month (birr)				
1) House Connection Owners	6.7	33.5	35.9	39.0
2) Yard Connection Users	2.6	13.1	13.9	15.1
3) Public Fountain Users	0.3	2.0	2.2	2.3
6. Ratio of Water Payment to Income (%)				
1) House Connection Owners	-	3.6	3.6	4.0
2) Yard Connection Users	0.5	2.5	2.9	4.0
3) Public Fountain Users	0.2	1.7	1.8	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	24,861	11,105	3,375	7,808	-	10,714	57,863
1997	25,607	11,438	3,476	7,808	-	10,983	59,312
1998	26,375	11,781	3,580	7,808	-	11,259	60,804
1999	85,637	31,244	114,518	10,658	7,628	6,977	256,662
2000	143,907	54,678	202,675	10,658	8,283	8,404	428,605
2001	178,487	58,596	224,278	21,127	9,584	9,841	501,912
2002	213,067	62,514	245,880	21,127	10,884	11,069	564,541
2003	247,647	66,432	267,483	21,127	12,184	12,297	627,170
2004	282,227	70,350	289,085	21,127	13,484	13,525	689,799
2005	316,807	74,268	310,688	21,127	14,784	14,753	752,428
2006	391,772	77,402	342,000	38,482	17,152	17,336	884,143
2007	466,736	80,535	373,311	38,482	19,520	19,572	998,156
2008	541,701	83,668	404,623	38,482	21,888	21,807	1,112,169
2009	616,666	86,802	435,934	38,482	24,256	24,043	1,226,183
2010	691,630	89,935	467,246	38,482	26,625	26,278	1,340,196
2011	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2012	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2013	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2014	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2015	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2016	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2017	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2018	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2019	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2020	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2021	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2022	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2023	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2024	691,630	89,935	467,246	0	26,625	25,509	1,300,944
2025	691,630	89,935	467,246	0	26,625	25,509	1,300,944

Note: H./Y. Connec. = House/Yard Connection
Public Founta. = Public Fountain
Non-Domest. = Non-Domestic
Techni. Servic. = Technical Service
'-' = included in 'Other Revenue', if any

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	58	59	61	257	429	502	565	627	690	752
Operation and Maintenance	82	84	87	273	298	355	367	379	392	404
Depreciation	0	100	199	199	199	199	199	199	199	199
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	82	184	286	473	497	554	567	579	591	604
Profit before Tax	-24	-125	-226	-216	-69	-52	-2	48	99	149
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	-24	-125	-226	-216	-69	-52	-2	48	99	149
Funds Statement										
Profit after Tax	-24	-125	-226	-216	-69	-52	-2	48	99	149
Loans	511	3197	3197	0	0	0	0	0	0	0
Subsidies	1533	6389	6389	0	0	0	0	0	0	0
Depreciation	0	100	199	199	199	199	199	199	199	199
Sources	2020	9561	9560	-17	131	147	198	248	298	348
Capital Works	2044	8519	8519	0	0	0	0	0	0	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	-24	1042	1041	-17	131	147	198	248	298	348
Applications	2020	9561	9560	-17	131	147	198	248	298	348
Loan Liabilities	516	3751	7017	7087	7158	7230	7302	7375	7449	7523
Cash Balance	-47	995	2037	2020	2151	2298	2496	2744	3042	3390

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	884	998	1112	1226	1340	1301	1301	1301	1301	1301
Operation and Maintenance	504	530	555	581	606	440	440	440	440	440
Depreciation	199	199	231	262	262	262	262	262	262	262
Payment of Interest	6	41	74	71	67	64	60	56	53	49
Expenditure	709	770	860	914	935	766	763	759	755	752
Profit before Tax	175	228	252	313	405	535	538	542	545	549
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	175	228	252	313	405	535	538	542	545	549
Funds Statement										
Profit after Tax	175	228	252	313	405	535	538	542	545	549
Loans	0	189	943	943	0	0	0	0	0	0
Subsidies	0	566	2830	2830	0	0	0	0	0	0
Depreciation	199	199	231	262	262	262	262	262	262	262
Sources	374	1182	4257	4349	667	797	801	804	808	812
Capital Works	0	755	3774	3774	0	0	13	13	0	0
Payment of Principal	26	186	349	352	356	359	363	366	370	374
Working Capital	349	241	134	223	312	438	425	425	438	438
Applications	374	1182	4257	4349	667	797	801	804	808	812
Loan Liabilities	7567	7607	8213	8825	8491	8153	7812	7467	7119	6767
Cash Balance	3738	3980	4114	4337	4649	5086	5512	5937	6375	6813

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	1301	1301	1301	1301	1301	1301	1301	1301	1301	1301
Operation and Maintenance	440	440	440	440	440	440	440	440	440	440
Depreciation	262	262	262	262	262	262	262	262	262	262
Payment of Interest	45	44	50	56	51	46	41	36	31	26
Expenditure	748	746	753	759	754	749	744	739	734	728
Profit before Tax	553	555	548	542	547	552	557	562	567	572
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	553	555	548	542	547	552	557	562	567	572
Funds Statement										
Profit after Tax	553	555	548	542	547	552	557	562	567	572
Loans	0	0	0	0	0	0	0	0	0	0
Subsidies	0	0	0	0	0	0	0	0	0	0
Depreciation	262	262	262	262	262	262	262	262	262	262
Sources	815	817	810	804	809	814	819	825	830	835
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	377	391	442	494	499	504	509	514	519	524
Working Capital	438	426	369	311	311	311	311	311	311	311
Applications	815	817	810	804	809	814	819	825	830	835
Loan Liabilities	6412	6042	5611	5117	4619	4115	3606	3093	2574	2050
Cash Balance	7251	7677	8046	8357	8668	8978	9289	9600	9911	10222

Source: JICA

Chapter 5 Improvement of Health and Sanitation

5.1 Plan for Sanitary Facilities

Nefas Mewcha's sanitation situation is very poor. The critical shortage of water supply aggravates even more the sanitary condition. The general use of open-area for defecation, the filled-up traditional pit latrines, the indiscriminate dumping of sullage and refuse have created environmental pollution and serious health hazards. The traditional pit latrines that are being used at present are not properly designed and constructed; and when they are filled up and emptied practically all of them cave-in and collapse.

Waste water production in liters per capita per day was estimated using water demand data for each type of water supply service.

Table 5.1.1 Water Demand in lpcd and Waste Water Production in lpcd for Nefas Mewcha

Item	HC			YC			PF		
	1995	2005	2010	1995	2005	2010	1995	2005	2010
• Water demand (lpcd)	38.1	58	63	14.8	34	37	1.6	15	16
• Waste water generation rate (%)	68	74	75	63	67	68	60	63	63
• Waste water production (lpcd)	26	43	47	9	23	25	25	9	10

From the water demand and waste water production per capita per day for Nefas Mewcha, as seen in Table 5.1.1, introduction of conventional sewerage system cannot be justified in any of the target years due to blockage of the system when the total water use is less than about 75 liters per capita per day. Therefore, the sanitary technologies proposed for Nefas Mewcha are those that are on-site technologies such as drainage and waste water disposal pit.

5.1.1 Plan of Toilet Facilities

The sanitary technologies envisaged for Nefas Mewcha are grouped into four major categories.

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

These technologies are related to the types of water supply services; and 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 simplest and the cheapest. 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 Nefas Mewcha, 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

Most of the dry solid wastes are being dumped in Nefas Mewcha. In order to curtail this indiscriminate dumping of refuse resulting in environmental pollution and water contamination, five refuse dumping sites have been proposed for Nefas Mewcha near the outskirts of the town on the north, south, east, west and north-east of the town. Collecting bins have to be strategically located with the agreement of the communities, kebeles and the Municipality of the town so that the households need not walk long distances to place their refuse in the collecting bins. The contents of the bins should be transported to the refuse dumping sites by refuse disposing truck or animal-drawn cart. The Municipality should take the responsibility of burning the refuse at the disposing sites in close coordination of 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 Nefas Mewcha 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 Nefas Mewcha are too low to justify the installation of conventional sewerage system in Nefas Mewcha. On account of this, the sanitary facilities proposed for Nefas Mewcha are on-site sanitary technologies.
- Those households that do not have any toilet facilities in Nefas Mewcha 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 Nefas Mewcha 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 Nefas Mewcha.
- 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 Nefas Mewcha 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 Nefas Mewcha for Target Years of 2005 & 2010 by Type of Water Services

Target Year	Households		
	HC	YC	PF
• 2005	320	1,140	2,950
• 2010	840	1,790	3,350

5.2.2 Estimate of Costs

(1) Capital Costs per Unit

For each type of toilet facility that is considered appropriate for Nefas Mewcha 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 Nefas Mewcha by the Year 2005 and 2010

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

- By the year 2005

  - All schools in Nefas Mewcha will have, at least, VIP collective toilets.
  - The Nefas Mewcha Hospital toilet facilities will be rehabilitated; and the clinic and possibly a health center will have VIP collective toilets.
  - Nefas Mewcha 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 Nefas Mewcha 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 Nefas Mewcha 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	6	65,000	390
• VIP public toilet for market area and bus terminal	4	95,000	380
• 100% households with HC to have PF toilets	320	7,500	2,400*
• 75% households with YC to have VIP shared toilets or higher	855	15,000	12,825*
• 75% households with PF to have VIP toilets	2,213	2,000	4,426*
• Vacuum truck	1	250,000	250
• Refuse disposal truck	1	180,000	180
• Sludge dumping site	3	10,000	30
• Refuse disposing site	5	6,500	33
• Refuse collecting bins	80	250	20
Total			21,714
Excluding Households' (*)			2,063

Table 5.2.5 Capital Costs of Sanitary Facilities for Nefas Mewcha 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	895	3,000	2,685*
• 100% households with PF to have VIP toilets	3,350	2,000	6,700*
• Replacement of vacuum truck	1	250,000	250
• Replacement of refuse disposal truck	1	180,000	180
• Replacement of refuse collecting bin	80	250	20
Total			12,985
Excluding Households' (*)			450

(5) Total Operating and Maintenance Cost

Indicative operating and maintenance cost for sanitary facilities for Nefas Mewcha 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	6	800	4.80
• VIP public toilet for market area and bus terminal	4	3,000	12.00
• Flush toilets for households with HC	320	1,250	400.00*
• VIP shared toilet for households with YC	855	400	342.00*
• VIP toilets for households using PF	2,213	300	663.90*
• 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	5	2,500	12.50
• Refuse collecting bins	80	50	4.00
Total			1,470.80
Excluding Households' (*)			64.90

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	895	1,000	895.00*
• VIP toilets for households using PF	3,350	300	1,005.00*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Refuse collecting bins	80	50	4.00
Total			2,445.00
Excluding Households' (*)			20.00

(6) Summary of Costs

- Capital Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	21,714	2,063
2010	12,985	450
Total	34,699	2,513

- Annual Operating & Maintenance Costs

Year	Cost in 1,000 Birr (Total)	Excluding Households'
2005	1,470.80	64.90
2010	2,445.00	20.00
Total	3,915.80	84.90

5.3 Application of Sanitary Education Program

The sanitary education program approach outlined in the Main Report, will use a four pronged approach with the Health Center, Schools, Religious Institutions and a health/sanitation promotion committee. In line with that approach and with reference to the material gathered during the field survey and experimental sanitary education program the following specific recommendations are made for Nefas Mewcha.

Suggested priorities for sanitary behavior improvements are outlined in Table 5.3.1. There are significant differences between this chart and the lowest income groups. Muslims, although only a statistically insignificant number in the household survey appear to have lower access to water and sanitation facilities than any other group. Low income households (under 100 Birr monthly) have the highest level of women headed households and have poorer personal and domestic sanitary practices than other groups. These differences must be accounted for in the project implementation, by targeting these groups particularly. The blocks are likely to be financial as all Muslims households reported lower than average monthly incomes.

There will need to be improvements in coordination between authorities responsible for sanitation by encouraging the formation of a health committee composed of members from the Woreda, Municipality, Hospital, Health Center, WSS, Red Cross etc. This could be facilitated by the CPP as part of the responsibilities of their role. Care should be taken to ensure active participation on this committee from religious institutions also.

In order to achieve improved sanitary conditions and behaviors, income generation activities are vital. These must target low income and Muslim groups in particular. Initiatives like local soap production will also raise interest in sanitation and the producers will also actively promote the use of soap for activities like handwashing.

Table 5.3.1 Sanitary Education Priorities in Nefas Mewcha

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). People (women/girls) must be encouraged to use piped water always for drinking (CPP)
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 simple sanitary disposal techniques, inc. veg gardens (CPP/all)
Medium -High	Handwashing 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 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	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)
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/girls) to be encouraged, information about health risks of children's excreta provided (CPP/all)
Medium -Low	Kitchen utensils and water scoop kept off the floor*	Domestic hygiene (women) although facilitated by shelf or similar available in kitchen to keep utensils off floor (women/ men) Construction of such shelves to be promoted (CPP)
Medium -Low	Fly Control	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 -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-High priority for PF Users	
	**High priority for Muslim Households, low priority for PC Users	
	***High priority for low income households	

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 93 m^3/day in 1995 to 583 m^3/day in 2000, 973 m^3/day in 2005 and 1,652 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 19 in 1995 to 31 in 2000, 35 in 2005 and 45 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 29, 32 and 41 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)	93	583	973	1,652
2. Water Production per Worker (m^3/day/worker)	4.9	20	30	40
3. Coefficient	1	1	1	1
4. No. of Personnel	19	29	32	41
5. Additional Personnel for Sanitation	0	2	3	4
6. Final No. of Personnel	19	31	35	45

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	1	1	1
4. Administration Service				
1) Head	0	0	0	1
2) General Administration Section				6
Secretaries/Typists/Clerks	2	2	2	2
Guards	4	5	6	
Sweepers/Janitors	0	0	0	0
Drivers	0	0	0	1
Sub-Total	6	7	8	9
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	7	8	9	12

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

Positions/Functions	1995	2000	2005	2010
5. Financial Service				
1) Head	0	0	0	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	0
5) Operation Section				
Meter Readers	1	1	1	1
Bill Distributors/Collectors	0	1	1	1
Water Sellers	5	6	7	7
Sub-Total	6	8	9	9
Total	8	10	11	13
6. Technical Service				
1) Head	0	1	1	1
2) Technical Records Section	0	1	1	1
3) Operation and Maintenance Section				
Mechanics	0	0	0	1
Electricians	0	1	1	2
Motor Operators	1	4	4	4
Plumbers	2	1	2	2
Sub-Total	3	6	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	1
6) Works Section				
Contracting	0	0	0	0
Designing/Drafting	0	0	0	0
Sub-Total	0	0	0	0
Total	3	9	10	13
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	19	31	35	45

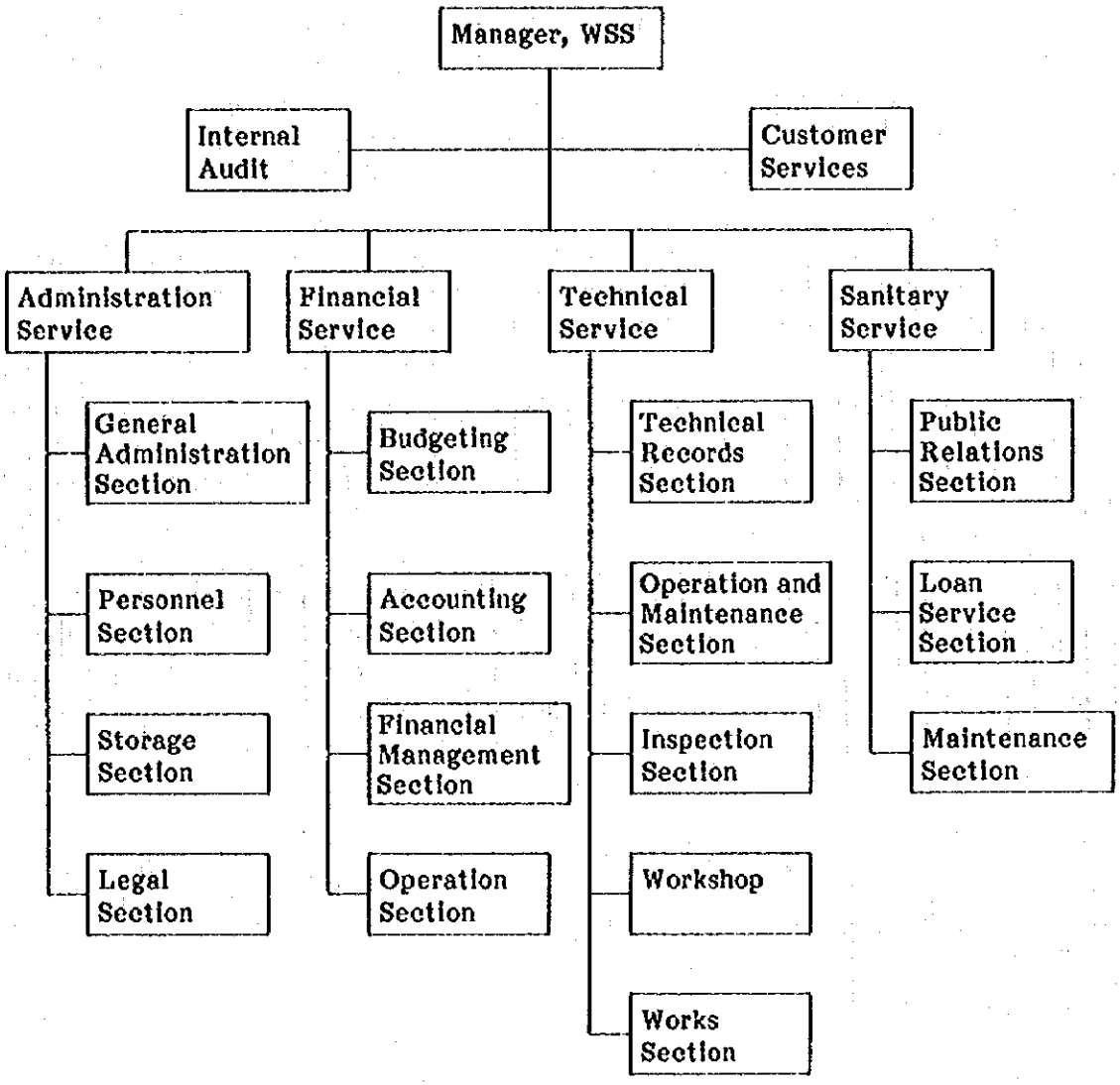


Figure 6.1.1 Proposed Model Organization Set-up of WSS

6.4 Community Building / Participation and WID

Based on the approach outlined in the Main Report, the following additional issues are pertinent to Nefas Mewcha:

- The priority need in Nefas Mewcha may not be water while there is a shortage of food in the surrounding rural areas. However water has been and still is a long term problem in the town. Sanitation facilities may not be expressed as a priority need, but there are sectors of the community where access to these is zero. Improved economic status of households should see improvements in sanitary behaviors. The following interventions should be considered.

- Demand for additional PFs was highest in areas on the outer edges of the town. Water points need to be opened for longer hours to supply the demand for water and opened on Sundays. People, including women, were willing to undertake community management of the PFs if committees were given adequate support. This would provide an ideal entry point for other community development initiatives. Support must therefore be adequate in order to facilitate the development process.

- Sanitation facilities would best be provided by community managed communal latrines. These must be easy to use and simple to maintain and copy. Public latrines may be appropriate in the center of town, but a shower is unlikely to work as the climate is very cool. Community management of a public latrine is unlikely to work without an income generating activity linked to it (such as a shower). Community management of latrines, like water points is a good way of strengthening community development activities, where adequate support is provided.

- The impact of the project will be maximized through an employment and/or income generation component. This should be linked to the community development activities of the CPP. Groups requiring special attention are the low income groups, particularly the women headed households and the Muslim community.

Chapter 7 Project Evaluation

7.1 Economic Evaluation

7.1.1 Economic Benefits

(1) General

There are two major benefits deriving from the implementation of the Project.

One is the time benefit. Under the present circumstances people in the eleven centers more or less go to the far-away springs/rivers and/or public fountains every day to fetch water. The time spent in such a way comes to an enormous amount when it is aggregated as an annual total for the whole town.

If the Project is implemented, less people will go to the above-mentioned water sources as more people will use house connections or yard connections. That is to say, the time for water fetching will be greatly reduced.

The JICA Study Team calculated the time to be reduced annually for the whole town in the future years under the "with project" conditions.

Eventually, the team converted the time into financial terms. This is the time benefit.

Another is the reduction of water-borne diseases. When the Project is implemented, more people will have an access to clean piped water. It will reduce the opportunities for them to get in touch with contaminated water and contract such diseases as diarrhea, dysentery, typhoid and scabies.

However, how many such cases will be reduced is very hard to estimate. Therefore, the team just wants to remind people that such an important benefit will be realized in the "with project" case.

(2) Calculation of Economic Benefits

How the above-mentioned time benefit was calculated is summarized below:

As a result of the socio-economic questionnaire survey conducted by JICA, the following information was collected:

Users	Time spent at a time (min.)	Daily frequency (times)	No. of persons at a time
Public fountains	66	2.0	1.1
Springs/rivers	102	1.9	1.4

If the number of households using public fountains and the number of households using springs/rivers is estimated in both the "without project" and "with project" cases in the

target years, one can work out the total time spent fetching water every year in both cases by utilizing the above tabulated information.

The respective number of households using the above two water sources in the "with project" case was estimated based on the service population projection in the other chapter. The respective number of such households in the "without project" case was calculated on the assumption that piped water users will increase by 3% every year.

Then, the difference in the aggregated annual water-fetching time between the two cases was calculated for each year.

Finally, such a time was converted into financial terms by using the following information:

Monthly household income (birr)	Family size (persons)	Waking hours in a day	Time value per hour (birr)
A	B	C	D=A/30/B/C
202	5.9	16	0.0713

The results are shown in Table 7.1.1.

7.1.2 Cost

The cost can be divided into capital cost and operation and maintenance (O & M) cost.

Capital cost is huge compared to the economic benefits resulting from the reduction of water fetching time. If one could quantitavely incorporate the subdual of water-borne diseases, benefit related to WID and multiplier economic effect into benefits, then one could consider the total cost including capital cost. But, the reality is such that one considers O & M cost - actually, a part of it - only for the sake of convenience.

O & M cost consists of electric cost, fuel cost, disinfection cost, personnel cost, installation cost of connections, purchase cost of water meters and other cost. (For more details refer to 4.5.) It was estimated as an annual recurrent cost for future years.

It turned out that the whole O & M cost is too large in comparison with the above benefits. Eventually, personnel cost was picked up, representing O & M cost.

The personnel cost used here is the incremental one, that is to say, the difference between the personnel cost in the " with project " case and the personnel cost in the " without project " case.

7.1.3 Economic Evaluation

Based on the data calculated in the above-mentioned way, cost benefit streams were prepared as shown in Table 7.1.2.

As it shows, the cumulative cost and benefits for 30 years come to 5,089 thousand birr and 5,402 thousand birr respectively. It means benefits are 106% of cost at the discount rate of zero.

That is to say, the cumulative benefits of the reduction of water fetching time for 30 years are a little greater than the cumulative personnel cost of WSS at 0 opportunity cost.

It is to be noted that time benefit resulting from project implementation is substantial, coming to more than the personnel cost of WSS.

Table 7.1.2 Saved Time and Benefit

Year	Saved Time (hours)	Benefit (birr)
1996	0	0
1997	0	0
1998	0	0
1999	355,359	25,347
2000	683,756	48,771
2001	864,834	61,687
2002	1,066,625	76,080
2003	1,290,548	92,052
2004	1,538,113	109,710
2005	1,811,060	129,179
2006	2,117,078	151,006
2007	2,447,291	174,560
2008	2,803,226	199,948
2009	3,186,497	227,285
2010	3,598,821	256,696
2011	3,598,821	256,696
2012	3,598,821	256,696
2013	3,598,821	256,696
2014	3,598,821	256,696
2015	3,598,821	256,696
2016	3,598,821	256,696
2017	3,598,821	256,696
2018	3,598,821	256,696
2019	3,598,821	256,696
2020	3,598,821	256,696
2021	3,598,821	256,696
2022	3,598,821	256,696
2023	3,598,821	256,696
2024	3,598,821	256,696
2025	3,598,821	256,696

Table 7.1.2 Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:thousand birr)

NO.	YEAR	CC	OM	CS	BF	CF
1	1996	0	0	0	0	0
2	1997	0	0	0	0	0
3	1998	0	0	0	0	0
4	1999	0	128	128	25	-103
5	2000	0	141	141	49	-92
6	2001	0	144	144	62	-82
7	2002	0	148	148	76	-72
8	2003	0	151	151	92	-59
9	2004	0	154	154	110	-45
10	2005	0	158	158	129	-28
11	2006	0	168	168	151	-17
12	2007	0	178	178	175	-3
13	2008	0	188	188	200	12
14	2009	0	198	198	227	29
15	2010	0	208	208	257	48
16	2011	0	208	208	257	48
17	2012	0	208	208	257	48
18	2013	0	208	208	257	48
19	2014	0	208	208	257	48
20	2015	0	208	208	257	48
21	2016	0	208	208	257	48
22	2017	0	208	208	257	48
23	2018	0	208	208	257	48
24	2019	0	208	208	257	48
25	2020	0	208	208	257	48
26	2021	0	208	208	257	48
27	2022	0	208	208	257	48
28	2023	0	208	208	257	48
29	2024	0	208	208	257	48
30	2025	0	208	208	257	48

7.2 Financial Evaluation

7.2.1 Calculation of FIRR

Regarding detailed information on revenues and cost, refer to Section 4.5.

(1) Initial Cost

It was assumed initially that the central government would provide subsidy to the Nefas Mewcha WSS amounting to 80% 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.

Based on the revenues and cost estimated in Section 4.5 under such an assumption, cost benefit streams were prepared for the 30 years starting in 1996.

Using them, financial internal rate of return (FIRR) was calculated. As a result, it worked out to 5.5%.

The value is judged to be rather on the high side in consideration of the nature and objective of the Project.

It is important for the central government to be paid back initial cost as much as possible, thus lessening its budgetary burden.

After repeated simulation, it was finally decided that the subsidy ratio of initial cost would be 75%.

(2) Final Results

Under the above-mentioned subsidy conditions, cost benefit streams were prepared as shown in Table 7.2.1.

Using the streams, FIRR was calculated. As a result, the value of 4.4% was obtained.

The value exceeds 1%, which is the assumed interest rate of external loan by 3.4%. It is judged to be sufficiently and reasonably high considering the nature and objective of the Project.

7.2.2 Sensitivity Analysis

To see how the value will be affected under different circumstances, sensitivity analysis was conducted. The conditions and results are shown below:

Item	Conditions	Results	Difference from Base Case
1. Case 1	Benefits : -10%	FIRR: 3.0%	-1.4%
2. Case 2	Initial Cost : +10%	FIRR: 3.7%	-0.7%
3. Case 3	Progress of : 1997=70% Construction 1998=30%	FIRR: 4.6%	+0.2%
4. Case 4	Progress of : 1998=70% Construction 1999=30%	FIRR: 3.5%	-0.9%

In Cases 3 and 4 detail design will be done in 1996 and 1997 respectively.

As the table shows, the value of FIRR is robust enough by maintaining the level of substantially more than 1% under adverse circumstances conceivable.

Case wise, the shortage of revenues will deal the strongest negative impact on the financial feasibility of the Project, followed by the delayed progress of works and, then, cost overrun, while earlier completion of works will raise the feasibility by a significant margin.

Table 7.2.1 Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:thousand birr)

NO.	YEAR	CC	OM	CS	BF	CF
1	1996	511	82	593	58	-535
2	1997	3197	84	3282	59	-3222
3	1998	3197	87	3284	61	-3223
4	1999	0	273	273	257	-17
5	2000	0	298	298	429	131
6	2001	0	355	355	502	147
7	2002	0	367	367	565	198
8	2003	0	379	379	627	248
9	2004	0	392	392	690	298
10	2005	0	404	404	752	348
11	2006	0	504	504	884	380
12	2007	189	530	718	998	280
13	2008	943	555	1499	1112	-386
14	2009	943	581	1524	1226	-298
15	2010	0	606	606	1340	734
16	2011	0	440	440	1301	861
17	2012	13	440	453	1301	848
18	2013	13	440	453	1301	848
19	2014	0	440	440	1301	861
20	2015	0	440	440	1301	861
21	2016	0	440	440	1301	861
22	2017	0	440	440	1301	861
23	2018	0	440	440	1301	861
24	2019	0	440	440	1301	861
25	2020	0	440	440	1301	861
26	2021	0	440	440	1301	861
27	2022	0	440	440	1301	861
28	2023	0	440	440	1301	861
29	2024	0	440	440	1301	861
30	2025	0	440	440	1301	861

7.3 Organizational Evaluation (Nefas Mewcha)

The existing organizational situation related to water supply and sanitation in Nefas Mewcha can be summed up as follows:

- The WSS of Nefas Mewcha is expected to financially stand on its own feet. But, it is not given the power commensurate with financial independence.

- The WSS of Nefas Mewcha is financially deeply in the red. As a result, workers are under-paid, they have little supplies and equipment for operation and maintenance and there is a shortage of skilled manpower.

- Sanitation functions in the WSS of Nefas Mewcha have been totally neglected. But, the sanitary situation in the town is such that organizational/institutional countermeasures are urgently required.

- A key for a successful implementation of water supply/sanitation projects lies in community involvement. It seems that the authorities have not given proper consideration in this regard.

- Another key for a successful implementation of water supply/sanitation projects lies in female participation. It appears that the authorities have not been properly aware of it.

To rectify the above situation, the following organizational/institutional measures have been proposed.

- Autonomy is a trump for a financially good performance. It is essential for the WSS to be institutionally given its own decision-making power regarding the revision of water tariff, hiring and firing of staff, remuneration, execution of small-scale rehabilitation or new works, purchasing of supplies and equipment, etc. Approval will be given by the regional organization, and it will be reported to the central organization.

- The fundamental conditions for any WSS to have a successful financial performance are to have a sufficient supply of water on one hand and to have a reasonable level of water price on the other. Both conditions are hopefully expected to be satisfied through the Project. If the WSS of Nefas Mewcha has a successful financial performance and its own decision-making power as well, then the accompanying difficulties such as low remuneration, shortage of skilled manpower and little availability of equipment and supplies will be eventually overcome.

- The organization related to sanitation will be newly established in the organizational set-up of WSS after the Phase 1 Project is completed in 1998. It will perform loan service and promotion activities regarding the installation of sanitation facilities.

- Sanitary/Health Committee will be organized in the town. The members will be composed of representatives from schools, hospitals, Weroda council, municipality, the bank, central and regional water supply organizations, WSS and community. The chairman will be elected from Weroda council. The major objective of the committee is coordinating and unifying the related activities so that sanitary awareness of the towns people and the installation of sanitation facilities will be effectively promoted.

- Public fountains to be newly constructed in future will be managed by the community if people are overwhelmingly in favor of it. According to the socio-economic questionnaire survey conducted by JICA, they strongly side with it. People will freed from the frustrations and constraints they experience every day today in connection with the opening hours, breakdowns and repairs, water tariff, etc. The community will have decision-making power in financial, personnel and technical terms subject to WSS's approval. The community is expected to financially stand on its own feet.

- Construction of community toilets will be promoted. Financial resources may come from the community itself or other sources. Sanitary/Health Committee and WSS will assist in the acquisition of fund. A strict financial management of the toilet will be required. The maintenance and operation, payment and collection of the user charge, the decision on user charge, etc. will be totally in the hand of the community. Sanitary/Health Committee and WSS will be always ready for helping the community in this regard.

- It is also proposed that the female participation ratio in the workforce of WSS, the community managed public fountain and the community toilet be more than 50%.

7.4 Technological Evaluation

The proposed water supply system is composed of relatively simple facilities, those of which are not quite different from existing ones. Although new material made of fiberglass reinforced plastic is to be introduced into such work as well casing, the light material could facilitate the construction work very smoothly. The material is also expected to be long life-span comparing to other conventional material, thus maintenance and renewal cost could be reduced in the long run.

In the Project, four and three number of boreholes are newly required in years of 2005 and 2010 and those including existing one are located with certain distance from each other or sometimes away from another. Therefore, mobilization is due required for the daily operation of those boreholes. In this regard, transportation must be strengthened by means of vehicle or motorbike, otherwise well attendant is additionally required in the number.