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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
AYKEL

(Volume II-V)

FEBRUARY, 1996

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

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 Aykel 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.

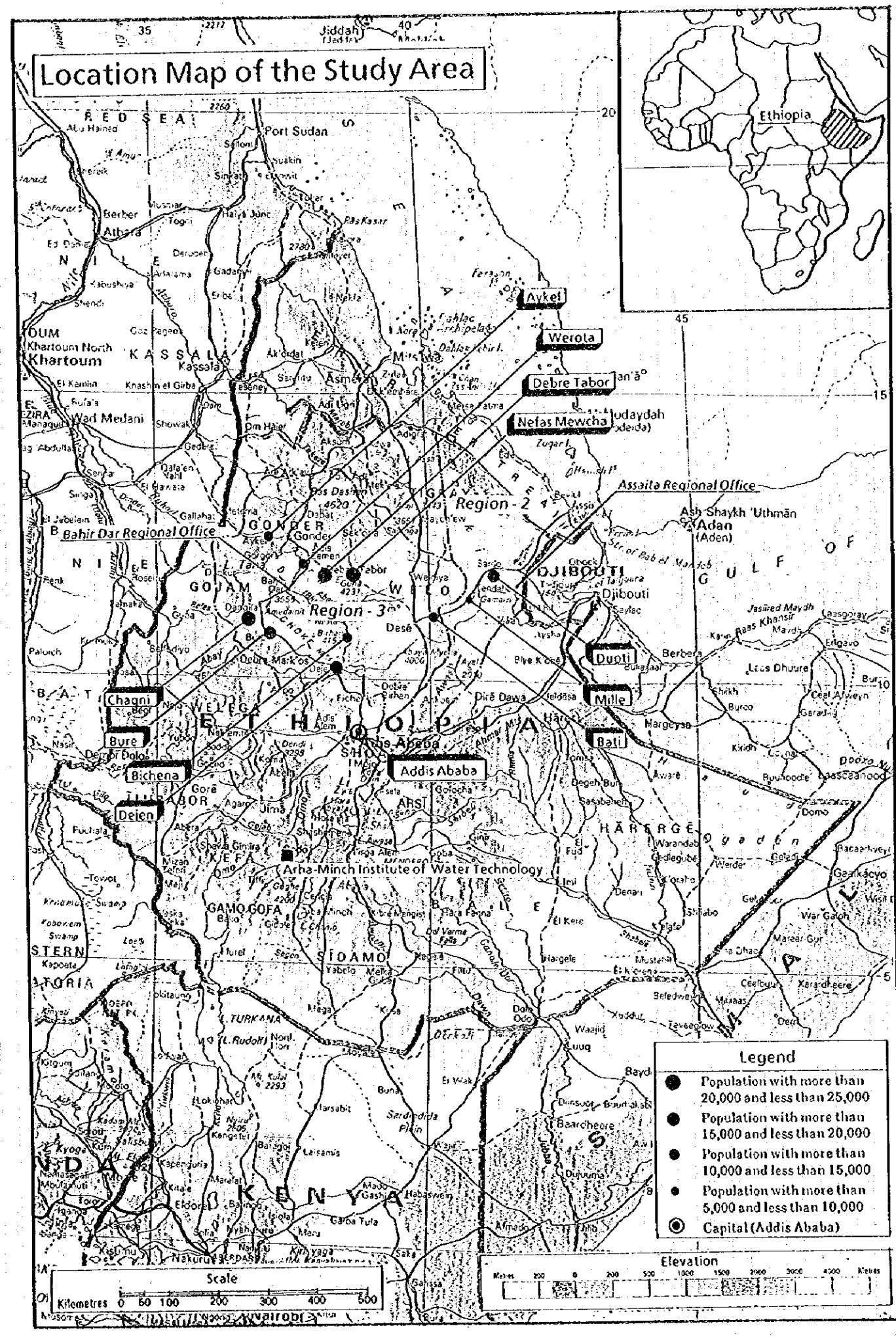
The major objectives of this Study are 1) to conduct a feasibility study on the water supply system in order to improve living condition of the population in the Study area by enhancing the level of the water supply services in terms of water quantity, water quality and its accessibility, 2) to formulate 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
Desé
Dire Dawa
Djibouti
Duoti
Mille
Bati
Chagni
Bure
Bichena
Deien
Addis Ababa
Arba-Minch Institute of Water Technology
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 50 100 200 300 400 500
Elevation
Meters -200 0 200 500 1000 1500 2000 3000 4000 Meters

General Description of Current Condition in Aykel

Items	Description
Administration	Amhara Region, North Gonder, No. of Kebele : 2
Residents	Total population : 11,718 (3.6 persons/ha) Average family size : 5.5 persons Amhara : 73% Christians : 81% (2 churches) Kimant : 20% Moslems : 19% (1 mosque) Tigre : 7%
Educational Conditions	

	Kinder garden	Elementary school	Junior high s.	Senior high s.
No. of school	1	2	1	1
No. of teachers	2	56	10	26
No. of students	95	1891	799	1159

Medical Conditions	Hospital : - Doctor : 1 Health center : 1 Nurse : 3 Health clinic : -
Economic Conditions	Hotels/restaurants : 115 Shops : 303 Cottage industry : 16 Butcheries : 16 Average monthly household income : 182 birr
Water Supply Condition	The source of WSS : Spring (1) Major other sources : Spring Domestic consumption : 19.0 cum/day (2.3 lpcd) Other consumption : 2.5 cum/day (total 21.5) Water service coverage : 71% House connection : - lpcd (-%, 5.0 birr/cum) Yard connection : - lpcd (-%, 5.0 birr/cum) Neighbors : - lpcd (-%, 5.0 birr/cum) Public fountain : 2.3 lpcd (71%, 5.0(4.1) birr/cum)
Sanitary Condition	Septic toilet : - /100HH Dry pit toilet : 36/100HH Community toilet : 2/100HH Open field : 62/100HH 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 : 64% ORS awareness : 48% Sanitary behaviors score : 757/1600 (47%) Needs : Adequate Water, Garbage Disposal
Remarks	1. Water charge in bracket is actually paid. 2. HH means "household". 3. ORS means Oral Rehydration Solution. 4. Faecal coliforms found in samples from the source and other springs.

Project Description of Aykel

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 11,718 (5.5%) 15,315 (5.0%) 19,546 (4.5%) 24,258
Water Demand Projected in cum/day	in 1995* 2000 2005 2010 Domestic : 19 193 350 630 Non Domestic : 3 68 95 129 Losses : 9 29 61 134 Total : 31 290 505 893
Dimensions of Water Supply System	Target Service Coverage: 85%(71% at present) Target Year of 2005 Deep Wells : 2 (140m) Rising Main : ϕ150 (4.90 km), ϕ100 (2.50 km) Booster of Rising : ϕ150mm,Q=0.42m^3/min,H=725m ϕ100mm,Q=0.42m^3/min,H=225m Reservoir : 130m^3(65×2) Distribution : ϕ200(285m),ϕ150(4,005m), ϕ75(1,050m),ϕ50(7,300m) Booster of Dist'n : ϕ200mm,Q=0.7m^3/min,H=13m Target Year of 2010 Deep Wells : 2 (101m) Rising Main : ϕ75(3.20km)
Water Tariff Structure & Accounting System	Introduction of Progressive Water Tariff** HC: 3.15 birr/m^3,YC: 2.45 birr/m^3,PF: 1.11 birr/m^3 Introduction of Double Accounting System
Plan of Sanitary Facilities Improvement	Construction of 3 public toilets and facilitation of other type toilets. Provision of toilet emptying system. Maintenance of main drainage and construction of supplemental drainages. Facilitation of waste water disposal pit and dry solid waste disposal system.
Plan of Sanitary Education and Implementation Program	Utilization of sanitary education manual and video. Application of sanitary education priorities(see report). Set-up of Sanitary/Health Committee. Assignment of Community Participation Promoter.
Organization Set-up	Strengthening of Planning & Project Department of MWR and relationship among central, regional and town. WSS to be composed of Administration, Financial, Technical and Sanitary Service, and manpower to be 22 in 2005 and 31 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)

Table of Contents

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 Aykel, water service coverage is 71 %, and the water consumption per capita per day is extremely low with the amount of 2.3 lpcd in average. Although water quality of the sources is acceptable with reference to WHO drinking water guideline in terms of physico-chemical aspects, many faecal coliforms have been detected in samples collected from the source, connections and household containers.

Toilet coverage is 38 % 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). Aykel is the one, located in Amhara Region, among the Eleven Centers along with Dupti, Mille, Bati, Nefas Mewcha, Debre Tabor, 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. Aykel 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 15 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

Aykel is located in the north of Lake Tana and the west of Gondar town. The town is founded on the top of basaltic hill which is a water divide for the Abay and the Tekeze.

There is a meteorological station of NMSA in the town but there is no gauging station around the town. Auga river, a tributary of the Tekeze, has a watershed area of 59.3 km^2 at the bridge on the road to Gondar. See Figure 2.1.1 for the locations and the watershed around Aykel.

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)	0.8	0.2	13.9	64.6	11.8	170.2	329.6	255.6	146.2	76.4	6.8	0.5	1,166.6
ETo(mm)*	144	145	144	142	141	141	142	144	143	141	142	143	1,712
A.Temp.(°C)	18.8	19.9	20.9	21.3	18.1	18.1	16.3	16.4	17.1	17.7	18.4	18.7	18.6

Remark: * = Data of Gondar

The distribution of monthly mean precipitation shows lowest of 0.2 mm in February and highest record of 329.6 mm in July. The mean annual rainfall is 1,166.6 mm.

Since the record of potential evapotranspiration is not available, the data of Gondar is listed in the table. The monthly potential evapotranspiration ranges from 141 mm to 145 m having very little variation.

The air temperature has a very small variation ranging between 16.3°C up to 21.3°C. The hottest month is April and the coolest month is July which is caused by the rainy season called Keremt.

In order to estimate the ground water recharge of the area 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 nine (9) year records between 1980 and 1990. 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, Aykel

Unit : mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	1.1	0.1	16.2	34.2	93.7	171.2	318.5	254.3	162.0	72.7	8.8	0.3	1,133.1
Q	0.4	0.0	6.5	13.7	37.5	64.5	127.4	101.7	64.8	29.1	3.5	0.1	449.2
P-Q	0.7	0.1	9.7	20.5	56.2	106.7	191.1	152.6	97.2	43.6	5.3	0.2	683.9
ETo	144	145	144	142	141	141	142	144	143	141	142	143	1,712
ETcrop	100.8	101.5	100.8	99.4	98.7	98.7	99.4	100.8	100.1	98.7	99.4	100.1	1,199.4
ETa	0.7	0.1	9.7	20.5	56.2	98.7	99.4	100.8	97.2	43.6	5.3	0.2	532.4
ΔS	0	0	0	0	0	8.0	91.7	51.8	0	0	0	0	151.5

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 June, July and August, which amounts to 151.5 mm in an average year. For the watershed area of Auga river at the bridge, the quantity of recharge is estimated as below assuming the whole area is the ground water recharge area:

$$0.1515 \times 59.3 \times 10^6 = 8.98 \times 10^6 \text{ m}^3/\text{year}$$

This is equivalent to 24.6×10^3 m^3/day.

The proposed sites for new wells are located along Wagurawa river and Qarani river, tributaries of Auga river. Since Wagurawa river and Qarani river have small watershed areas, 7.95 km^2 and 4.2 km^2 respectively, it must be checked if there is a sufficient recharge for the wells.

Yearly water balance sheets were prepared for nine (9) years between 1980 and 1990 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
1980	--	--	--	--	--	76.6	145.7	80.5	0	--	0	0	302.8
1981	0	0	0	0	0	0	67.9	49.3	0	0	0	0	117.2
1982	0	0	0	0	0	0	36.9	18.7	0	0	0	0	55.6
1983	0	0	0	0	--	1.6	145.7	103.7	0	0	0	0	251.0
1984	0	0	0	0	--	14.9	75.6	0	0	0	0	0	90.5
1985	0	0	0	0	32.9	0	63.7	53.5	0	0	0	0	150.1
1986	0	0	0	0	0	30.5	142.3	103.1	65.9	0	0	0	341.8
1989	0	0	0	0	0	6.2	92.4	46.8	0	0	0	0	145.4
1990	0	0	0	0	0	0	55.0	23.8	42.2	0	0	0	121.0

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 91.8 mm and 70.8 mm respectively. For the watershed area of Wagurawa river:

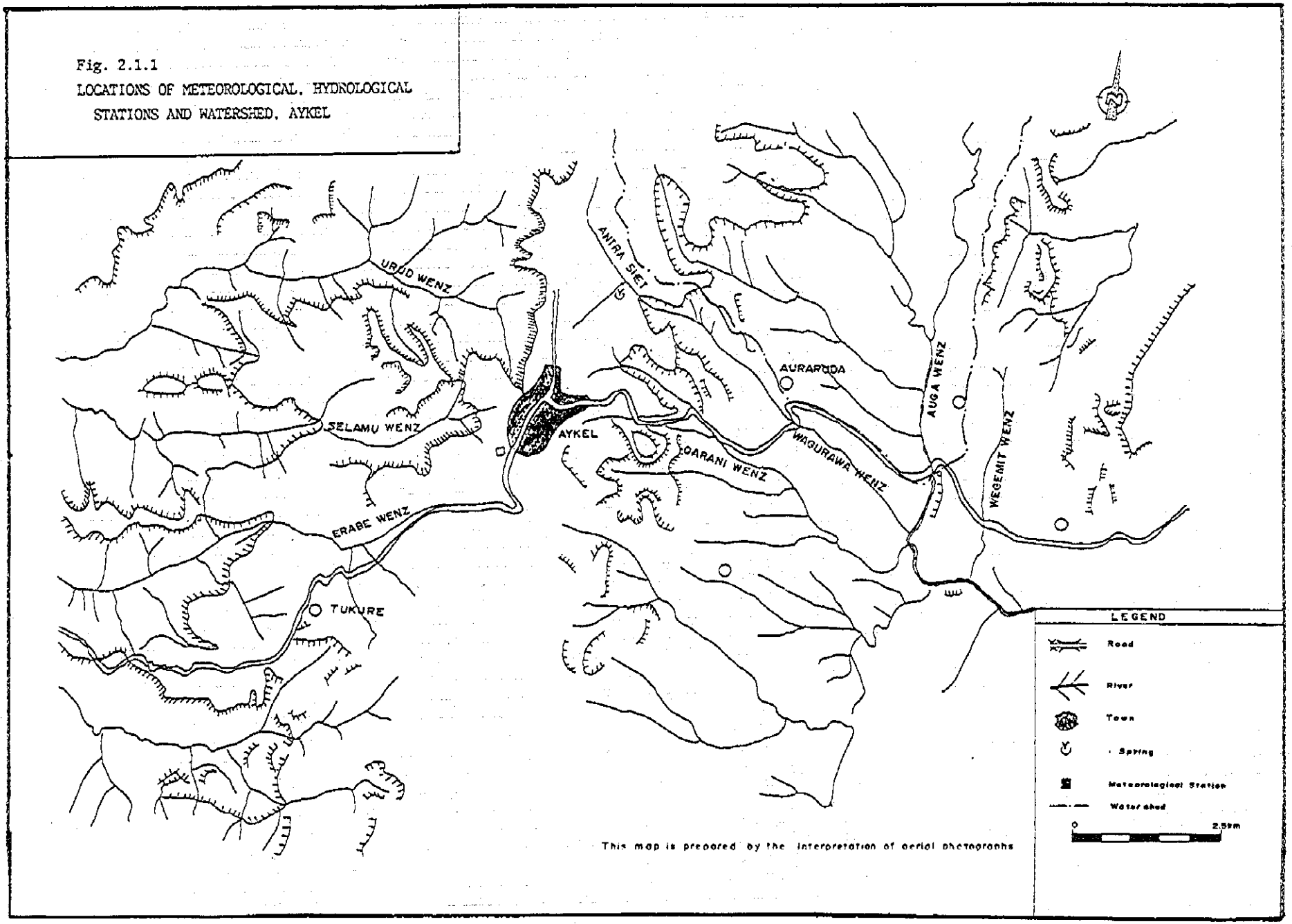
5-year recharge $0.0918 \times 7.95 \times 10^6 = 0.730 \times 10^6$ m^3/year
10-year recharge $0.0708 \times 7.95 \times 10^6 = 0.563 \times 10^6$ m^3/year

These are equivalent to 2,000 m^3/day and 1,542 m^3/day respectively. For the watershed of Qarani river.

5-year recharge $0.0918 \times 4.2 \times 10^6 = 0.386 \times 10^6$ m^3/year
10-year recharge $0.0708 \times 4.2 \times 10^6 = 0.297 \times 10^6$ m^3/year

These are equivalent to 1,058 m^3/day and 815 m^3/day respectively.

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



2.2 Hydrogeology

2.2.1 Geology

Aykel is located in the northwestern margin of Lake Tana Basin where a flat plateau extends from north-northeast to south-southwest. The town is situated on the top of isolated hill about 2200 m.asl. The Northwest area from the town is dominated by a lot of deep cut valleys. A flat plain of about 1900 m.asl spreading in a direction parallel to the ridge predominates the southeastward from the town.

The geology of Aykel area affects the landform surrounding the town. The area dominated by the ridge and deep cut valleys is covered by alkali-olivine basalt and tuff which belong to the Ashangi group. The flat plain area is dominated by shale rich alternative layers containing intercalated thin coaly shale, which is usually observed in the lacustrine sedimentary rocks. The escarpment between the ridge and the lowland plain is associated with the block faulting as it shows the parallel lineaments trending from north-northeast to south-southwest.

In regard to sedimentary rocks in the lowland plain, it shows a syncline structure. The beds at the west edge of the plain dip east to southeast and the ones at the east edge dip west, and the basal conglomerate which is composed of basalt boulders and pebbles crops out at the river bed near the abandoned borehole. These facts indicate that the shale layers were deafter the basaltic eruption. It is now generally recognized that the eruption of large volumes of magma usually results in extensive subsidence in the source area. It may be inferred that the basaltic eruption resulted in the block faulting an the subsidence followed by lacustrine sedimentation in this area.

2.2.2 Hydrogeology

(1) Groundwater

The flat plateau underlying the town makes a boundary of watershed between the Abay Basin and the Tekeze Basin. This situation makes artesian ground water potential discourage. Moreover, the basalt lava predominates with a thickness of more than 200 m in the plateau. The basalt is fairly impermeable with no or little leakage into lower layers, so that the weathered basalt at the subsurface stores shallow ground water which is furnished to springs and hand dug wells. In fact, there are no drilled boreholes existing on the plateau, but some springs and a lot of hand dug wells are observed in the town. The depth of hand dug wells varies between 10 and 15 m. They are dried up in the dry season but numerous families rely on these wells.

Eastward from the town, the Qarani River Basin forms a spindle shaped plain about 5 km wide and approximately 20 km long. This plain is related with faulting activity and fracturing which are capable of storing of ground water. One borehole was drilled in 1980 by BWWCA. Its yield was less than 1 l/s in spite of drilling up to 186 m depth. This borehole, therefore, was abandoned for the reason that the yield was not sufficient to justify the lying of pressure pipelines over a distance of 5 km with an elevation difference

of 275 m. However, ground water potential is expectantly in this lowland plain from the topographical and structural point of view.

(2) Other Water Source

There is no perennial surface water in this area under influence of the situation on the watershed between the Abay and the Tekeze drainage basin. Spring water intermits and ground water level in hand dug wells reduces in the dry season.

Chapter 3 Present Social, Water Supply and Sanitation Condition

3.1 Result of Water Quality Analysis

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

3.1.1 Physico-chemical aspects

There are several springs in Aykel, on which people are depending, and also fairly number of people use hand dug wells in both laundry and drinking. Although the Water Committee handles a spring as the source, the spring has been terminated for a couple of months because of technical failure of the facilities as of July 1995. Three (3) samples had been collected for the springs, one of which was from the source of Water Committee and the others were from Islamwonz and Sholaitu springs.

All the analyzed chemical constituents were found within the acceptable range recommended by WHO drinking guideline except color and turbidity detected on Sholaitu and Islamwonz springs and iron for Sholaitu spring, both of which are not the source of Water Committee.

One (1) sample from a hand-dug-well located in Kebele 01 was undertaken for this test. The water can be accepted for drinking, although pH levels of 6.00 stands out of the proposed guideline value of between 6.5 and 8.5. It is notified that such pH levels of less than seven (7) may cause severe corrosion of metals, which requires high maintenance cost, in the distribution system.

3.1.2 Bacteriological Aspects

Thirty two (32) samples had been tested, and those samples were highly contaminated with faecal coliforms (too-many-to-count), except two (2) in which 82 and 98 number of faecal coliforms were counted per 100ml sample. Since the springs and hand dug wells are fed with shallow aquifer and surface runoff, those can be easily contaminated with bacteria originating in poor sanitary condition accompanied by excreta and sewerage. In Aykel, proper sanitary inspection of the source and occasional chlorination must be employed in case of utilizing spring or shallow well.

3.2 Current Water Consumption and Demand

3.2.1 Water Production and Consumption

The billed consumption data is given by the Water Committee and summarized in Table 3.2.1. Production data is not available, because water flow measurement is not equipped with the existing system. The large scale consumers such as commerce connection and governmental connection does not exist.

There are many natural spring spots in the town, and people also utilize those springs for domestic use.

3.2.2 Current Water Consumption

According to the census conducted by the Team, the total population served by the water supply is about 8300, accounting for 71% of the total population. Domestic, institutional, commercial and industrial consumptions are estimated based on the records of Jan., 1995 and the census data. Since water was distributed from public fountains except for the health center, domestic consumption figure indicates only that of public fountain. 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	1781	8329	(100)	19.0	(2.3)	125.8	(15.1)
House Connection	-	-	(-)	-	(-)	-	(-)
Yard Connection	-	-	(-)	-	(-)	-	(-)
Public Fountain	1781	8329	(100)	19.0	(2.3)	125.8	(15.1)
Neighbors	-	-	(-)	-	(-)	-	(-)
Institutional	6			0.4		8.3	
Commercial	456			2.0		50.2	
Industrial	3			0.1		0.1	
Total	2246			21.5		184.4	

There was only one (1) customer i.e. the health center with house connection. The health center consumed 0.23 m^3/day in Jan., 1995. The commercial bank and its two (2) residential houses have been disconnected since Dec., 1995.

People was served by only two (2) public fountains. The users consist of 1,781 households and 6 institutions. There are 459 households engaged in small businesses and industries such as breweries (Tela, Tej, Araki houses), tea rooms shops, hotels (lodgings), coffee bars, eateries, etc.

The domestic lpcd of PF users is calculated at 2.3 lpcd from the census data and the consumption records of the water committee. With the lpcd and the population served accounted at 8,329, the domestic consumption is accordingly calculated at 19.0 m^3/day. The commercial and industrial consumptions are estimated at 2.0 m^3/day and 0.1 m^3/day, respectively. There are five (5) institutional users i.e., Serake elementary school, the army camp, the prison, the police office and the Werota finance department office. Their institutional consumption is estimated at 0.1 m^3/day.

3.2.3 Current Water Demand

The water required by the users of traditional sources and public fountains was surveyed. In the study, six (6) sample households of each user category are selected. The samples are located in the central area where the public fountains exist. The traditional source users (TSU) are users of hand-dug wells.

At present, people can use the piped water only for drinking. For the other domestic purposes, people use water of hand-dug wells and springs.

In order to estimate the day demand for domestic purposes for the users of the water supply, the lpcd of PF users is applied because almost all of the dug wells are dried up in the end of the dry season. The domestic demand of the users is shown in Table 3.2.2.

Table 3.2.1 Water Consumption in Aykel

Consumption (m3)

	IC (Bank)	IC (Health)	Sub Total 1	PF1	PF2	PF3	PF4	Sub Total 2	Grand Total
May-93			0		67	70	18	155	155
Jun-93			0					0	0
Jul-93			0					0	0
Aug-93			0					0	0
Sep-93			0					0	0
Oct-93			0					0	0
Nov-93			0					0	0
Dec-93			0					0	0
Jan-94			0					0	0
Feb-94			0					0	0
Mar-94			0	96	103	186	18	403	403
Apr-94	9	6	15	349	350	340		1,039	1,054
May-94			0	249	180	380		809	809
Jun-94	6	8	14	201	145	266		612	626
Jul-94	7	14	21	135	137	198		470	491
Aug-94	5	28	33	144	106	168		418	451
Sep-94			0	155	155			310	310
Oct-94	10	4	14	153	177			330	344
Nov-94	5	45	50	267	312			579	629
Dec-94		7	7	254	158	216		628	635
Jan-95		7	7	276	389			665	672
Feb-95		7	7	239	280	18		537	544
Mar-95			0	245	267			512	512
Apr-95			0	145	142			287	287
Total			168					7,754	7,922
Average									528
Maximum									1,054

*recoded in Ethiopian calendar

*Production is not measured because of non metering instrument.

* data in March '94 is a total comsumption from June '93 to March '94

IC: Individual Connection

PF: Public Fountain

3.3 Water Supply Facilities Condition

3.3.1 General

The water supply system in Aykel was constructed by EWWCA in 1980 to 1982. Water source in this town is spring, and water supply is served by the piped water system. The existing water supply system consists of one intake facilities, one transmission facilities, and one distribution facilities as shown in 3.3.1.

3.3.2 Water Source

Existing intake facilities consists of three spring boxes and a collecting chamber. The original spring has diverted and is flowing to another direction at present. Any measurement instruments are not provided with the facilities, so the current flow is not quantified.

Spring water is delivered to the service reservoir by an Italian-made mono-pump. The mono-pump is driven by a Indian-made generator with the capacity of 23.6KW. Technical data of mono pump is unavailable. Both of the pump and generator seem to be old enough to be replaced according to the visual observation.

Existing collecting chamber is made of masonry with a capacity of $42m^3$. There is no measurement instrument for in the collecting chamber.

During the Teams survey in Aykel, the existing mono-pump was not functioning, so that water supply was not operating for a long time.

3.3.3 Distribution Facilities

Water stored in the elevated tank is supplied to town by the gravity. Existing elevated tank is of steel-made with a capacity of $10m^3$.

Existing pipeline network is the branched distribution system with galvanized steel pipes. The diameters of the pipes range from DN 25 to DN 65 and given below.

Table 3.3.1 Existing Pipeline Data

Diameter (mm)	Length (m)	Material
25	150	G.S
40	320	-do-
50	770	-do-
65	2280	-do-

3.3.4 Service Level

The service mode is divided into two: individual connection and public fountain. There are only two individual connections for a bank and a health center, and the domestic use is served by only four public fountains.

The public fountains are operating twice a day:7:300AM-12:00PM and 4:00PM-6:00PM.

3.3.5 Disinfection

It is reported that no disinfection was performed.

3.3.6 O & M and Management

Aykel town is classified as rural town and under the control of Gonder WSS in Amhara Region. Water supply management is being carried out by the Water Committee, founded in 1993. It is reported that water committee has requested Regional Office to be raised to satellite town and hand over the management to WSS office in Gonder.

No regular check-up for water supply facilities is made in Aykel town. In case of breakdown of the facilities, the technical crew in Regional office is dispatched upon request.

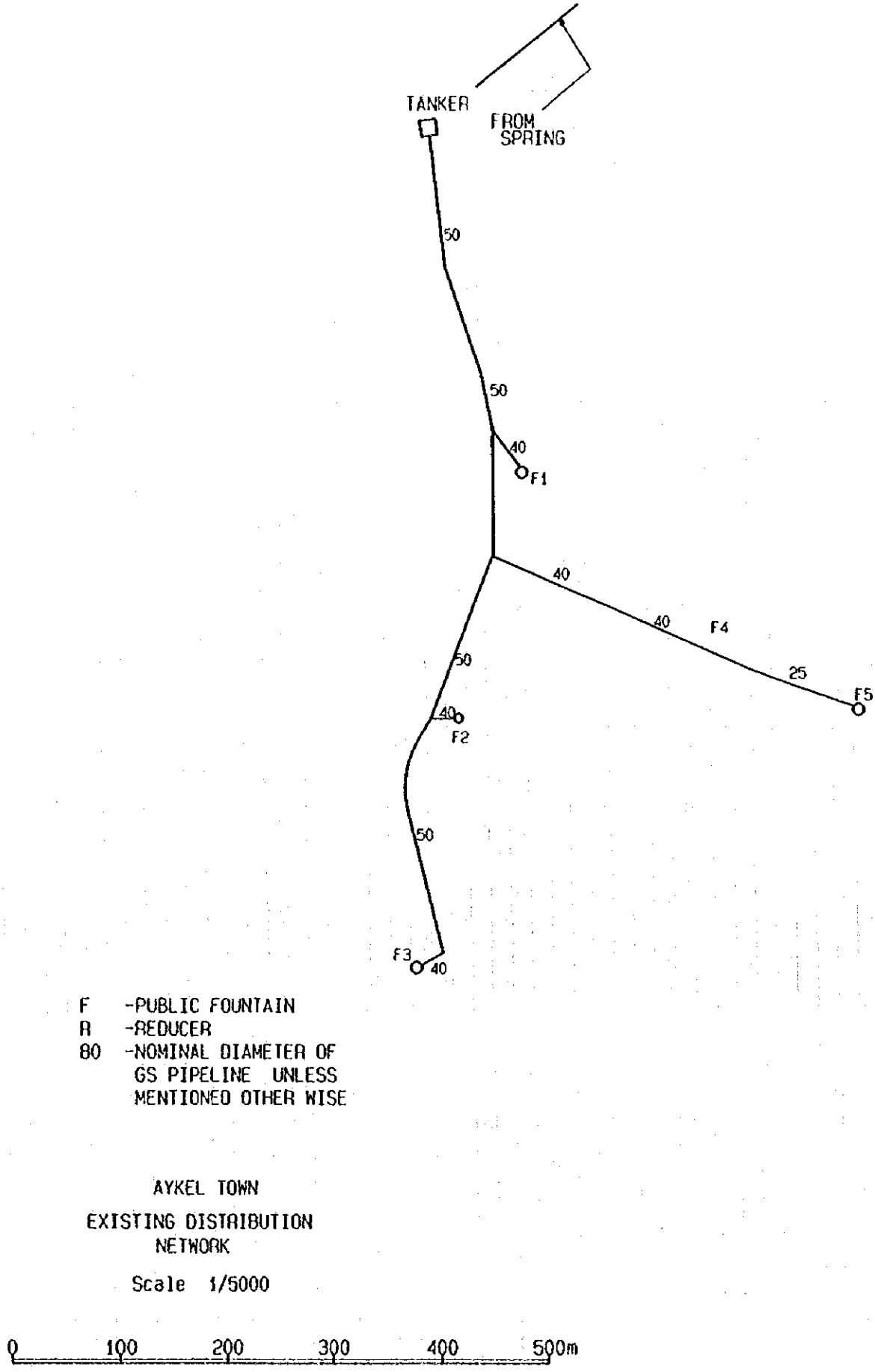


Figure 3.3.1 Schematic layout of Existing Facilities (No scale)

3.4 Sanitary Facilities Condition

3.4.1 Toilet Facilities

The sanitation situation in Aykel is very poor. Many people depend on open-field for excreta disposal. Aykel has Thursday and Saturday markets in a week. There are no toilet facilities near the markets; and all the people that come to market use open-field nearby for disposing their body wastes. This has made the area near the market very unhygienic and has greatly contributed to environmental pollution.

The 1984 Population and Housing Census does not cover Aykel; and no sanitation survey has, therefore, been made. The 1995 JICA Household Survey of 100 households in Aykel has revealed important information about the type of toilet facilities used. Out of 100 households that have been surveyed 62% do not have any toilet facilities and they use open-field excreta disposal; 36% use dry pit latrines and only 2% use community toilet. From this one can see the toilet situation in Aykel is very bad and excreta along the street and open-areas in the town is a common sight.

The Municipality of Aykel has constructed one public toilet out of wood-stick walls and corrugated iron sheets roofing. The flooring is also constructed out of wood-sticks with wider spaces between sticks where children could easily fall. The partitions are also poorly done out of wood-sticks with wider opening, where privacy does not exist.

When the pit latrines are filled up, the people dig new ones if they have space. If they do not have space they try to empty them if they can get vacuum truck from Gonder. If none of the two is possible, then they go to open-field. This aggravates the sanitary situation; and increases the environmental pollution and possible water contamination.

Aykel does not have sludge dumping site. If a vacuum truck can be obtained from Gonder, then dumping of the sludge is done any convenient place near the outskirts of the town.

Aykel has schools where some do not have toilet facilities and others have. Of special mention here are the toilet facilities of the Aykel Senior High School. The school has 3 toilets well constructed and kept fairly clean. There is one pit latrine for girls, one for boys and one for teachers. All the three are located at different sites. They are fully utilized; and this is a good example for siting toilets for boys and girls separately and at different locations. In other centers where boys and girls have separate but at one location, their full utilization has been minimal because the girls do not use theirs at ease due to prevailing culture.

3.4.2 Other Sanitary Facilities

People of Aykel dump their dry solid wastes any place where it is convenient for them. The Municipality says that it has provided 3 sites for dumping refuse; but people are not using them expect those that live closeby; possibly due to distance.

People dump their sullages in front of their houses or along the streets. As such, there are no rules and regulations for disposing sullage. Since hotels, restaurants, bars and other

drinking places dump their sullage along the streets, the accumulated sullages at various places are becoming and displeasing sight, sources of bad odour and breeding places for mosquitoes and flies.

There is no abattoir or places for killing animals for meat. Animals are being slaughtered at any convenient places available and the wastes are dumped in any available open places or along the streets.
There is practically no drainage for storm water in the town. There are no side drainage ditches along many of the streets except for the main road that passes through the middle of the town. Even here, the drainage ditches are filled up with various waste materials and rubbishes and the passages for waste are blocked, and thereby creating stagnant waters for breeding of insects.

In conclusion, one can see that the importance of sanitation in Aykel is so low that to improve the situation considerable effort need to be made on the provision of toilet facilities, prevention of environmental pollution, water contamination and on sanitary education.

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 Committee of Aykel is 13, which is one of the smallest 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	Committee Member	Contract
1. Chairman, W.C.	1	0	1	0
2. Secretary	1	0	1	0
3. Administration				
Messenger	1	0	0	1
Store keeper	1	0	1	0
Guards	2	0	0	2
Sub-total	4	0	1	3
4. Finance				
Accountant	1	0	1	0
Auditor	1	0	1	0
Treasurer	1	0	1	0
Water sellers	0	4	0	4
Sub-total	3	4	3	4
5. Technical				
Motor operator	1	0	0	1
Total	9*	4	5*	8

Note: * = The secretary functions as the accountant at the same time.

As the table shows, there are 5 committee members and 8 contract workers. Female workers are 4 in number or 31%. It is more than 27%, which is the average percentage of female workers in 11 towns. When one classifies the functions into administrative, financial and technical ones, with the chairman of Water Committee and secretary being included in administrative functions, and secretary and accountant being counted as 0.5 each, their respective shares work out to 42%, 50% and 8%. On the other hand, their 11 town averages are 37%, 41% and 22%. It is to be noted that the share technical functions is very low compared to its 11 town average.

Aykel has public fountains only as distribution facilities. Also, the regional WSSA will technically assist the committee when the need arises. That is why there is only one motor operator as technical staff.

Annual water production per worker, which is the broadest labor productivity indicator is estimated at something like 3,478 m^3. It is on the high side among the 9 towns excluding Dupti and Mille.

Committee members are not paid. The monthly remuneration per contract worker is 70 birr, which is the lowest.

It follows from the above that the participation rate of female workers is high, the number of technical staff is only one, and the size of workforce seems to be well controlled.

3.6 Financial Condition of Water Committee

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

Aykel is the only one among the 11 towns in which water supply is managed by Water Committee selected and established by the community.

The price of water is 10 cents per 20 liter or 5 birr per m^3 birr for users of public fountains. It is 5 times higher than the price in most of 11 towns. There are no connection owners.

Production and consumption of water in the last fiscal year (Jul. 1993 to Jun. 1994) are calculated at something like 11,303 m^3 and 10,173 m^3 respectively with leakage ratio assumed as 10%. The daily water consumption as divided by population comes to 2.4 liter. This is the second lowest among the 11 towns, the lowest being 1.0 liter in Debre Tabor.

Income for the last year is calculated at something like 50,863 birr. The source of income is public fountain users. Income from every m^3 of water consumed might be something like 5 birr, which is by far the highest among the 11 towns.

Expenditures for the same year were something like 22,560 birr. Major items of expenditures were fuel (59.0%), salaries for contract employees (29.8%) and oil (5.9%). Expenditures per m^3 of water produced work out to something like 2 birr, which is on the high side. Fuel cost is responsible for it. The income-expenditure ratio comes to 225.5%.

This is the highest among the three towns in which the water supply organization was in the black.

It follows from the above that although production cost of water would be high, much higher income is realized through a drastically high water price.

The number of personnel is 13, of which 5 are committee members made up of chairman, secretary cum accountant, treasurer, auditor and store keeper, and the remaining 8 are contract workers. This workforce is one of the smallest among the 11 towns.

Annual water production per worker is estimated at something like 3,478 m^3, which is on the high side among the 11 towns. Annual income per worker would be something like 3,913 birr, which is also on the high side. Annual expenditures per worker would be something like 1,735 birr, which is by far the lowest.

Average monthly salaries of contract workers are 70 birr. It is the lowest among the towns concerned. Committee members are not paid.

It follows from the above that labor productivity seems to be high because of a small size of workforce, a high water price and a minimal personnel cost.

Financial performance of the water supply organization in the town has greatly improved since the inauguration of Water Committee in 1992.

3.7 Social Background and People's Awareness

3.7.1 Population and social composition

The population in Aykel was 11,718 at the time of the household survey and was divided into two Kebeles. According to the household survey, the average household size was 5.5, the level of female headed households was very high at 74% and land ownership was 61%. 01 Kebele was larger than 02 Kebele 1487 : 594 households. The population were mostly Amhara. The results of the household survey were 73% Amhara, 20% Kimant and 7% Tigre, of which 93% speak Amharic as their first language. 80% of respondents to the survey were Christians while 19% were Muslims and 1% follow other religions. There was reported to be a high population growth rate in the town. The town had a number of social organizations; in Aykel the Muslim EDERs were called Jemmia, and there was one Sanbate linked to the Church. In the two lowest income groups (i.e. income of less than 100 Birr monthly), the number of female headed households increased to 93% of responses to the questionnaire.

3.7.2 Sanitary conditions

Many people in the town do not have latrines and practice open defecation, especially the poor and those in rented housing. The level of latrine coverage according to the household survey was 43%. People do not have latrines due to lack of affordability. Lack of land and lack of awareness were lesser constraints. Generally people seemed to be aware of water

and sanitation related disease prevention, the exception being the poorest community spoken with. The lowest income groups in the household survey had the lowest level of access to latrines.

People were in favor of community latrines with community management but felt that they would need some support and even enforcement from appropriate officials. All groups thought that they would be able to keep the latrines clean. About half of the groups preferred to have the facility shared by groups of families, while the others prefer to share by sex. No groups requested pour flush latrines, although 10% of the respondents to the household survey identified septic tanks as their sanitation need. Not all groups could afford to consider having water in the latrines. None of the groups felt they would be able to finance the desludging of the latrines once they were filled up. They thought that the most practical option would be to close the latrines and dig new ones. There did not seem to be any cultural reason why manual desludging of latrine compost could not be considered.

If a public shower facility were available in the center of Aykel would be used by both men and women.

3.7.3 Water situation

Water was often in short supply in the town. The water supply system was not functioning during the site visit in June 1995. This was due to technical problems including pump breakdown, lack of spare parts and lack of technically competent person to fix the pump in Aykel town itself. Supply from the public fountains was insufficient to supply the demand for the town. There were no private connections although some members of the community would like them and have registered this demand with the water committee. The majority of town people use spring water. There were large queues at the springs for water and men accompany women and children to the springs outside daylight hours. This probably accounts for the greater proportion of boys collecting spring water (12%) than water from public fountains (5%) in the household survey results. Laundry was undertaken by both men and women at the springs or the nearby river.

There were a number of handdug wells in the town. The water from these wells was of inferior quality, being very hard and having taste problems. Well water was used in time of shortage of spring water. Water provides an income for daily laborers who fetch water for others from the springs, and also an income for some private well owners. The people involved with this trade seemed happy to find other ways of generating income should the water supply system be improved.

The price of water varies with demand and increases during periods of shortage i.e. the dry season (March/April). Water direct from the spring water was free but people will charge 25 to 50 cents per jerry can for delivering it to households. Well water was cheaper being 15 to 25 cents per jerry can. People seemed willing to pay more than the public fountain price for a better water supply service. The main requirement was longer water point service time. There were probably enough public fountains to satisfy demand if they functioned for four hours every day.

Most people expressed an interest in community management of the water points. The poorest people did not think that they were able to manage the water system but would be able to pay for the water they use. Richer people were requesting private connections. Some people were so frustrated by the public fountain that they said they would even prefer to buy water from people with private connections than to buy water from public fountains! The lack of support to the water committee from WSSA was suggested as a likely root to the problems of the water supply system.

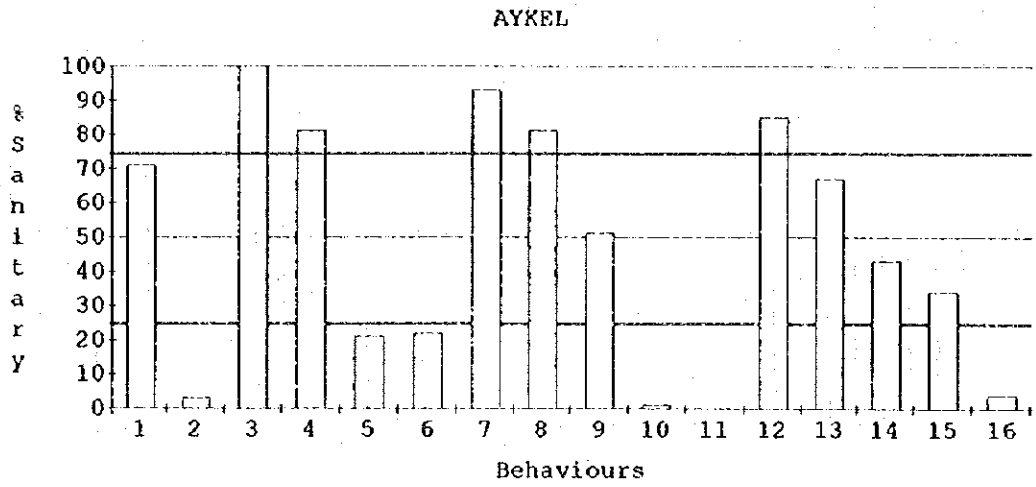
Women and men would benefit from an improved water supply system. Students, particularly female students would benefit and be able to spend more time studying.

3.7.4 Health indicators

The town population had a relatively high level of sanitary awareness compared with the other towns in the study. In the household survey, some 65% of households were aware of the cause of diarrhea and 49% knew how to prepare ORS correctly. Food and water hygiene was reasonable but handwashing was poor with only 21 households using soap for handwashing after defecation and 26% of households with young children wash their hands with soap after handling children's stools. 28% of respondents requested sanitary education as part of any sanitation program.

Aykel had a Health Center which serves a population of more than 32,600 within a 10 km radius of the town. Among the staff there were two sanitarians. The sanitation program had serious problems due to a lack of budget. Malaria was the most common cause for people presenting at the health center. Intestinal Parasites were the next most common complaint. The next most common diseases were pneumonia, diarrhea, anemia, skin disease, gastritis, fevers kwashiorkor and tonsillitis. Conjunctivitis in children and Tuberculosis (TB) were also common. The people in group meetings were aware of the sanitary education program being carried out at the health center to in-patients. The school had had in-puts from the health center for the Anti-AIDS and Red Cross Clubs.

The indicator sanitary behaviors reported in the household questionnaires were recorded in Figure 3.7.1 below:



No.	SANITARY BEHAVIOURS	%sanitary
1	Access to piped water	71
2	Use piped water supply always	3
3	Covered water container	100
4	Water scoop kept off the floor	81
5	Handwashing with soap after defecating	21
6	" after handling childrens stools*	22
7	Covering cooked food during storage	93
8	Not eating unwashed raw fruit and vegetables	81
9	Kitchen utensils stored off the floor	51
10	Rubbish burried or burned	1
11	Wastewater disposed of in soak-away or drain	0
12	No animals kept in the house	85
13	Home not infested with flies	67
14	Latrine in use by household	43
15	Latrine in use by all household members	34
16	Infant's excreta disposed of in latrine*	4
TOTAL SCORE FOR SANITARY BEHAVIOURS		757

* As proportion of households with young children

Figure 3.7.1 Indicator Sanitary Behaviours

There was little variation in this score between water user groups or by religion. There was a noticeable reduction in score for the lowest income groups, principally due to lack of access to latrines. This summary of indicator behaviors suggests areas where sanitary improvements were required. The highest priority areas were use of piped water always, handwashing after defecation and after handling children's excreta, sanitary disposal of solid waste and waste water and safe disposal of children's excreta. These high-middle priorities for sanitary behavior improvement were access to latrines and the use of latrines by all family members. The low-middle priorities for sanitary behavior improvement were access to piped water, keeping kitchen utensils off the floor and fly reduction.

3.7.5 Education

Aykel had one elementary school, one junior school and one high school. The percentage of female staff at each of these schools was 52, 33 and 6 respectively during the questionnaire survey. There were 1,159 pupils attending the secondary school (335 boys and 824 girls). As there were only six class rooms the school operates a shift system with some pupils attending in the morning and the others attending in the afternoon. In all classes there were more girls than boys. This was because pupils mostly come from rural areas (70%) and the boys were required to help their families with agricultural work at home. Girls however have a higher drop out from school and generally perform less well. Some gave the reason for this as the amount of time girls spend collecting water and the lack of electricity to study by at night.

The school had a health/Anti AIDS and Red Cross Club, led by the biological science teachers and well supported by the staff of the health center. Health education was given to these clubs each Friday from the health center staff. Subjects include HIV and other common diseases.

There were no water facilities at the school. Although there was a public fountain in the corner of the school grounds, this was insufficient for the people living around the school and students must bring their own water to the school if needed. There were three latrines, one for boys, one for girls and one for the staff. The boys latrines were located far from the girls latrines and both were used as intended.

3.7.6 Religious Institutions

The Orthodox Church was already involved with health education. Priests attended a four-month course at Bahir Dar and undertake health education classes each week on Sundays during the religious teaching sessions. This was thought to be very effective. The teaching could be more effective with provision of materials and training in how to use them and also some incentives for the health education work. The Priests have no water supply except spring water brought to them by deacons and trainees. They have no latrines. The Priests felt that community latrines would be a good option but that people in the town might also need some income generation activities in order to maximize on their existing health knowledge.

The Mosque had not been involved in health education to date but was willing to get involved. The Mosque had a particular water problem as the spring they were nearest to had been designated as a source of Christian "holy" water. Muslims were not able to use this spring. They tried to dig a well but were not successful. This lack of water for the Mosque makes prayers difficult. The Mosque had a latrine but the students at the Mosque use open field sites for defecation.

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 17 governmental organizations excluding schools dealing with general administration, finance, education, health, water supply and sanitation, communications, police, justice, water resources development, agriculture, commerce, meteorology, culture & sports and municipal affairs.

The number of government employees is 412. It is a medium scale among the 11 towns. The number of them per 1,000 population works out to 35, which is also at a medium level. Their average monthly salaries are 391 birr, which is on the high side.

This town has two Kebele. There are two NGO's.

3.8.2 Population

The population of the town is 11,281 according to the preliminary results of the 1984 population census. It is one of the smallest among the 11 towns. Ethnically, Amhara is predominant, occupying 73.3% of the population, followed by Kimant with 19.8% and Tigre with 6.9 %. Religion-wise, 81% of the population is Christians and 19% Moslems. There are 2 churches, 1 mosque and 1 other religious institution.

It is to be noted that the Kimant are the original people of the town. In this respect Aykel is unique among the towns concerned.

The average family size is 5.5 persons. This is on the small side among the towns concerned. The area of the town is 322 ha. It is on the small side. The population density is calculated at 36.4 persons/ha. This is on the high side.

3.8.3 Educational Conditions

There are 1 kindergarten, 2 elementary schools, 1 junior high school and 1 senior high school. The total number of pupils/students is 3,944. It is on the large side. The number of pupils/students per 100 population is calculated at 34, which is the highest among the 11 towns.

Literacy ratio and primary school enrollment ratio are observed to be 80% and 85-90% respectively. If that is the case, they are both the highest among the towns concerned.

Aykel is characterized as an educational town.

3.8.4 Medical Conditions

There are 1 health center and 1 private drug store. The total number of medical personnel in the health center is 18. It means that there are 1.5 medical personnel for every 1,000 population. The figure is a medium one.

The types of diseases people suffer most are water-borne and sanitation-related diseases such as intestinal parasite, skin diseases, malaria and eye diseases, and respiratory tract

infections such as upper respiratory tract infection, pneumonia and bronchitis. The number of top ten disease cases treated in the health center in 1993/94 was 13,683.

The estimated total number of cases treated last year in the hospital was divided by the estimated service population. It came to 35.0%, which is the second highest, following 48.1% in Nefas Mewcha. It is suspected that there is something to do with the acute shortage of water and people's custom of open field excretion.

Under 5 mortality rate is not known. Life expectancy is observed to be 55 years.

Ratio of households more or less using septic tanks and pit latrines is 39%. This is the lowest among the 4 towns.

It appears that this town suffers from medical/sanitary problems.

3.8.5 Economic Conditions

The number of hotels and restaurants is 115 (25.5%), that of shops 303 (67.3%), that of cottage industry 16 (3.6%) and that of others 16 (3.6%), adding up to 450 (100.0%). The total number of commercial/industrial establishments per 1,000 population comes to 38. This is at a medium level. The number of hotels and restaurants per 1,000 population is 10, which is also at a medium level.

Major occupations in the town are trade, agriculture & animal husbandry, government employees and day laborers.

Major products are edible oil, leather products and flour. Major marketable items are agricultural products such as tef, wheat, millet, maize, beans and oil seeds, livestock such as oxes, cows, sheep, goats, donkeys and chickens, household items, etc.

There are two market days in a week, namely Saturday and Thursday. They say 10,000 to 15,000 people gather on a market day.

The average monthly household income is 182 birr. This is the lowest among the 11 towns.

3.9 Town Planning and Development

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

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

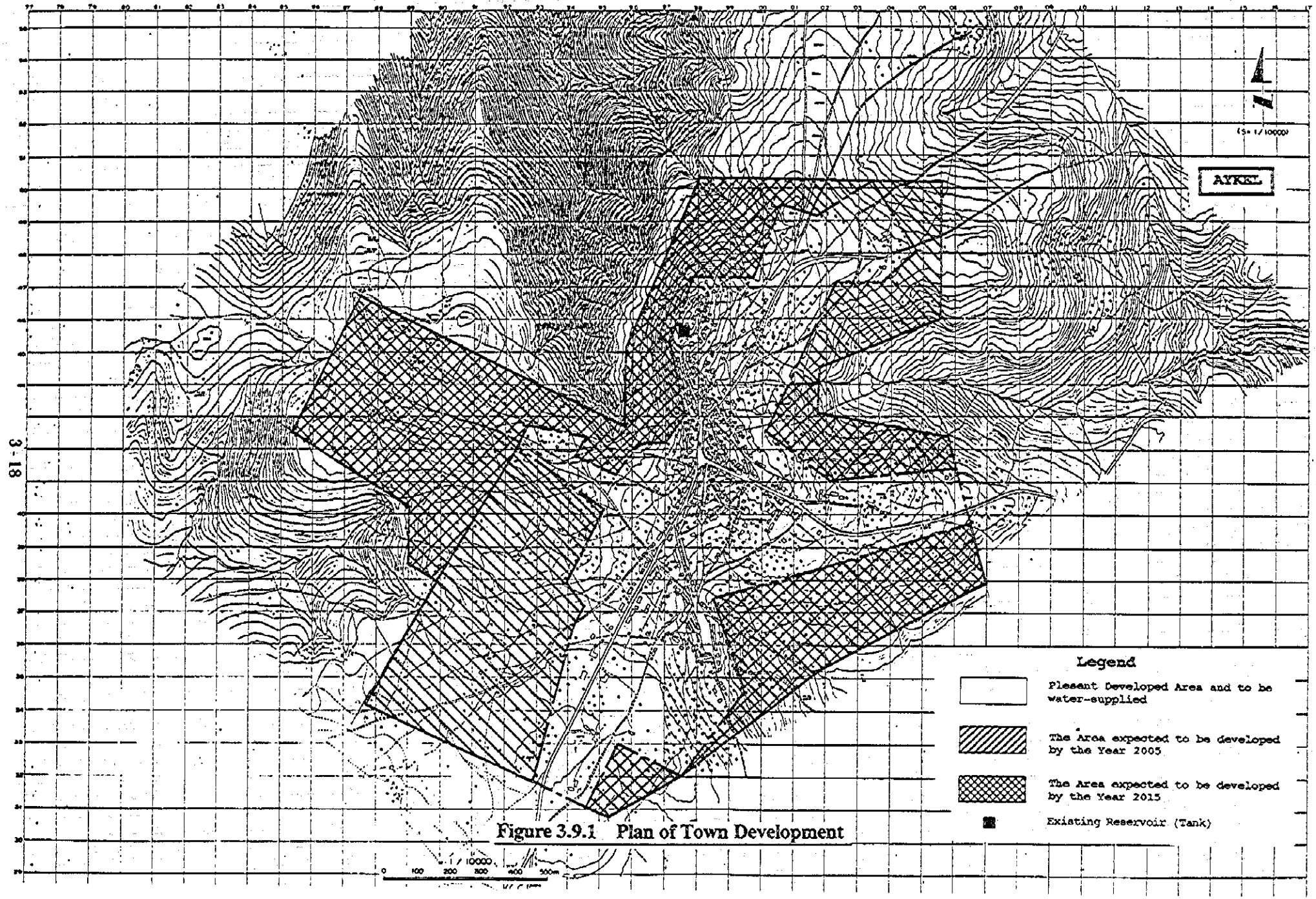


Figure 3.9.1 Plan of Town Development

Chapter 4 Plan of Water Supply System

4.1 Water Demand Projection

4.1.1 Population Projection

The population of Aykel was 4,804 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 population figures are available so far as those of Aykel are concerned. Central Statistical Authority (CSA) published 1974 population estimates for those towns whose population was supposed to be more than 2,000. The population of Aykel was considered to be below 2,000 in that year.

Since 1984 also CSA published its own estimates of population. According to them population of the town in 1992 and 1993 was 8,712 and 9,281 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 8,517 in 1994. When one uses the figures, the average annual population growth rate during the 10 years from 1984 to 1994 works out to 5.89%. 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. However, the team has gotten the preliminary figures of the census for Aykel during the field survey. They are 11,718. The team adopted them for the 1995 population of the town.

Aykel is located along the envisaged Cross-African Highway connecting Uganda, Kenya, Ethiopia and Sudan. The study on the project has been already finished. It is going to be funded by AfDB and will start in the near future. It may have a big economic impact on the town in such fields as oil manufacturing, brick manufacturing, filling stations and hotel-related business.

As the average annual population growth rate 1995 to 2000 5.5% 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 5.0% and 4.5% respectively.

As a result the projected population of the town for 2000, 2005 and 2010 works out to 15,315, 19,546 and 24,258 respectively (Refer to Table 4.1.1).

Table 4.1.1 Population of Aykel

1. Past Population

1984 Population Census	1994 Cartographic Census	Average Annual Growth Rate 1984 to 1994
4,804	8,517	5.89%

2. Population Projection

1995	2000	Average Annual Growth Rate 1995 to 2000
11,718	15,315	5.5%
2000	2005	Average Annual Growth Rate 2000 to 2005
15,315	19,546	5.0%
2005	2010	Average Annual Growth Rate 2005 to 2010
19,546	24,258	4.5%

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.

85% of the population is targeted at the year of 2010 to be served by the piped water system, and the ratio served by the traditional water use is 15%, considering the current ratio of the population served. Based on the the ratio of the households who are payable for the mode-wise water charge, target ratio of the sum of house and yard connections (YC) at the year of 2010 is 44%, and 12% of this ratio is house connection (HC).

Table 4.1.2 Population Forecast by Service Modes

	Population (%)							
	1995		2000		2005		2010	
HC	0	(0.0)	306	(2.0)	1172	(6.0)	2910	(12.0)
YC	0	(0.0)	811	(5.3)	3127	(16.0)	7762	(32.0)
PF	8329	(71.1)	10728	(70.0)	11694	(59.8)	9948	(41.0)
Sub total	8329	(71.1)	11845	(77.3)	15993	(81.8)	20620	(85.0)
TSU	3389	28.9	3470	22.7	3553	18.2	3638	15.0
Total	11718	100.0	15315	100.0	19546	100.0	24258	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 less than 900 mm). Based on these conditions, the domestic water demands at the years of 2000, 2005 and 2010 are obtained as follows:

Table 4.1.3 Domestic Water Demand by Modes

	m^3/day (lpcd)							
	1995		2000		2005		2010	
HC	0.0	(0.0)	16.5	(54)	68.0	(58)	183.3	(63)
YC	0.0	(0.0)	26.0	(32)	106.3	(34)	287.2	(37)
PF	19.2	(2.3)	150.2	(14)	175.4	(15)	159.2	(16)
Total	19.2		192.7		349.7		629.7	
Average	6.4	(2.3)	64.2	(16)	116.6	(22)	209.9	(31)

(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 Non Domestic Water Demand in 1995

Item	Unit	Nos.	Demand (m^3/day)	Remarks
School	5 l/person	3,944	19.7	
Hospital	20 l/staff	19	0.4	
Hotel	100 l/bed	30	3.0	10 beds/place × 3 places = 30 beds
Bar...	200 l/bar	112	22.4	
Mosque	5 l/visitor	200	1.0	200 visitors/place × 1 place = 200
Offices	5 l/person	412	2.1	
Total			48.6	

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	19.7	25.7	32.8	40.9	Population growth rate
Hospital	0.4	0.5	0.6	0.7	-do-
Hotel	3.0	4.5	6.6	9.5	Population growth rate +3%
Bar, Tea shop	22.4	33.7	49.5	71.1	-do-
Mosques	1.0	1.3	1.7	2.1	Population growth rate
Offices	2.1	2.7	3.4	4.2	-do-
Total	48.6	68	95	129	

(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	19	193	350	630
Non Domestic	3	68	95	129
Losses	9	29	61	134
Total	31	290	505	893

* Actual consumption

(4) Maximum Day Demand and Peak Day Demand

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

Table 4.1.7 Maximum Day Demand Peak Day Demand

Item	Factor	1995	2000	2005	2010
Average Water Demand (m^3/day)		31	290	505	893
Maximum Day Demand (m^3/day)	1.2	37	348	606	1072
Peak Day Demand (m^3/hour)	1.6	2	23	40	71

4.2 Water Resources Development

4.2.1 Evaluation of Water Resources

Aykel has annual precipitation of 1,166.6 mm and annual ground water recharge of 151.5 mm in an average year. In the town area located in the plateau, there are many springs and hand dug wells but their yield is small and many of them dry up in late dry season.

Even the water source of water supply i.e. a spring in Antra Shet valley yields very little in the season. From the view point of water supply, springs and hand dug wells are not feasible. On the other hand, in the lowland of Auga river to the east, the river is perennial having a large watershed area of 59.3 km^2 at the river crossing on the road to Gondar.

The geology is basalt lava with a thickness of more than 200 m in the plateau. On other hand, the lowland is composed of sedimentary rocks in which shale dominates underlain by basalts. The study area is dissected by the linearments according to the aerial photograph interpretation. The primary permeability of basalts and shales is low but it could be increased with secondary prosity caused by faults and fracture openings. It is expected that rocks are fractured and weathered along the lineations as favorable as for ground water exploitation.

Geoelectrical survey was conducted at 15 points in total, three (3) in the plateau and 12 in the lowland including the site of the abandoned well near Auraruda. The location of VES stations are shown in Drawing. These points are classified into three groups by the apparent resistivity value and the shapes of resistivity curves. The curves of the points on the plateau, Station No.13, No.14 and No.15, show bumpy forms and their resistivity values range from 50 to 150 ohm-m. As the result of the interpretation of those curves, the specific resistivity values range from 30 to 460 ohm-m and these values imply that the plateau is underlain by basalt. On the curves of the points in the lowland plain, Station No.3, No.4, No.5, No.6, No.7 and No.8, the apparent resistivity values at the subsurface are about 10 ohm-m. The specific resistivity values are low, which is less than 5 ohm-m and these results also imply that the lowland plain is underlain by shale layers. Intercalation of shale and sandstone layers is indicated with the values between 3 and 30 ohm-m. Station No.1, No.2, No.9, No.11 and No.12 are located on the foot of escarpment. The apparent resistivity values range from 10 to 100 ohm-m. The curves of No.1, No.9 and No.11 show rising apparent resistivity values as the depth increases. On the other hand, the curves of No.2 and No.12 form bumpy curves which indicate weathered basalt intercalation.

Considering the lineations and the results of VES, borehole sites are selected at Station No.2, No.5, No.7 and No.10 totally four (4) sites. The results of VES are shown in Appendices. Station No.2, No.5 and No.10 are located along the tributaries of Auga river. Their watershed areas are relatively small i.e. 4.2 km^2 with Qarani river for Station No.2 and 7.95 km^2 with Wagurawa river for Station No.5 and No.10. The 5-year annual ground water recharge of dry years is estimated to be equivalent to 1,058 m^3/day and 2,000 m^3/day for the watershed areas of Qarani river and Wagurawa river respectively. Station No.7 is located beside the large recharging unit i.e. the Auga.

4.2.2 Strategy of Water Resources Development

The characteristics of the major aquifers at the proposed well sites are shown below 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.2	15 - 27 62 - 96※	Weathered and Fractured Basalt -Ditto-	23	1	New Well
2	VES St.5	11 - 34※	Shale and Sandstone	11.5	3	-Ditto-
3	VES St.7	1 - 35 35 - 58	Weathered and Fractured Basalt Highly Fractured Shale	28.5	1	-Ditto-
4	VES St.10	15 - 31※	Shale and sandstone	8	3	-Ditto-

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

The depths of major aquifers were detected by the geoelectrical survey. The thickness of major aquifer is reduced into a half because a part of basalts and shales are highly weathered and may become clayish. The permeabilities of basalts are assumed according to the design criteria and the permeabilities of shale and sandstone layers are assumed at 3 m/day.

The optimal yields of the wells are estimated with the formula listed in the design criteria with a well diameter of 200 mm and a drawdown of 20 m.

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	278	0	20	New Well for Year 2005
2	418	1	21	New Well for Year 2005
3	345	1	21	New Well for Year 2010
4	291	0.5	20.5	New Well for Year 2010

The optimal yields of Well No.1 and Well No.2 totaling to 696 m^3/day cover 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.1 and Well No.2 before year 2005 because they are located nearer to the town.

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 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 length is longer than the calculated by the following formula.

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

where
- Ls: Length of screen (m)
- Q: Pumping rate (l/s) (assumed equal to the optimal yield)
- A: Surface area of screen 0.66 m^2/m
- N: Opening ratio 0.12
- V: Inflow velocity 0.5 cm/s for Well No.1 and No.3; 1.0 cm/s for Well No.2 and No.4 (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 Wells

Well No.		1	2	3	4
Pumping Rate	(m^3/day)	278	418	345	291
	(l/s)	(3.2)	(4.8)	(4.0)	(3.4)
Diameter of Well	(mm)	200	200	200	200
Casing Length	(m)	66	18	48	24
Screen Length	(m)	36	20	16	16
Well Depth	(m)	102	38	64	40
Drilling Diameter	(mm)	300	300	300	300

4.3 Plan of Water Supply System

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

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

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

4.3.1 Water Supply System in 2005

(1) Boreholes

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

W1 (proposed)	278 m^3/day
W2 (proposed)	418 m^3/day
Total	696 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:

Q = 0.2 ~ 0.5 m^3/min., H = 70 ~ 80 m, P = 5 kw, 2 set

(3) Boosting Facility and Rising Mains

The booster pumps with following capacities will be installed to transfer the water to reservoir. And the collecting chambers with the following capacities will be constructed as well.

BP.1 and BP.2 Q = 0.42 m^3/min., ϕ = 150 mm, H = 225 m P = 55 kw × 2 set

Rising mains will range from 100 mm to 150 mm and transferred water to the new reservoir. Total length is about 7,400 m.

(4) Reservoir

The existing reservoirs is used, therefore, the additional capacity of the reservoir is required to meet the water demand at the year of 2005, and the required capacity is about 130 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 attached in the Drawings. The main pipelines planned are shown as follows:

Table 4.3.1 Distribution pipelines

DN (mm)	Length (m)
200	285
150	4,005
75	1,050
50	7,300

(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 0.7 kg and necessary more than 0.11 PPM at the end of distribution pipe.

(7) Administration Building

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

4.3.2 Water Supply System in 2010

(1) Borehole

Two boreholes will be additionally constructed in the second phase to meet the water demand at the year of 2010. The production rate planned is summarized as follows.

W3 (proposed)	345 m^3/day
W4 (proposed)	291 m^3/day
Total	636 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:

Q = 0.24 m^3/min., H = 50 m

(3) Boosting Pump and Rising Mains

Additional booster pump with following capacity will be installed to transfer the water to reservoir. And the collecting chamber with the necessary capacity will be constructed as well.

Rising mains with a diameter of 75 mm will be constructed additionally for above.

(4) Distribution Network

The layout of distribution network for the year of 2010 is not prepared in this Study. It is because the projected population does not match up to current master plan of the town planing. It is preferable to design a layout plan after formulation of new master plan.

(5) Disinfection

Disinfection will be performed by the injection system directly into the reservoirs. Daily consumption ratio of chemical will be estimated at about 1.3 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	13,926	5,346	19,272
2010			10,546

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

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

Table 4.4.2 Total Project Cost of Sanitary Facilities in Thousand Birr

Year	Cost
2005	1,421
2010	443

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	3.15
2. Yard Connection Users	2.45
3. Public Fountain Users	1.11

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 168 birr, 293 birr and 519 birr will be daily required in 2000, 2005 and 2010 respectively.

The second is fuel cost. It will not be used for pumps.

The third is disinfection cost. It is estimated that 4 birr, 7 birr and 14 birr will be daily required in 2000, 2005 and 2010 respectively.

The fourth cost is personnel cost. It is estimated that 18, 22 and 31 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 32, 91 and 182 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	10,665	4,729	15,394
2) Engineering Cost (12% of 1))	1,847		1,847
3) Contingency (5% of 1) + 2))	626	236	862
Sub-Total	13,138	4,965	18,103
4) Buildings		993	993
5) WSSD's Management Cost (2% of 1) + 2) + 3) + 4))		382	382
Sub-Total		1,375	1,375
Total	13,138	6,340	19,478
6) Water Purification Units (included in total)	10	15	25
2. Phase 2			
1) Construction Cost			6,138
2) Engineering Cost (10% of 1))			614
3) Contingency (10% of 1) + 2))			675
Total			7,427
Grand-Total			26,905

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

   100% 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 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 = 127.4%
Working Capital/Revenues = 27.5%

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

It is to be noted that the above values exceed the required levels by a considerable 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	-	975	847	819
2) Yard Connection Users	-	609	485	374
3) Public Fountain Users	239	218	183	146
2. Share of Households (%)				
1) House Connection Owners	0.0	2.0	6.0	12.0
2) Yard Connection Users	0.0	5.3	16.0	32.0
3) Public Fountain Users	71.1	70.0	59.8	41.0
3. Water Consumption/Household/Month (m^3)				
1) House Connection Owners	-	8.9	9.6	10.4
2) Yard Connection Users	-	5.3	5.6	6.1
3) Public Fountain Users	0.4	2.3	2.5	2.6
4. Water Price (birr/m^3)				
1) House Connection Owners	-	3.15	3.15	3.15
2) Yard Connection Users	-	2.45	2.45	2.45
3) Public Fountain Users	5.00	1.11	1.11	1.11
5. Payment for Water Supply/Household/Month (birr)				
1) House Connection Owners	-	28.1	30.1	32.7
2) Yard Connection Users	-	12.9	13.7	15.0
3) Public Fountain Users	2.0	2.6	2.7	2.9
6. Ratio of Water Payment to Income (%)				
1) House Connection Owners	-	2.9	3.6	4.0
2) Yard Connection Users	-	2.1	2.8	4.0
3) Public Fountain Users	0.8	1.2	1.5	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	0	41,242	3,932	0	0	0	45,174
1997	0	42,066	4,011	0	0	0	46,077
1998	0	42,908	4,091	0	0	0	46,999
1999	22,462	33,409	42,052	6,223	1,532	2,953	108,631
2000	40,110	57,811	74,274	6,223	1,915	3,607	183,940
2001	65,004	59,751	80,172	17,728	3,006	4,513	230,174
2002	89,898	61,691	86,070	17,728	4,097	5,190	264,674
2003	114,792	63,630	91,969	17,728	5,188	5,866	299,173
2004	139,686	65,570	97,867	17,728	6,279	6,543	333,672
2005	164,580	67,510	103,765	17,728	7,370	7,219	368,172
2006	220,504	66,263	111,192	35,507	9,555	8,860	451,881
2007	276,427	65,016	118,620	35,507	11,740	10,146	517,456
2008	332,351	63,769	126,047	35,507	13,925	11,432	583,031
2009	388,275	62,522	133,474	35,507	16,110	12,718	648,606
2010	444,199	61,275	140,902	35,507	18,295	14,004	714,181
2011	444,199	61,275	140,902	0	18,295	13,293	677,964
2012	444,199	61,275	140,902	0	18,295	13,293	677,964
2013	444,199	61,275	140,902	0	18,295	13,293	677,964
2014	444,199	61,275	140,902	0	18,295	13,293	677,964
2015	444,199	61,275	140,902	0	18,295	13,293	677,964
2016	444,199	61,275	140,902	0	18,295	13,293	677,964
2017	444,199	61,275	140,902	0	18,295	13,293	677,964
2018	444,199	61,275	140,902	0	18,295	13,293	677,964
2019	444,199	61,275	140,902	0	18,295	13,293	677,964
2020	444,199	61,275	140,902	0	18,295	13,293	677,964
2021	444,199	61,275	140,902	0	18,295	13,293	677,964
2022	444,199	61,275	140,902	0	18,295	13,293	677,964
2023	444,199	61,275	140,902	0	18,295	13,293	677,964
2024	444,199	61,275	140,902	0	18,295	13,293	677,964
2025	444,199	61,275	140,902	0	18,295	13,293	677,964

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

Table 4.5.3(1) Financial Statement

(Unit: thousand birr)

No.	1	2	3	4	5	6	7	8	9	10
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Income Statement										
Revenue	45	46	47	109	184	230	265	299	334	368
Operation and Maintenance	20	20	21	192	210	275	291	306	321	337
Depreciation	0	17	33	33	33	33	33	33	33	33
Payment of Interest	0	0	0	0	0	0	0	0	0	0
Expenditure	20	37	54	225	244	308	324	339	355	370
Profit before Tax	25	9	-7	-116	-60	-78	-59	-40	-21	-2
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	25	9	-7	-116	-60	-78	-59	-40	-21	-2
Funds Statement										
Profit after Tax	25	9	-7	-116	-60	-78	-59	-40	-21	-2
Loans	0	688	688	0	0	0	0	0	0	0
Subsidies	1939	8082	8082	0	0	0	0	0	0	0
Depreciation	0	17	33	33	33	33	33	33	33	33
Sources	1964	8795	8795	-83	-26	-45	-26	-7	12	31
Capital Works	1939	8082	8082	0	0	0	0	0	0	0
Payment of Principal	0	0	0	0	0	0	0	0	0	0
Working Capital	25	713	714	-83	-26	-45	-26	-7	12	31
Applications	1964	8795	8795	-83	-26	-45	-26	-7	12	31
Loan Liabilities	0	694	1396	1410	1424	1438	1452	1467	1482	1496
Cash Balance	50	763	1477	1393	1367	1322	1296	1289	1301	1333

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	452	517	583	649	714	678	678	678	678	678
Operation and Maintenance	443	473	504	534	564	411	411	411	411	411
Depreciation	33	33	33	33	33	33	33	33	33	33
Payment of Interest	0	8	15	14	13	13	12	11	11	10
Expenditure	476	514	551	581	610	457	456	455	454	454
Profit before Tax	-25	3	32	68	104	221	222	223	224	224
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	-25	3	32	68	104	221	222	223	224	224
Funds Statement										
Profit after Tax	-25	3	32	68	104	221	222	223	224	224
Loans	0	0	0	0	0	0	0	0	0	0
Subsidies	0	675	3376	3376	0	0	0	0	0	0
Depreciation	33	33	33	33	33	33	33	33	33	33
Sources	9	712	3440	3477	137	254	255	256	257	257
Capital Works	0	675	3376	3376	0	0	13	13	0	0
Payment of Principal	0	34	69	70	71	71	72	73	74	74
Working Capital	9	2	-5	31	66	183	171	171	183	183
Applications	9	712	3440	3477	137	254	255	256	257	257
Loan Liabilities	1511	1484	1415	1345	1274	1203	1131	1058	984	910
Cash Balance	1341	1343	1338	1369	1435	1618	1789	1960	2143	2326

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	678	678	678	678	678	678	678	678	678	678
Operation and Maintenance	411	411	411	411	411	411	411	411	411	411
Depreciation	33	33	33	33	33	33	33	33	33	33
Payment of Interest	9	8	8	7	6	5	4	4	3	2
Expenditure	453	452	451	451	450	449	448	448	447	446
Profit before Tax	225	226	227	227	228	229	230	230	231	232
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	225	226	227	227	228	229	230	230	231	232
Funds Statement										
Profit after Tax	225	226	227	227	228	229	230	230	231	232
Loans	0	0	0	0	0	0	0	0	0	0
Subsidies	0	0	0	0	0	0	0	0	0	0
Depreciation	33	33	33	33	33	33	33	33	33	33
Sources	258	259	260	260	261	262	263	264	264	265
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	75	76	77	77	78	79	80	80	81	82
Working Capital	183	183	183	183	183	183	183	183	183	183
Applications	258	259	260	260	261	262	263	264	264	265
Loan Liabilities	835	759	683	605	527	448	368	288	207	125
Cash Balance	2509	2692	2875	3058	3241	3424	3607	3790	3973	4156

Source: JICA

Chapter 5 Improvement of Health and Sanitation

5.1 Plan for Sanitary Facilities

Aykel'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 Aykel

Item	HC			YC			PF		
	1995	2005	2010	1995	2005	2010	1995	2005	2010
• Water demand (lpcd)	0	58	63	0	34	37	2.3	16	17
• Waste water generation rate (%)	0	74	75	0	67	68	60	63	64
• Waste water production (lpcd)	0	43	47	0	23	25	1	10	11

From the water demand and waste water production as seen in Table 5.1.1, conventional sewerage system cannot be justified for Aykel even by the year 2010. Therefore, the sanitary technologies envisaged for Aykel are on-site technologies such as drainage and waste water disposal pit.

5.1.1 Plan of Toilet Facilities

The sanitary technologies envisaged for Aykel 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 Aykel, sullage is presently being dumped in front of the households or along the streets. This poses a health risk if it is allowed to continue to be dumped everywhere.

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

(2) Dry Solid Waste

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

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

(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 Aykel 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. Proposed drainage facilities are indicated on Aykel Map or City Plan.

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 Aykel are too low to justify the installation of conventional sewerage system in Aykel. On account of this, the sanitary facilities proposed for Aykel are on-site sanitary technologies.
- Those households that do not have any toilet facilities in Aykel 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 Aykel 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 Aykel.
- 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 Aykel 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 Aykel for Target Years of 2005 & 2010 by Type of Water Services

Target Year	Households		
	HC	YC	PF
• 2005	210	360	2,340
• 2010	530	1,410	1,810

5.2.2 Estimate of Costs

(1) Capital Costs per Unit

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

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

- By the year 2005

  - All schools in Aykel will have, at least, VIP collective toilets.
  - The Aykel Hospital toilet facilities will be rehabilitated; and the clinic and possibly a health center will have VIP collective toilets.
  - Aykel 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 Aykel 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 Aykel for Year 2005

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• VIP collective toilets for schools	8	65,000	520
• VIP collective toilets for clinics and health centers	2	65,000	130
• VIP public toilet for market area and bus terminal	3	95,000	285
• 100% households with HC to have PF toilets	210	7,500	1,575*
• 75% households with YC to have VIP shared toilets or higher	270	15,000	4,050*
• 75% households with PF to have VIP toilets	1,755	2,000	3,510*
• Vacuum truck	1	250,000	250
• Refuse disposal truck	1	180,000	180
• Sludge dumping site	2	10,000	20
• Refuse disposing site	4	6,500	26
• Refuse collecting bins	40	250	10
Total			10,556
Excluding Households' (*)			1,421

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

Facilities	No	Unit Cost (birr)	Total Cost (1,000 Birr)
• 50% of households with HC to have flush toilets	265	7,500	1,988*
• 50% of households with YC to have VIP toilets or higher	705	3,000	2,115*
• 100% households with PF to have VIP toilets	1,810	2,000	3,620*
• Replacement of vacuum truck	1	250,000	250
• Replacement of refuse disposal truck	1	180,000	180
• Replacement of refuse collecting bin	50	250	13
Total			8,166
Excluding Households' (*)			443

(5) Total Operating and Maintenance Cost

Indicative operating and maintenance cost for sanitary facilities for Aykel 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	8	800	6.40
• VIP collective toilets for clinics and health centers	2	800	1.60
• VIP public toilet for market area and bus terminal	3	3,000	9.00
• Flush toilets for households with HC	210	1,250	262.50*
• VIP shared toilet for households with YC	270	400	108.00*
• VIP toilets for households using PF	1,755	300	526.50*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Sludge dumping site	2	2,000	4.00
• Refuse disposing site	4	2,500	10.00
• Refuse collecting bins	40	50	2.00
Total			946.00
Excluding Households' (*)			49.00

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	265	1,250	331.25*
• VIP or higher toilets for households with YC	705	1,000	705.00*
• VIP toilets for households using PF	1,810	300	543.00*
• Vacuum truck	1	7,500	7.50
• Refuse disposal truck	1	8,500	8.50
• Refuse collecting bins	50	50	2.50
Total			1,597.75
Excluding Households' (*)			18.50

(6) Summary of Costs

- Capital Costs

Year		Cost in 1,000 Birr (Total)	Excluding Households'
2005		10,556	1,421
2010		8,166	443
	Total	18,722	1,864

- Annual Operating & Maintenance Costs

Year		Cost in 1,000 Birr (Total)	Excluding Households'
2005		946.00	49.00
2010		1,597.75	18.50
	Total	2,543.75	67.50

5.3 Application of Sanitary Education Program

In line with the approach proposed in the Main report, additional suggestions were listed based on the findings of the field survey of Aykel. They were as follows:

Table 5.3.1 Sanitary Education Priorities in Aykel

Priority level	Type of Behavior	Blocks to Improved Practice
High	Piped water used always	Piped water not always available in sufficient quantities (Water Committee/WSS role) and not available when required by people (WSS role) at sites convenient for collection (WSS role). Water Committee not sufficiently supported to function effectively
High	Solid waste disposal in covered pits or burned	Sites not allocated for public waste disposal sites or not managed strictly (Municipality/Woreda role) Individuals must be informed of where they can dispose of waste (Municipality/Woreda role) and shown safe disposal techniques (CPP/all)
High	Waste water disposal in pits, drains or vegetable gardens	Drainage insufficient and disposal into drains not strictly managed (Municipality/Woreda role) Individuals must be informed of where they can dispose of waste water (Municipality/Woreda role) and shown safe disposal techniques (CPP/all)
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)
High	Handwashing after handling children's stools	Personal hygiene (women, boys and girls roles) made more easy by improving access to water and soap/ash nearer to latrine (women's role) and improving the status of such Behavior (All role)
Medium-High	Latrine coverage for all households	Latrine availability to be increased - Public Latrine construction and maintenance (Municipality/Woreda role) - Community/private latrine construction and maintenance (WSS/CPP/All role) easier with examples of low cost latrines/loans for latrines (WSS)
Medium-High	Latrine use by all household members	Where there is a latrine, not all household members use it. Use by all family members should be encouraged and status of latrine users promoted(CPP/All)
Medium-Low	Fly Control	Associated with climate but also related to solid and liquid waste disposal and excreta disposal (Municipality/Woreda /All role) Behaviors like covering of food and water pots during storage should be maintained (CPP/All)
Medium-Low	Access to Piped water	Improved access and level of piped water supply (WSS role) All use water but this depends mostly on opening times, location of supply sources and to a lesser extent to price (women/girls/boys roles)
Medium-Low	Kitchen utensils kept off the floor	Domestic hygiene (women's role) although facilitated by shelf or similar available in kitchen to keep utensils on (women and men's role) Construction of such shelves to be promoted (CPP)

* High priority for lowest income groups

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 31 m^3/day in 1995 to 290 m^3/day in 2000, 505 m^3/day in 2005 and 893 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 the existing Water Committee be elevated to the WSS status from 2000 onward. Also, it is proposed that sanitation functions be introduced 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.

When Water Committee is elevated to WSS in 2000, committee members and contract workers will basically become permanent employees.

Considering the above factors, it is proposed that the number of employees will increase from 13 in 1995 to 18 in 2000, 22 in 2005 and 31 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 16, 19 and 27 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 comprised 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)	31	290	505	893
2. Water Production per Worker (m^3/day/worker)	2.4	20	30	40
3. Coefficient	1	1.1	1.1	1.2
4. No. of Personnel	13	16	19	27
5. Additional Personnel for Sanitation	0	2	3	4
6. Final No. of Personnel	13	18	22	31

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	0
3. Internal Audit	1	1	1	1
4. Administration Service				
1) Head	0	0	0	0
2) General Administration Section				
Secretaries/Typists/Clerks	1	1	1	1
Guards	2	2	3	4
Sweepers/Janitors	0	0	0	0
Drivers	0	0	0	1
Sub-Total	3	3	4	6
3) Personnel Section				
Recruitment and Assignment	0	0	0	0
Training	0	0	0	0
Remuneration	0	0	0	0
Sub-Total	0	0	0	0
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	4	4	5	7

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

Positions/Functions	1995	2000	2005	2010
5. Financial Service				
1) Head	0	0	0	0
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	0	0	0	1
Bill Distributors/Collectors	0	0	0	1
Water Sellers	4	4	5	4
Sub-Total	4	4	5	6
Total	6	6	7	9
6. Technical Service				
1) Head	0	0	0	0
2) Technical Records Section	0	0	0	0
3) Operation and Maintenance Section				
Mechanics	0	0	0	1
Electricians	0	0	0	1
Motor Operators	1	4	4	4
Plumbers	0	0	0	1
Sub-Total	1	4	4	7
4) Inspection Section				
Water Meter Technicians	0	0	0	1
Leakage Detectors	0	0	0	0
Water Quality Analysts	0	0	1	1
Sub-Total	0	0	1	2
5) Workshop	0	0	0	0
6) Works Section				
Contracting	0	0	0	0
Designing/Drafting	0	0	0	0
Sub-Total	0	0	0	0
Total	1	4	5	9
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	1	1
Drivers	0	0	0	1
Sub-Total	0	0	1	2
Total	0	2	3	4
Grand-Total	13	18	22	31

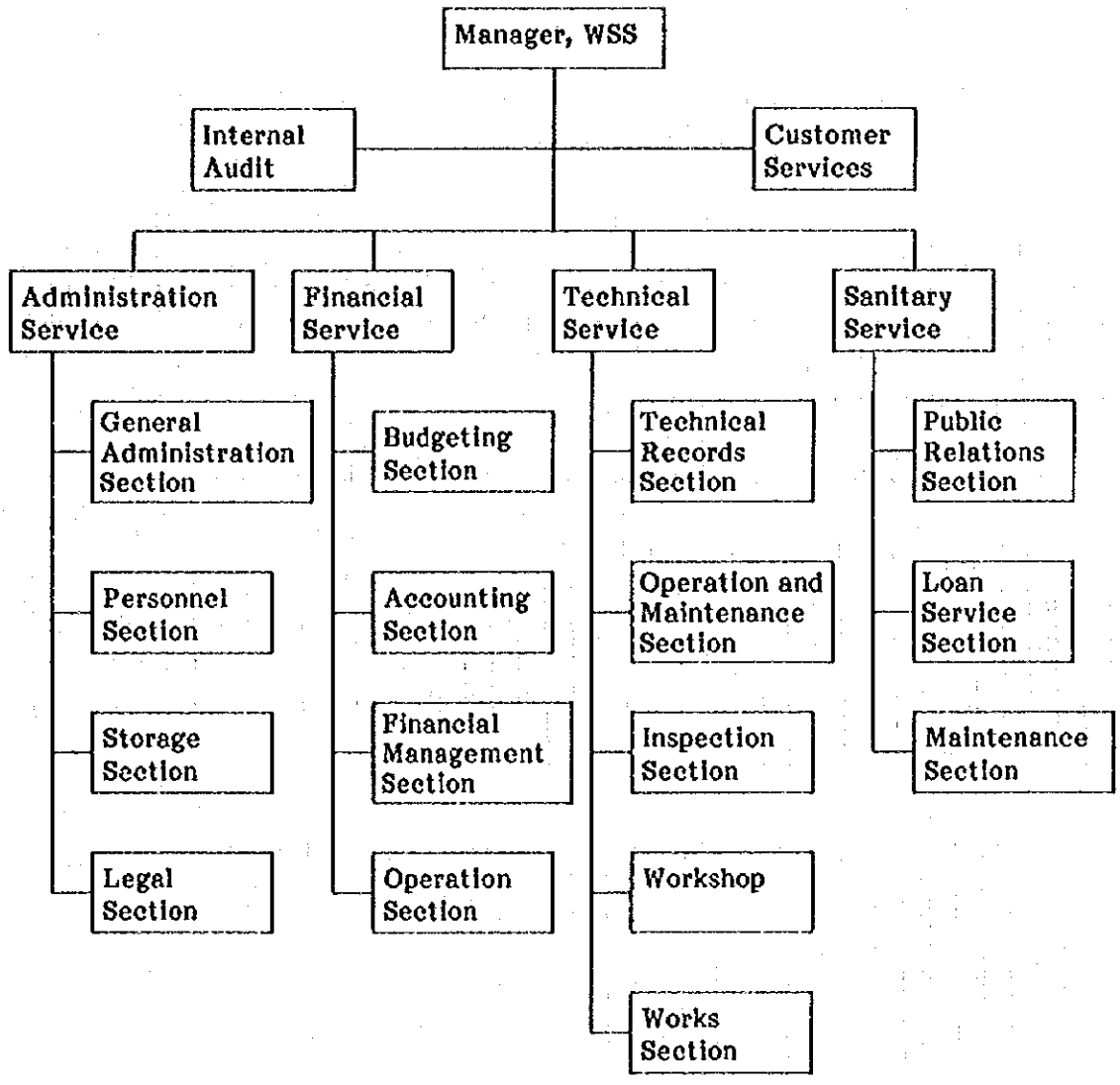


Figure 6.1.1 Proposed Model Organization Set-up of WSS

6.4 Community Building / Participation and WID

In line with the approach outlined in the Main report, the following specific suggestions have been made in relation to Aykel, in light of the field survey work:

- WSSA to take a more active role in supporting the water committee in their role as managers of the water supply scheme and including the technical aspect. Women to be encouraged to participate actively on the water committee and as maintenance caretakers of piped water points, including technical and management trainings.

- Functional public fountains with longer service time, to be incorporated. Women, girls and boys to be consulted on locations of water points and opening times required. This was most likely to be early mornings every day of the week.

- Private connections with adequate service time to be supplied to those who can afford them. Attention should be given to prioritize connections to poorer households and to female headed households.

- Public latrine (not pour flush) to be provided with shower and hand washing facilities in the center of town with some mechanism for ensuring the sanitary operation and maintenance of this facility. Income from the shower should provide enough money to finance the cleaning of the latrines by male and female official cleaners. This facility should be located in a place affording as much privacy as possible to ensure it's use by women.

- Community latrines mostly with water for handwashing in areas where people were living in rented Kebele housing. Women in particular should be consulted on the siting, use and selection of the facility.

- WSS/CPP to support existing health education through a coordination body linking the Church, Health Center, School and the Water Committee. This should also include the remit to include the Mosque and possibly NGOs like WaterAid who have an office in the town.

- Provision of budget for sanitary education work in the town, including a series of materials already prepared in Ethiopia and copies of the Study's sanitation education manual.

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	84	2.1	1.3
Springs/rivers	126	2.0	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 2% 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
182	5.5	16	0.0689

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 multipier 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 4,023 thousand birr and 5,788 thousand birr respectively. It means benefits are 144% 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 by 44% more 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, considerably surpassing personnel cost of WSS.

Table 7.1.1 Saved Time and Benefit

Year	Saved Time (hours)	Benefit (birr)
1996	0	0
1997	0	0
1998	0	0
1999	340,338	23,463
2000	645,124	44,474
2001	863,334	59,518
2002	1,095,980	75,556
2003	1,343,803	92,641
2004	1,607,574	110,825
2005	1,888,011	130,158
2006	2,285,441	157,557
2007	2,697,761	185,982
2008	3,125,654	215,481
2009	3,569,837	246,102
2010	4,031,056	277,899
2011	4,031,056	277,899
2012	4,031,056	277,899
2013	4,031,056	277,899
2014	4,031,056	277,899
2015	4,031,056	277,899
2016	4,031,056	277,899
2017	4,031,056	277,899
2018	4,031,056	277,899
2019	4,031,056	277,899
2020	4,031,056	277,899
2021	4,031,056	277,899
2022	4,031,056	277,899
2023	4,031,056	277,899
2024	4,031,056	277,899
2025	4,031,056	277,899

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	91	91	23	-67
5	2000	0	96	96	44	-52
6	2001	0	101	101	60	-41
7	2002	0	105	105	76	-30
8	2003	0	110	110	93	-17
9	2004	0	114	114	111	-3
10	2005	0	118	118	130	12
11	2006	0	129	129	158	29
12	2007	0	139	139	186	47
13	2008	0	149	149	215	66
14	2009	0	159	159	246	87
15	2010	0	170	170	278	108
16	2011	0	170	170	278	108
17	2012	0	170	170	278	108
18	2013	0	170	170	278	108
19	2014	0	170	170	278	108
20	2015	0	170	170	278	108
21	2016	0	170	170	278	108
22	2017	0	170	170	278	108
23	2018	0	170	170	278	108
24	2019	0	170	170	278	108
25	2020	0	170	170	278	108
26	2021	0	170	170	278	108
27	2022	0	170	170	278	108
28	2023	0	170	170	278	108
29	2024	0	170	170	278	108
30	2025	0	170	170	278	108

7.2 Financial Evaluation

7.2.1 Calculation of FIRR

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

(1) Initial Trial

Initially it was assumed that the central government would provide subsidy to the Aykel 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 turned out that FIRR cannot be worked out because cumulative cost is greater than cumulative benefits.

The over-sized cost is mainly attributed to an expensive electricity cost in O & M cost.

After repeated simulations, it was finally decided that the subsidy ratio of initial cost would be 100%.

(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 6.1% was obtained.

The value exceeds 1%, which is the assumed interest rate of external loan by 5.1%. 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: 3.4%	-2.7%
2. Case 2	Initial Cost : +10%	FIRR: 5.6%	-0.5%
3. Case 3	Progress of : 1997=70% Construction 1998=30%	FIRR: 6.5%	+0.4%
4. Case 4	Progress of : 1998=70% Construction 1999=30%	FIRR: 5.8%	-0.3%

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 feasibility of the Project, followed by cost overrun and the delayed progress of works, 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	0	20	20	45	25
2	1997	688	20	708	46	-662
3	1998	688	21	708	47	-661
4	1999	0	192	192	109	-83
5	2000	0	210	210	184	-26
6	2001	0	275	275	230	-45
7	2002	0	291	291	265	-26
8	2003	0	306	306	299	-7
9	2004	0	321	321	334	12
10	2005	0	337	337	368	31
11	2006	0	443	443	452	9
12	2007	0	473	473	517	44
13	2008	0	504	504	583	80
14	2009	0	534	534	649	115
15	2010	0	564	564	714	150
16	2011	0	411	411	678	267
17	2012	13	411	423	678	255
18	2013	13	411	423	678	255
19	2014	0	411	411	678	267
20	2015	0	411	411	678	267
21	2016	0	411	411	678	267
22	2017	0	411	411	678	267
23	2018	0	411	411	678	267
24	2019	0	411	411	678	267
25	2020	0	411	411	678	267
26	2021	0	411	411	678	267
27	2022	0	411	411	678	267
28	2023	0	411	411	678	267
29	2024	0	411	411	678	267
30	2025	0	411	411	678	267