Chapter 4 Design Criteria of the Project

4.1 Water Resources Development

4.1.1 Groundwater Development

Excluding Dupti and Bure, groundwater of deep aquifers is the most suitable water resource to be developed since water is potable without treatment. Principally, the safe yield i.e. the quantity of ground water which can be extracted from the target aquifers is determined from the water balance analysis for the aquifers. The recharge to the aquifers can be estimated from the water balance analysis for surface water. However, it is difficult to estimate the groundwater which goes out from the aquifer to downstream areas and to deeper aquifers because of insufficient data with the aquifers.

In this Study, the safe yield concept is approximated in such a way that safe yield is limited to the quantity of recharge estimated in an average year. However in the Abisinian plateau, since watershed area for well is very small, this approximation cannot avoid overpumping because of:

- Groundwater flow to the downstream area is not negligible, and
- Groundwater stored in the aquifer is very much limited. In the dry season, the static water level will be lowered significantly by pumping.

For such watersheds, the criterion is newly adopted; namely, recharge in drought period (5 year in return period) is to be the maximum for the safe yield. This criterion is applied for Bati, Aykel, Debre Tabor, Nefas Mewcha, Bure, Bichena and Dejen, those of which have relatively small watershed areas ranging from 1 to 5 km^2.

(1) Optimal Yield of the New Wells

The target aquifers, which are consisted of basalts probably fractured by faults and weathered except for Dupti, are identified by linearment analysis. The yield hydraulically optimal to the well (optimal yield) depends on the degree of fracturing and weathering which is represented by permeability in hydraulics. It also depends on the thickness of the aquifer. For Dupti, the target aquifers are consisted of alluvium such as sand and silt with gravel layer and gravel and sand layer.

The following permeability categorized with geologic lithology representing the major aquifers is adopted for the design.

Table 4.1.1 Design Permeabilities of Aquifers

Lithology	Centers	Permeability
Fractured and/or Weathered Basalt	All centers except for Dupti	1 m/day
Sand and Silt with Gravel	Dupti	4 m/day
Gravel and Sand	Dupti	20 m/day

The permeability of fractured and/or weathered basalt is an average value of the pumping test results reported by the drillers. The permeability of sand and gravel aquifer in Dupti is obtained from the pumping test results of the WSS borehole No. 1. The permeability of sand and silt with gravel aquifer is estimated from the composition and the loose character of the aquifer.

The optimal yield will be calculated with the following formula.

$$Qopt = 2\pi \cdot K \cdot H \cdot Sd \cdot Ew / \ln\left(\frac{R}{rw}\right)$$

where, Qopt: Optimal Yield
π: 3.14
K: Permeability
H: Thickness of Aquifer
Sd: Design Drawdown
Ew: Well Efficiency
R: Radius of Cone of Depression
rw: Radius of Well

Pumping tests were conducted in Bati and Bure and resulted as follows.

Table 4.1.2 Results of Pumping Tests

		Bati Well No. 5	Bure Baguna Well
Optimal yield	(m^3/day) (l/s)	135 1.56	330 3.82
Drawdown	(m)	12.0	11.31
Aquifer Loss	(m)	9.5	8.91
Well Loss	(m)	2.55	2.40
Well Efficiency		0.79	0.79
Transmissivity	(m^2/day)	18.9	48.9
Permeability	(m/day)	0.45	2.26
Allowable Drawdown	(m)	24.0	22.6

For the design of optimal yield of the proposed wells, the well efficiency is assumed at 0.8 referring the results. Radius of cone of depression is calculated only for Bati because an observation well was not engaged in Bure. The radius is calculated at 55m using the Thiem-Dupuit formula, which is extremely small. For the design, the radius of cone of depression is assumed to be 300m at minimum considering the aquifers composed of alluvium. According to the formula, the yield of the well does not vary much depend on the radius. Taking the ratio of yield at 1.0 for the radius of 300m, the ratio is 1.14 for 150m and it is 0.89 for 600m.

The design drawdown for the proposed deep wells is fixed at 20m considering pessimistic situations rather than the aforementioned tested wells. For the shallow wells in Dupti, the design drawdown is fixed at 10m considering the depth of the aquifer.

(2) Optimal Yield of the Existing Wells

According to pumping tests analysis for the wells in Bati and Bure, the optimal yield of the wells were resulted at 40 - 90 % of the safe yield reported by the drillers. There are many reasons thought for this such as deterioration of screen (clogging), rough step drawdown test, poor analysis on step drawdown test etc. Being based on this fact, the optimal yield of the existing wells are to be estimated with the well efficiency of 0.4.

4.1.2 Spring Development

In general, the low-water flow in an average year which is 355 day flow in probability is considered to be the minimum intake rate for the design. And, the average yield of rainy season is the maximum intake rate.

The spring near Edget Behibret elementary school in Bure is an exception because the spring forms a pond gushing at the bottom. Since it is difficult to intake all the yield, the intake rate is reduced to 50 % of the above criteria.

4.1.3 Surface Water Development

In Bure, Manzana Stream is an option to be developed by means of weir. The minimum required flow after exploitation of the water can be considered to be nil because there is no water use at the downstream and another tributary fosters the stream at only 100 m downstream of the proposed site. The intake rate is designed at less than the low-water flow in an average year. The capacity of the spillway is to be more than three times as much as the maximum discharge observed during the Study period.

4.2 Water Demand Projection

4.2.1 Population Projection

(1) Past Population and Its Growth

The government of Ethiopia conducted the first national population census in 1984. In October 1994, the second national population census was taken. However, the results of the latter are not yet published.

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

CSA published population estimates for the intermediate years between 1984 and 1993, however they are not solidly based. In 1993 to 1994, CSA conducted the nation-wide cartographic census using its own expert staff. The census was done before the second population census. According to CAS, the results of the cartographic census are more dependable than those of the second population census.

The population in 1974, 1984 and 1993/1994 is shown for each of the Eleven Centers in Table 4.2.1. The population in 1974 is not a dependable one, therefore it is just for reference. The centers with no 1974 figures are those whose population was estimated to be less than 2,000 in that year. The population in 1984 and 1993/1994 is solidly based on a consistent manner. It is reasonable, therefore, to use the average annual growth rates between the two years as a basic material to project future population. They are shown for the Eleven Centers in the same table. They vary from 3% to 8%.

(2) Population Projection

Regarding the 1995 population, it was basically estimated using the 1984 to 1993/1994 average annual growth rate as mentioned above. However, the Study Team has collected the 1994 population census figures for Bati, Werota, Aykel and Chagni although they are preliminary ones. The Team adopted them as the 1995 population. For Dupti, WSSA estimates and for Mille water consumption census figures were adopted. The reasons are explained in the Feasibility Study Report for the two centers. These population estimates are shown in Table 4.2.1.

Regarding the projection of population from 1996 onward, it was done based on the average annual growth rate 1984 to 1993/1994 for all Eleven Centers. The population growth between 1974 and 1984 was also considered for the centers where such data are available. Further, socio-economic conditions for each of the towns were taken into account.

The more a project is long-term, the more the uncertainty increases regarding the projection. Therefore, one should be more cautious and conservative for a longer-term projection. Also, rural centers had been concentrated with population influx due to drought or other factors in the past, leading to high population growth. The population growth could be expected to be stable as the situation becomes stable. In line with this reasoning, the average annual growth rate was basically dropped by 0.5% every five years. For Chagni, the rate was cut by 1% every five years because the past population growth of the center has been quite rapid, reaching the top among the Eleven Centers in 1995 and it was considered that constraining factors such as population density will work more as years go by. Also, the average annual growth rate for the population of Dejen was estimated to be 3% for 10 years from 1995 to 2005. It is because the population growth of the center is the slowest among the centers concerned, but one does not find any immediate factors that will hasten a further slowing of the growth.

The projected population in 2000, 2005 and 2010 is shown for each of the Eleven Centers in the following table.

Table 4.2.1 Population Projection

1. Past Population and Its Growth

Towns	1974 CSA	Growth Rate	1984 PC	Growth Rate	1993/94 CC
Dupti	-	-	8,995	5.06%	14,737 (WSSA)
Mille	-	-	1,169	8.80%	2,716 ('94)
Bati	9,570	0.29%	9,852	3.55%	13,970 ('94)
Werota	4,810	6.40%	8,941	6.46%	15,707 ('93)
Aykel	-	-	4,804	5.89%	8,517 ('94)
Debre Tabor	10,600	3.69%	15,226	4.83%	23,273 ('93)
Nefas Mewcha	2,820	8.41%	6,323	7.30%	11,922 ('93)
Chagni	-	-	8,586	8.26%	18,992 ('94)
Bure	7,440	0.97%	8,191	5.49%	13,250 ('93)
Bichena	-	-	7,951	5.70%	13,094 ('93)
Dejen	4,700	4.41%	7,239	3.21%	9,622 ('93)

2. Projection of Population

Towns	1995	Growth Rate	2000	Growth Rate	2005	Growth Rate	2010
Dupti (WSSA)	14,737	5.0%	18,809	4.5%	23,439	4.0%	28,517
Mille (JC)	3,902	8.0%	5,733	7.5%	8,230	7.0%	11,543
Bati (PC)	14,354	3.5%	17,048	3.0%	19,763	2.5%	22,360
Werota (PC)	21,845	6.0%	29,234	5.5%	38,208	5.0%	48,764
Aykel (PC)	11,718	5.5%	15,315	5.0%	19,546	4.5%	24,258
Debre Tabor (CC)	25,575	4.5%	31,871	4.0%	38,776	3.5%	46,054
Nefas Mewcha (CC)	13,726	7.0%	19,251	6.5%	26,376	6.0%	35,297
Chagni (PC)	26,823	6.0%	35,895	5.0%	45,812	4.0%	55,737
Bure (CC)	14,745	5.0%	18,819	4.5%	23,452	4.0%	28,533
Bichena (CC)	14,629	5.5%	19,120	5.0%	24,403	4.5%	30,411
Dejen (CC)	10,250	3.0%	11,883	3.0%	13,776	2.5%	15,586

Notes: CSA = Forecast by Central Statistical Authority
Growth Rate = Annual average growth rate
PC = Population Census
CC = Cartographic Census
JC = JICA Census (Water Consumption Census)

4.2.2 Water Demand Projection

(1) Target Percentage of Population Served

100% of the population at the target years basically shall access the water supply system including traditional water source such as hand-dug well and spring. The percentage of population served by the piped water is estimated as follows, ranging from 75% to 100%, taking current coverage rate of piped water into account. The water supply in the Center which is not served by the piped water with the rate of 100% is to be supplemented in combination with the traditional water sources.

Table 4.2.2 Target Percentage by the Piped Water at Target Year 2010

Center	Target rate (%)	Current rate (%)
Dupti	100.0	45*
Mille	100.0	97
Bati	95.0	87
Werota	100.0	96
Aykel	85.0	71
Debre Tabor	75.0	34
Nefas Mewcha	100.0	93
Chagni	75.0	46
Bure	95.0	83
Bichena	85.0	67
Dejen	95.0	83
Average	91.0	68

* Although the current rate is very low in Dupti, the target rate has to be set at 100% because of no alternatives other than Awash river.

(2) Water Demand

Water demand in each center is calculated by adding the followings:

- Domestic demand (m^3/day)
- Non domestic demand (m^3/day)
- Unaccounted losses (m^3/day)

(3) Domestic Demand

(a) Service Mode

Service mode for the projection of water demand is categorized in the following three modes as referred to the present situation:

- House connection,
- Yard connection, and
- Public fountain

Generally, yard connection in Ethiopia is subdivided into yard connection and neighborhood connection. In this Study, neighborhood connection is accounted to be yard connection for the purpose of water demand projection, because neighborhood connection is regarded as unexpected one which was introduced due to insufficient connections.

(b) Demand by Service Modes

Generally, the present demand consists of drinking, food preparation and cooking, cleaning, washing, ablution, etc. Based on the water census survey the current demand with the different mode is summarized below.

Table 4.2.3 Domestic Demand Censused

Center	Domestic Use (lpcd)		
	HC	YC	PF
Dupti	-	51	33
Mille	83	52	32
Bati	57	47	26
Werota	33	32	24
Aykel	-	-	15
Debre Tabor	31	28	24
Nefas Mewcha	38	27	22
Chagni	64	27	23
Bure	25	23	16
Bichena	27	20	18
Dejen	57	22	17
Average	46	33	23
Actual Consumption	43	20	4
WSSA Guideline	60	35	15

With reference to above table, followings are obtained:

- The demand for household connection ranges 27 lpcd to 83 lpcd and the average among Eleven Centers is 46 lpcd. The average is lower than that of WSSA guideline value 60 lpcd, because the demand may be conservative under situation of insufficient water.

- The demand for yard connection ranges from 20 lpcd to 52 lpcd, while the average is 35 lpcd which is almost same as WSSA guideline value.

- The demand for public fountain ranges 15 lpcd to 33 lpcd and the average is 23 lpcd. This average is higher than that of WSSA guideline value 15 lpcd. However, as long as water is fetched from public fountain, the supply per household member could not exceed 15 liter per day.

Based on above, WSSA recommendation values seem to be reasonable ones and water users whose demand is over the recommendation values are expected to shift the upper mode. Also, house connection users could be expected to consume more water than their current demand when ample water is realized.

Thus, the typical demand by modes is to follow WSSA recommendation value in this Study, and be adjusted with reference to the current consumption, climatic condition and time elapse after completion of the Project.

(c) Change of Service Mode

The percentage of population by service modes will also vary according to the time. The percentage composition at year 2010 is estimated based on payable amount, which is about 4% of household income based on the recommendation by the World Bank, of each service mode (refer to "8.2 Proposed Water Tariff"), and the composition is to vary progressively from the current composition.

(4) Non-Domestic Demand

Non-domestic demands by category are given in Table 4.2.4, and those are summed up by the three categories for the projection; namely, institutional, commercial and industrial. Institutional demand is projected with the population growth rate, and commercial and industrial demands are projected with economic growth rate which is to be the population growth rate plus 3%.

Table 4.2.4 Various Non-Domestic Demands

Category	Day demand	Category
School	5 l/pupil	Institutional
Hospital, Health Center	20 l/staff	-do-
Hotel, Eatery, etc.	100 l/bed	Commercial
Bar, Tea shop	200 l/bar	-do-
Mosque	5 l/visitor	Institutional
Office	5 l/person	Institutional

Note: No major industry exists in Eleven Centers.

(5) Unaccounted Losses

Unaccounted losses are generally divided into three; namely, leakage, illegal use and flushing use. According to the data on water production/consumption, the current unaccounted losses range from 10% to 48% of the total production. In this Study, unaccounted losses at the years of completion of the project and 2010 are proposed at 10% and 15% of total water demand, respectively. Unaccounted losses increase linearly from 10% at the year of completion to 15% at the Year 2010.

Table 4.2.5 Current Unaccounted Losses

Center	Unaccounted losses (%)	Production m^3	Consumption m^3
Dupti	29	90,925	73,699
Mille	26	74,875	68,575
Bati	42	207,112	118,896
Werota	21	121,240	95,068
Aykel	N.A.	N.A.	7,922
Debre Tabor	48	20,210	12,278
Nefas Mewcha	29	72,640	51,246
Chagni	35	158,343	102,867
Bure	21	128,500	101,509
Bichena	10	45,429	40,455
Dejen	12	84,365	74,130

Note: The data is from May 1993 to April 1995.

(6) Fire Demand

Water demand for fire fighting is provided as a reserve of 10% of the service reservoir volume.

(7) Maximum Day Demand

The water consumption through a year varies from day to day. The maximum day demand is the highest demand in a day of specific year. The data concerned with the maximum day demand is not recorded by WSS office. Therefore, the factor to be adopted is based on the factors used in similar projects in Ethiopia and given in the following table.

Table 4.2.6 Maximum Day Demand Factor

Project	Factor
34 Towns W.S.	1.4
12 Towns W.S.	1.1-1.2
2 Towns W.S.	1.4
5 Towns W.S.	1.2

Taking the seasonal difference into account, the factor of 1.5 is proposed in Mille and Dupti, and the factor of 1.2 in the remaining nine centers.

(8) Peak Hour Demand

Peak hour demand can be obtained from following formula:

$Qh = K \times Qd / 24$

Where, Qh : Peak hour demand
K : Peak hour factor
Qd : Maximum day demand

The peak hour factor is greatly influenced by the people's living standard, service mode, population size and the scale of the water supply system. In case the water supply is stable and sufficient, the factor ranges from 1.1 to 4 in general.

The factor of 2.0 is proposed for Mille, which population is the smallest among Eleven Centers, and the factor of 1.6 for the remaining 10 centers.

4.3 Water Supply System

4.3.1 Utilization of the Existing Facilities

Utilization of the existing facilities in the Eleven Centers is firstly proposed in order to reduce the initial project cost. The utilization criteria shall be based on the following factors:

- the age and condition of the existing facilities,
- the capacity of the existing facilities, and
- the compatibility of the existing facilities.

4.3.2 Power Supply for Water Supply Facilities

Hydroelectricity will be utilized for the power source of water supply facilities in Bati, Debre Tabor, Werota, Bichena and Bure where hydroelectricity is available, and also stand by generator is to be provided for the emergency case. In other centers where hydropower is not available such as Dupti, Mille, Aykel, Nefas Mewcha, Chagni and Dejen, on-site generator will be adopted, and standby generator will be facilitated in Mille and Chagni which are not specifically scheduled for being extended hydropower.

4.3.3 Water Source

Water source will be secured from spring, groundwater, and surface water from the viewpoint of water availability, water demand, water quality, simplicity of operation, and reduction of recurrent cost.

In case that treatment plant is required due to water turbidity, the source shall be adequate to meet the 130% maximum day demand, considering the consumption for washing filter. On the other hand, the source shall meet the 120% maximum day demand as far as the water quality is within the WHO's water quality guideline.

(1) Groundwater

Groundwater is to be developed stage by stage. Boreholes shall be developed within a well-field as much as possible from the economical point of view.

(2) Surface Water

Intake facility for surface water and spring will be designed for the maximum day demand of the Year 2010, while raw water pumps will be designed for the maximum day demand of the Year 2005. Beside the raw water pumps, standby pump shall be provided.

Treatment plant, where required, will be designed for the maximum day demand of the year 2005 and expanded in the Year 2010. The consumption for washing filters will be added to the volume of production.

4.3.4 Pumping Station

Pumping and boosting stations will have a standby pumping facility with 100% capacity. The pumping station is to be located at the nearest place of borehole in order to maintain efficiency of the generating facilities.

4.3.5 Rising Main

In order to keep the optimum pressure condition, any connection onto the rising main shall not be accessed. The rising main will be designed for the maximum day demand of the Year 2010.

4.3.6 Distribution System

Distribution system will be basically such that the distribution can be done by gravity. The system generally consists of primary, secondary, and tertiary distribution mains, and will be of looped-network.

The primary and secondary mains are to be included in this Project in two target years of 2005 and 2010 in keeping pace with expansion of the center, while the design is made to meet the peak hour demand in the Year 2010.

4.3.7 Pipeline

(1) Location and Depth

Pipeline, particularly main, will be routed along the existing roads as well as ones shown in the town master plan. Marker will be placed where pipelines exceed the developed area.

Distribution pipelines will be laid with a minimum depth of 600 mm from the ground surface.

(2) Velocity

The maximum velocity of the flow will be 2.5 m/s, and the minimum velocity will be 0.6 m/s.

(3) Pressure

The minimum pressure in the distribution network shall not be less than 15 meters manometric head, while the maximum pressure shall not be above 50 meters manometric head.

(4) Pipe Material

Pipe material is depending on the marketability. It is expected that the majority will be of SP, PVC and FRP, and JIS or ISO will be adopted in this Study.

4.3.8 Reservoirs

The storage volume of service reservoir and elevated tank will be provided for one-third of the day demand of the Year 2005. In addition, the reservoir and the tank will be provided to meet the requirement of fire hydrants for a duration of two hours.

4.3.9 Public Fountain

Public fountain will be located within 200 m to 300 m walking distance in high population density area and about 500 m walking distance in population scattered area.

Five to Six faucets will be supplied in one public fountain, and one fountain is to be provided for about 200 households who are not served by any individual service connection. The design will be made so that people can carry clay pot on their back or put on their cart more easily comparing to existing ones.

4.3.10 Fire Hydrants

Fire hydrant shall be installed at selected public places such as school, health center, etc. and at low point of distribution network as well.

4.3.11 Controls and Metering

Controls for water supply system will be manually operated, except where automatic controls are the only alternatives.

- Manual Operation
  - Switching on and off of pumps
  - Pipeline valves

- Automatic Operation
  - Shut down of pump due to low water level or low flow
  - Shut down of motor due to low voltage or electric interruption

4.3.12 Location of Flushing Devices and Valves

Flushing devices will be provided at the low points of rising main and distribution network.

Valve chamber will be provided at major pipe junctions in order to ensure flexible operation in case of system breakdown. Also, air valve will be provided at specific point, where necessary.

4.3.13 Flow Measurement

In order to ensure effective water supply management, flow measurement will be provided at certain point in pumping station, house connection, yard connection, public fountain, and etc.

4.3.14 Water Quality

The raw water source shall be free from any contamination. The quality of treated water shall be comply with the drinking water guideline values recommended by WHO.

4.3.15 Target Year and Life-Span

The components of water supply system are designed to cover the target year of either 2005 or 2010. The expected life-span of the water supply facilities varies according to the specification employed, material, type of civil work and type of mechanical/electrical work. The design target year and the expected life-span of the facilities are summarized in Table 4.3.1.

Table 4.3.1 Target Year and Life-Span

Component	Target Year	Expected Life-span (years)
Intake facility	2010	40
Well	2005	30
Spring collection chamber	2005	30
Pump	2005	25
Generator	2005	25
Treatment facility	2005	30
Disinfection system	2005	10
Clear water pump	2005	25
Rising main	2010	-
Reservoir	2005	40
Elevated tank	2005	30
Distribution main	2010	-
FRP pipes	-	40
PVC & Steel pipes	-	30
Buildings	-	30
Public fountain	-	30

4.4 Drainage and Sewerage Projections

Waste water flow data is non-existent in all centers. Since Water Supply has a major relationship in the production of waste water, waste water estimate is made from the

available water supply data. Other factors that need to be considered that affect the water use are:

- climate,
- size of the community,
- density of development,
- dependability and quality of water supply,
- extent of metered water services, and
- the economic situation

The components that make up the waste water flows may include waste water discharges from:

- residential areas,
- commercial areas,
- institutions, and
- water using other sources

For domestic purposes, water is put to the use of drinking, washing, laundry, bathing, toilets, faucets, leakages etc. which produce the corresponding waste water. Therefore, in the estimation of waste water production, the generation rate from each of the above components has to be considered. Since the water supply data itself is very meager and data on other factors scarce, the waste water estimated figures are only indicative. Table 4.4.1 shows waste water production estimate per capita per day based on per capita water demand. In estimating waste water production, such generation rates raging from 0.6 to 0.8, depending on water supply service mode, have been adopted.

Tables 4.4.2 and 4.4.3 show waste water production for domestic water for the target years of 2005 and 2010 in each center, while Table 4.4.4 shows the ones for non domestic water.

Based on those tables, waste water projected is summarized in Table 4.4.5, which consists waste waters from both domestic and non domestic. The waste water is not large in the volume, ranging from about 200 to 900 m^3 per day in year 2005 and from about 500 to 1,500 m^3 per day in year 2010 per center.

Conventional sewerage is one of the sanitation alternative that should be considered in communities when the situation calls for it. However, the sewer system is very expensive to construct; namely, they require skilled people, well-organized and well-staffed municipal organization for the operation and maintenance, and they are not suitable if water supply is limited because they are liable to block.

Based on the above projected waste water, conventional sewerage system is not required to Eleven Centers other than drainage facilities accompanied with waste water disposal pit (sullage disposal pit). This drainage also works for the purpose of draining rain water and keeping free from stagnant water.

Table 4.4.1 Water Demand in lpcd and Waste Water Production in lpcd

Center	HC			YC			PF			Unit
	1995	2005	2010	1995	2005	2010	1995	2005	2010	
1. Dupti										
WD	0	71	77	30.8	42	45	6.7	18	20	lpcd
WWGR	0	77	78	66	70	70	60	63	64	%
WWP	0	55	60	20	29	31	4	11	13	lpcd
2. Mille										
WD	83.4	71	77	29.3	42	45	6.8	18	20	lpcd
WWGR	81	77	78	66	70	70	60	63	64	%
WWP	67	55	60	19	29	31	4	11	13	lpcd
3. Bati										
WD	49	65	70	26	38	41	6	16	17	lpcd
WWGR	71	75	77	65	68	69	60	63	64	%
WWP	35	49	54	17	26	28	4	10	11	lpcd
4. Werota										
WD	28.6	58	63	19.1	34	37	1.5	15	16	lpcd
WWGR	66	74	75	64	67	68	60	63	63	%
WWP	19	43	47	12	23	25	0.9	9	10	lpcd
5. Aykel										
WD	0	58	63	0	34	37	2.3	16	17	lpcd
WWGR	0	74	75	0	67	68	60	63	64	%
WWP	0	43	47	0	23	25	1	10	11	lpcd
6. D/Tabor										
WD	16	58	63	4.2	34	37	2.3	15	17	lpcd
WWGR	63	74	75	60	67	68	60	63	64	%
WWP	10	43	47	2	23	25	1	9	11	lpcd
7. N/Mewcha										
WD	38.1	58	63	14.8	34	37	1.6	15	16	lpcd
WWGR	68	74	75	63	67	68	60	63	63	%
WWP	26	43	47	9	23	25	1	9	10	lpcd
8. Chagni										
WD	63.8	58	63	15.1	34	37	4.9	19	21	lpcd
WWGR	75	74	75	63	67	68	60	64	64	%
WWP	49	43	47	9	23	25	3	12	13	lpcd
9. Bure										
WD	23.6	58	63	20.5	34	37	4.6	15	16	lpcd
WWGR	65	74	75	64	67	68	60	63	63	%
WWP	15	43	47	13	23	25	3	9	10	lpcd
10. Bichena										
WD	26.4	58	63	14.7	34	37	4.7	19	21	lpcd
WWGR	66	74	75	63	67	68	60	64	64	%
WWP	17	43	47	9	23	25	3	12	13	lpcd
11. Dejen										
WD	5	58	63	17	34	37	5	18	20	lpcd
WWGR	60	74	75	64	67	68	60	63	64	%
WWP	3	43	47	11	23	25	3	11	13	lpcd

WD - Water Demand, lpcd
WWGR - Waste Water Generation Rate, %
WWP - Waste Water Production, lpcd

Table 4.4.2 Waste Water Production by Type of Water Service in Target Year 2005

Center	HC	YC	PF	Total WWP in m^3
1. Dupti				
proj. pop.	4,781	8,930	7,005	
wwplpcd	55	29	11	
wwp (m^3)	263	259	77	599
2. Mille				
proj. pop.	1,078	3,497	3,655	
wwplpcd	55	29	11	
wwp (m^3)	59	101	40	141
3. Bati				
proj. pop.	3,061	9,730	7,725	
wwplpcd	49	26	10	
wwp (m^3)	150	253	77	480
4. Werota				
proj. pop.	3,859	15,397	18,952	
wwplpcd	43	23	9	
wwp (m^3)	166	354	171	691
5. Aykel				
proj. pop.	1,172	1,954	12,867	
wwplpcd	43	23	10	
wwp (m^3)	50	45	129	224
6. D/Tabor				
proj. pop.	3,567	12,563	9,537	
wwplpcd	43	23	9	
wwp (m^3)	153	289	86	528
7. N/Mewcha				
proj. pop.	1,899	6,725	17,411	
wwplpcd	43	23	9	
wwp (m^3)	82	155	157	394
8. Chagni				
proj. pop.	3,252	14,980	13,477	
wwplpcd	43	23	12	
wwp (m^3)	140	345	162	647
9. Bure				
proj. pop.	2,743	7,926	11,060	
wwplpcd	43	23	9	
wwp (m^3)	118	182	100	400
10. Bichena				
proj. pop.	3,538	8,492	7,714	
wwplpcd	43	23	12	
wwp (m^3)	152	195	93	440
11. Dejen				
proj. pop.	1,418	5,166	6,175	
wwplpcd	43	26	11	
wwp (m^3)	61	134	68	263

proj. pop. - Projected Population
wwplpcd - Waste Water Production in liters per capita per day
wwp - Waste Water Production

Table 4.4.3 Waste Water Production by Type of Water Service in Target Year 2010

Center	HC	YC	PF	Total WWP in m^3
1. Dupti				
proj. pop.	11,691	15,969	857	
wwplpcd	60	31	13	
wwp (m^3)	701	495	11	1,207
2. Mille				
proj. pop.	2,424	6,349	2,770	
wwplpcd	60	31	13	
wwp (m^3)	145	197	36	378
3. Bati				
proj. pop.	5,813	10,956	4,441	
wwplpcd	54	28	11	
wwp (m^3)	314	307	49	670
4. Werota				
proj. pop.	9,625	22,919	16,580	
wwplpcd	47	25	10	
wwp (m^3)	435	573	166	1,174
5. Aykel				
proj. pop.	2,910	7,762	9,948	
wwplpcd	47	25	11	
wwp (m^3)	137	194	109	440
6. D/Tabor				
proj. pop.	8,290	19,803	6,448	
wwplpcd	47	25	11	
wwp (m^3)	390	495	71	956
7. N/Mewcha				
proj. pop.	4,942	10,589	19,766	
wwplpcd	47	25	10	
wwp (m^3)	232	265	198	695
8. Chagni				
proj. pop.	7,245	21,737	12,821	
wwplpcd	47	25	13	
wwp (m^3)	341	543	167	1,051
9. Bure				
proj. pop.	5,705	11,413	9,990	
wwplpcd	47	25	10	
wwp (m^3)	268	285	100	653
10. Bichena				
proj. pop.	8,515	14,901	2,434	
wwplpcd	47	25	13	
wwp (m^3)	400	373	32	805
11. Dejen				
proj. pop.	3,117	6,234	5,456	
wwplpcd	47	25	13	
wwp (m^3)	146	156	71	373

proj. pop. - Projected Population
wwplpcd - Waste Water Production in liters per capita per day
wwp - Waste Water Production

Table 4.4.4 Water Demand and Waste Water Production of Non Domestic in m³/day

Center	2005		2010	
	Demand	Waste	Demand	Waste
1. Dupti	184	147	253	202
2. Mille	129	103	206	165
3. Bati	102	82	128	102
4. Werota	221	177	317	254
5. Aykel	95	76	129	103
6. D/Tabor	441	353	591	473
7. N/Mewcha	256	205	385	308
8. Chagni	154	123	205	164
9. Bure	94	75	124	99
10. Bichena	65	52	86	69
11. Dejen	99	79	125	100

Note: Waste water generation is assumed to be 0.8.

Table 4.4.5 Waste Water Projection in m³/day

Center	2005			2005		
	Domestic	Non	Total	Domestic	Non	Total
1. Dupti	599	147	746	1,207	202	1,409
2. Mille	141	103	244	378	165	543
3. Bati	480	82	562	670	102	772
4. Werota	691	177	868	1,174	254	1,428
5. Aykel	224	76	300	440	103	543
6. D/Tabor	528	353	881	956	473	1,429
7. N/Mewcha	394	205	599	695	308	1,003
8. Chagni	647	123	770	1,051	164	1,215
9. Bure	400	75	475	653	99	752
10. Bichena	440	52	492	805	69	874
11. Dejen	263	79	342	373	100	473

Chapter 5 Improvement of Health and Sanitation

From the surveys made, the sanitation situation in all Eleven Centers is very poor. The physical facilities of sanitation are generally very dilapidated and highly deteriorated; namely, the people lack proper use of toilets, the maintenance of the toilets is neglected, the importance given to sanitation among the people and the official is very low, excreta-brone and water-borne diseases in al centers are very high. In short the sanitation conditions are appallingly bad, and some action plans need to be devised and some policy changes need to be initiated in order to improve the sanitation and health situation in the Centers.

5.1 General Condition of Improvement

To improve the sanitary condition, measures must be undertaken from the view point of not only hardware but also software. Only the sanitary facilities can not achieve the purpose, the improvement of sanitation, vis-a-vis sanitary education. The followings are the focal points to be considered:

- Introduce sanitary facilities agreeable to the population; namely, simple design which can be copied easily by the users, utilization of local material and so on,
- Construct not only major facilities like toilet but also the others such as refuse dumping site, as well as provision of emptying system,
- Construct and/or rehabilitate such facilities as drainage and solid dumping site, keeping pace with other facilities,
- Get the population/community participated in the design stage and construction stage,
- Enhance the motivation of the population rather than just educating them,
- Establish maintenance system of those facilities by the user under supervision of WSS and municipality,
- Keep close relationship with the related organizations such as hospital, clinic, municipality, Kebele, etc, and facilitate or coordinate their activities related to sanitation, and
- Activate the role of WSSA at the Central, Regional, Local and Community levels pertaining to sanitation in line with new set up of these organizations.

5.2 Proposed Measures Based on Experimental Practice

Experimental practices had been carried out in order to facilitate the formulation of this Project, those of which are:

- Construction of experimental toilet,
- Practice of sanitary education, and
- Practice of emptying toilet.

The experimental practice identified the hindrance and blockade for the community regarding sanitation improvement, and clarified the measures which must be taken into the formulation of the Project.

By feed-backing the experience and outcomes of those experimental practices, the plan of the Project can be more practically materialized and be more acceptable.

5.2.1 Experimental Toilet

(1) Design and Construction

Initially, various types of toilet facilities have been looked into such as public toilet, community toilet and shared toilet.

Among those, community toilet had been selected for the experimental practice based on the followings:

- Public toilet needs longer construction period, which gives constraint to the use before the end of second field survey of phase II study. This makes difficult to assess the user's sense related to the actual use.
- Also, a type of public toilet equipped with shower was proposed as an good example of income generation. However, the shower uses much water, therefore it is very difficult to be operated continuously in view of current ironical shortage of water.
- A type of toilet, which can be easily copied by the user, could be an good example, since it facilitate the diffusion of such toilet.
- A type of toilet, which can involve a community rather than individuals, could be an good experiment, since there is a possibility to materialize the ways of how to get the community involved, organized, motivated and participated.

Out of the Eleven Center, Werota and Bati have been selected to be the centers for constructing the community toilet. Werota has a major ethnic composition of Amhara 97% with Tigre 3%, while Bati has two major ethnic compositions of Amhara about 49% and Oromo 28%. The major religious composition in Werota is 80% Christians and about 20% Muslims, whereas in Bati the religious composition is 88% Muslims and 12% Christians. This information gives an indication of different cultural settings that exist in Werota and Bati, and the importance of having the Experimental Toilet in these centers.

The toilets have masonry walls at the pits, reinforced concrete slab as flooring, hollow concrete blocks as both external and internal walls of the superstructure, corrugated iron sheets as roofing, cement wash basins and PVC ventilation pipes 100 mm in diameter.

Because of the time constraint, a contractor was assigned to the construction rather than depending on the community itself for the construction. The Contractor went to each site with the Project Staff to accept the sites from the town officials. At the same time mobilization was started to both Werota and Bati. The Contractor commenced work at Werota first and then at Bati.

In the construction of the toilets at both sites some members of the community living in the area have participated as part of the employees of the Contractor.

They were paid with reference to the local rate, which is 6 to 7 birr per day, and agreed to pool 1 birr per day for the preparation of emptying the toilet to be required in every two years.

On August 7, 1995, key-transfer ceremony was held in Werota, and the keys of the toilet were officially handed over to the community through its elected committee. Both user's committee committed on the occasion to take all responsibility of operation and maintenance of the toilet with the help from WSS and municipality.

The Bati toilet was completed on August 10, 1995. The transfer of keys to the chairman of the users' committee (i.e. community) was made.

(2) Operation and Management

In both Werota and Bati, the Communities that use the toilets have been organized through community participation promoters. The administration, operation, maintenance and safe guarding of the toilets have become their responsibilities to effectively and usefully utilize the toilets.

In Werota, about 30 number of households were firstly called for the use of the toilet taking into consideration of the size of the toilet with 5 cubicles and one urine. However, since almost all households around the community do not have toilet facilities, the number increased to be 46 households with the consent of initially programmed ones.

The community was easily organized for the purpose of using the toilet with the little help from the promoter. A couple of meetings were held, during which they elected their representatives; namely one coordinator, one accountant and assistant (female) each assigned to them. They estimated the toilet required about 60 birr per month for the operation and maintenance, which consist of employment of guard and payment of water charge. The toilet was supposed to require a guard because it was located near a market. The guard was appointed among the community members, and also assigned to clean the toilet.

The community allocated the about 60 birr for the operation and maintenance into household members with fifty cent to two birr each according to their income.

Although they need emptying fee in every two years, the amount could be born from the surplus of the monthly payment and interest on which the community pooled during participation of the toilet construction.

Also, an idea was proposed by the community, for which ticket for the use of the toilet by other than the community member was to be sold, expecting people from the market. This could be an example of income generation, though the amount is not big.

In Bati, 54 households have been registered for the use of the toilet. Bati community gave the Team another idea for the usage of the toilet. The toilet was initially designed to be used by sex as adopted in Werota. The community requested group-household-use other than use by sex. In the group-household-use, those households are divided into six groups, each of which operates and maintain one cubicle (the urine was changed to the 6th cubicle). This manner makes the responsibility for operation and maintenance of the toilet more clearly.

Six groups had chosen each representative, and they formed the steering committee of the toilet. Among the six representatives, chairman, dupty chairman and accountant (female) had been elected.

The required amount for operation and maintenance was estimated to be about 100 birr per month. For this group household use, they don't need guard, however emptying could be more expensive in Bati than Werota, because of unavailability of vacuum truck near Bati. Water charge will be also more than that in Werota community since they are mostly Muslim, and electricity was installed. Thus, the amount of 100 birr per month was approximately estimated and allocated into the household members with one to three birr based on their income.

The WSS office and the municipality in both centers are to assist the communities on technical matters whenever need arises. The proper functioning of the toilets in both centers has to be monitored in the future.

5.2.2 Experimental Practice of Emptying

The Study Team has arranged vacuum truck from WSSA Bahir Dar Office to empty pit latrines in Werota and Bati. It was planned to undertake 50 disposal trips each in Werota and Bati.

All the trips planned in Werota could not be achieved because of the difficult accessibility to the latrines, created by rainfall associated with poor drainage condition. For instant the Werota Senior High School toilet could not be emptied because the vacuum truck was bogged down in the mud and has to be towed out with grader. Due to difficulty of access and narrow opening of the some pit latrines, only 36 disposal trips were made in Werota.

Since Werota does not have any refuse dumping site, the sludge had to be transported to a duping site in Bahir Dar.

In Bati, out of 50 disposal trips only 24 were done due to difficulty of dumping places. No proper dumping place was prepared earlier and dumping the sludges over cliffs that look over river valleys has created dispute between rural people and Bati municipality. Since the municipality could not settle the disputes on time, emptying the toilets had to resort finally to 24 disposal trips only. The need of prior preparation of proper dumping sites has been discussed with Bati municipality for better health and environment.

5.2.3 Experimental Practice of Sanitary Education

Sanitary education should be tailored to the needs of the community who will receive such activities. It will not be effective if it is duplicating subject matter already known by the recipients and it will not be effective if it is used to compensate for facilities in appropriately designed and constructed.

In the light of the information available, and knowing that health awareness for diarrhoeal diseases is generally high among the populations of the Eleven Centers, the component was designed to tackle the lack of motivation people seem to have towards improving their own health conditions. Such a change of mind-set takes a significant amount of time and energy, probably an intensive campaign over one year with follow up for two years afterwards. This time was not available during the period of the Study. Consequently, any results from the Study's sanitary education activities are likely to be minimal, especially in the long term. However, the Study experimented with two methods of "Film Show" and "Street Theater" of sanitary education during Phase II study. The film show was carried out in Bati and the street theater in Werota. Both are suitable forms of mass media sanitary education in small Ethiopian towns.

(1) Film Show

The showing of a film in Bati was a simple procedure and rapidly carried out. Advertisements were made by megaphone around the center with the help of the Municipality. The Municipality organized a police presence for crowd control. The film "Prescription for Health" was shown during the early evening the same day in the open space, using the electricity from the WSS Office. The film drew an audience of some 600 people. The film made in Thailand has highly suitable subject and with Amharic sound track, however, the audience paid most attention to the physical appearance, clothing and customs of the Thai people at the expense of listening to the words and messages of the film.

Response by the target community of the experimental toilet have been reported by the CPP as remembering about three months after seeing the film, ". . and we realized that not only pure water is necessary for health but also good latrine facilities. So, we will keep the toilet clean and maintain it properly".

A similar film produced in Ethiopian small towns does not have the disadvantage identified by the film made in Thailand. The video produced by the Team is entitled "Simple Steps . . . for Better Health". Although this video has not been converted to 16mm film, it could be shown to smaller audiences, of a maximum 40 to 50 people.

(2) Street Theater

The street theater in Werota took some five days to organize. The effect of a street theater performance is probably greater than that of showing a film and so the medium can be justified as part of a more intensive program. Twenty eight students were chosen by the Headmaster of Werota High School to perform in the dramas. One four hours training session on street theater was organized. The lesson plan for this is shown in Table

5.2.1. Student were divided into four groups. The subjects chosen were Personal Hygiene, Domestic Hygiene, Environmental Hygiene, Safe Excreta Disposal. No sanitary education was needed at the start of this session because the student's awareness in the subject was already sufficiently high. For two hours every day for the next three consecutive days, practices were held including one dress rehearsal the day before the performance in the street. During the practices, advise was given to the students from those in their group, from those in other groups and from the Study Team. In this way students picked and researched the topics for the dramas, wrote the sketches and performed them all by themselves.

The four dramas were performed in the street outside a house near to the experimental toilet site. A crowd of about 150 people were present to watch the drams, including the community, community leaders, religious leaders and officials from government offices. Reactions from the students, officials and the community alike about the dramas have been positive, thus the street theater was observed to be an effective way of popularizing sanitary education. The success was partly due to the methodology itself, but also to the creativity the students exercised in the preparation and performance the dramas.

During the performance, a video was made to record the dramas. The video could be used for sanitary education purposes, as good as another video titled "Simple Steps . . . for Better Health".

Table 5.2.1 Street Theatre lesson Plan

Street Theatre Lesson Plan

TIME	ACTIVITIES
	Objectives
14.01	-give you a taste of street theatre -inform the community about the community toilet -get the community thinking about improved sanitation
	Street Theatre -can be done anywhere -tells a simple story -is short, lively and spontaneous -is flexible enough to allow audience participation
14.05	What makes a good show? (Flipchart 1) -humour (jokes, men dressed as women, stereotype characters etc) -drama (hero/villain style, ghosts, death, etc) -action (lots of movement, not much sitting/lying down) -interesting dialogue/story -clear slow speech, one actor speaking at one time, -no long speech by one actor -getting the audience involved (pantomime style etc) -local reference (relevant comments to the audience) -getting the message across...
14.09	Warm-up Awkward doing warm-ups but the drama is much better if you have a warm up first Knots Animal noises (dog, cat, chicken, cow) Stereotype characters (angry, drunk, beggar, politician)
14.15	What hygiene message do we want to promote in the community?
14.31	Allocate groups to titles Specify 5-10 minute plays to be done outside in the street
16.01	Preparation of plays and props
	Performances of drama's groupwise
	After each play give feedback on what did and did not work first feedback by group itself, then by other groups,
16.45	Discussion on logistics and arrangements
16.55	Discuss how they will use the medium in the site

PRACTICE AND REHEARSALS.....

5.3 Basic Plan of Improvement of Sanitary Facilities

5.3.1 Toilet Facilities

In almost all the centers the people mostly use, at present, open defecation and traditional pit latrines. Very few people use flush toilets either due to the inadequacy of water supply service or the inability to afford to pay for flush toilets and satisfactorily maintain them. The traditional pit latrines that are being used presently are ill-designed, poorly constructed and totally lack maintenance. Because of this situation several of them cave-in, the toilet floors collapse and become very dangerous to children; and while emptying them, most of the holes become too narrow to allow the use of the hose of the vacuum track. Since the use of traditional pit latrines is going to be frequent now and in the immediate future, the present defects have to be improved. The improved traditional pit latrines must have proper lining (branches, stone, adobe, etc), wider holes, strong flooring, constant maintenance and up-keep.

(1) Household Toilet

Domestic sanitation facilities are proposed as follows taking types of water supply service into consideration, which is also directly related to their income level.

Table 5.3.1 Proposed Toilet Type related to Water Service Mode

Types of Water Supply Service	Proposed Toilet Type
1. Public Fountain + Traditional Water Sources	• Improved Traditional Pit Latrine • VIP Latrine
2. Yard Connection	• VIP Latrine • Pour-Flush Latrine+Soakaway Pit
3. House Connection	• Pour-Flush Toilet+Soakaway Pit • Cistern-Flush Toilet+Septic Tank

(2) Non-Domestic Toilet

The type of non-domestic toilet depends on the number of users, availability of water, maintenance system and so on. In any case, water should be available on the site, since the washing of hands and cleaning the toilet are essential. The following facilities are proposed for each type of non-domestic toilet user.

Table 5.3.2 Proposed Toilet Type for Non-domestic

Category	Toilet Type
Communities	• VIP Latrine
Schools	• VIP Latrine
Markets and Bus Terminals	• VIP Public Toilet • Pour Flush Public Toilet
Government Institutions	• VIP Latrine • Cistern Flush Toilet+Septic Tank +Soakaway
Commercials	• VIP Latrine • Pour Flush or Cistern Flush Toilet +Septic
Hotels, Restaurants, etc.	• VIP Latrine • Pour Flush Latrine+Septic Tank +Soakaway Pit • Cistern Flush Latrine+Septic Tank +Soakaway Pit
Health Centers, Clinics, Hospitals	• VIP Latrine • Pour Flush Latrine+Septic Tank +Soakaway Pit • Cistern Flush Latrine+Septic Tank +Soakaway Pit

5.3.2 Sullage Disposal

Sullage is the waste water that does not contain excreta, but coming out from the house due to bathing, laundry, preparation of food, cooking, washing of dishes and utensils in the kitchen, and other personal and domestic activities. Sullage always contains some pathogens though the concentration is much lower than in sewage. Therefore sullage poses a health risk if it is allowed to continue to be dumped everywhere as it is being done now in every center. Sullage disposal pit needs to be prepared in households, hotels, restaurants, bars, tej and tella houses, health center, clinics, etc. The sullage soakaway pits, should be lined with open-joints until it is about 30 cm below the ground where it should be pointed.

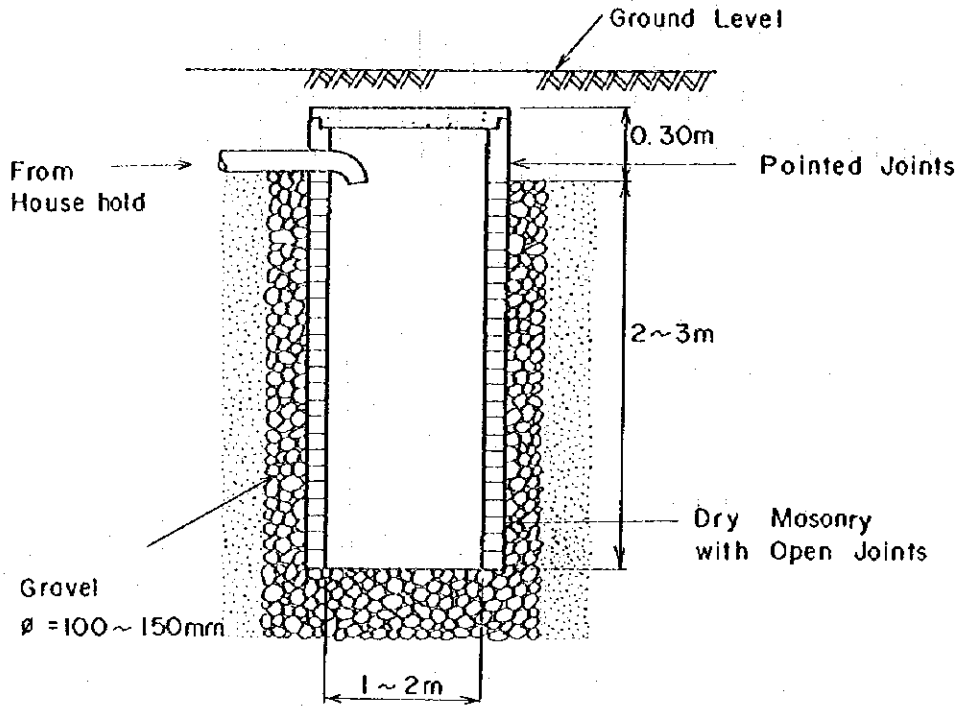

Figure 5.3.1 Typical Sullage Disposal Pit

5.3.3 Dry Solid Waste Disposal

At present, there are few solid waste disposal sites. Strategical sites should be allocated at the outskirts of the center for dumping. The dumping site should be prepared in the from of a "depression" or similar to that of a stock pond.

Each household should have a container with a lid to collect the refuse or put its refuse in a nearby bin provided by the Municipality. The collected refuse should be transported to the dumping site by refuse disposal truck or by animal drawn cart. The dumped refuse should be burnt as frequently as the need arises.

5.3.4 Storm Water Drainage

Storm water drainage is the responsibility of municipality at present. Practically all the centers have a main road constructed by the Ethiopia Road Authority (ERA) passing through the middle of each one of them. These main roads have properly constructed side as well as cross drainage facilities. But town rubbishes and other waste materials have blocked most of them, and the drainage facilities are not functioning the work they are constructed for. Consequently the blockages cause water to stagnate and in some cases causing floods. Those blocked drainage facilities have to be opened up and kept up the maintenance to have the facilities always work.

The parallel streets to the main road and the side streets should have drainage ditches install in them either by road equipment or by labor intensive method to avoid formation of stagnant water. Whenever a side street joins the main street concrete pipes or culverts should be installed as drainage facilities. Monitoring and maintenance have to be done so that these drainages are not blocked to avoid any flooding or stagnation of water.

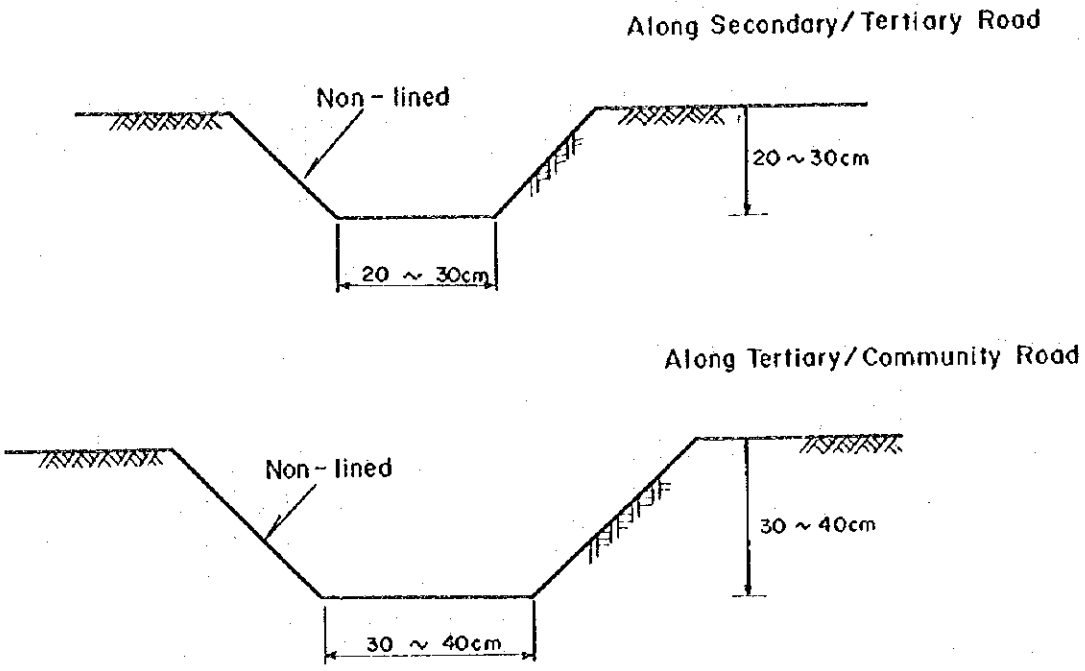

Figure 5.3.2 Typical Section of Drainages

5.4 Basic Plan of Sanitary Education and Implementation Program

The Ministry of Health has overall responsibility for health including sanitary education. They have a cadre of trained sanitarians based in most of the towns in the Eleven Centers. Thus any sanitary education activities relating to WSSD and WSSs should be carried out in close coordination with these sanitarians.

5.4.1 Focal Areas

There are four major areas where sanitary education can be encouraged by building on the interests of other existing local structures; namely, health centers, schools, religious institutions and health committees. They will be a more sustainable option than creating a new sanitary-related-cadre.

(1) Health Centers

In all of the Eleven Centers there are health centers or clinics which already undertake some sanitary education activities. Some also have sanitarians with responsibilities for improving the sanitary awareness of people in the centers. Often these health services are under resourced and need to be supported. Their education activities tend to be didactic lectures with little visual material. By providing both the sanitary education manual and the sanitary education video, which have been produced in this Study, in addition to already available materials (including charts, posters, videos and slides) to the Ministry of Health staff, the quality of these education activities may automatically improve. There is also a need to provide video deck and slide projection equipment to each of the centers.

(2) Schools

Health workers in many of the centers are already involved at local schools by giving classes. The quality of their classes are likely to improve with the use of the sanitary education manual This manual would allow the health worker to act as a facilitator and to get the students to find out as much information from a wide range of sources to make materials which the health center could usefully utilize. WSS should facilitate these activities and where appropriate sessions on water and sanitation could be taken.

(3) Religious Institutions

In some of the Eleven Centers, churches have already been enlisted into health education activities. The largest program has been the Anti-Aids campaign. Churches include talks on the subject during or after religious meetings and also hand out pamphlets. In some towns (e.g. Aykel and Werota) the priests have received training on wider health education activities. This program should be supported and the priests encouraged to use it in their weekly program. In other centers (e.g. Dejen) priests have initiated some sanitary education activities, but these have not been adequately coordinated with or supported by the health center. Health staff must be encouraged to link with Churches and Mosques in order to gain the support from these respected establishments and encourage the population to make changes in behavior. WSS should be in a position to facilitate this.

(4) Sanitary/Health Committee

Sanitary/Health Committee can be organized from representatives of organizations and interested individuals. For example, representatives from WSS, Health Center (or Clinic), the Woreda/Municipality, Kebeles, schools, religious establishments, community elders, Women's organizations, NGOs and other interested parties. When the members meet, they can discuss health related issues including the water and sanitation related diseases. A wide membership provides the committee with a wide support base for any activities it wants to promote. Such a committee also increases the level of coordination for health related activities including campaigns on sanitary education and the generation of local by-laws enforcing sanitary improvements in public areas. With the support of the authorities, community members can also be encouraged to actively enforce sanitary improvements with a type of neighborhood watch scheme. WSS should be in a position to facilitate the effective functioning of the committee.

5.4.2 Sanitary Education Manual

Many educational materials have been produced before in Ethiopia providing information about health, sanitation and hygiene which are relevant for the Eleven Centers. However, they are not readily available, even in Addis Ababa. Funding the production of copies of these materials and distributing them to WSS, Health Centers/Clinics, Schools and Religious Institutions would be a valuable contribution to raising sanitary awareness in the Study Centers. In support of the above sanitary education approach, a manual has been prepared during this Study. It contains tools and methodologies to encourage people to build on their existing health knowledge, motivating them to find out more and to lower the health risks they expose themselves to by improving their sanitary behaviors.

The motivational sanitary education manual has both English and Amharic versions. The manual can be used by community participation promoter (CPP), Regional Offices and WSSs in coordination with Ministry of Health staff, and science teachers for use with schools during health classes and Health and Anti-Aids Clubs. As much of the material already available in Ethiopia have few pictures, a new set of relevant educational pictures have been drawn. These are included at the back of the manual. The manual includes sections on making contact with the community, obtaining data, techniques for presenting information to adults and children and monitoring change. The manual also contains a list of some organizations involved in sanitary education and a list of useful materials available in Ethiopia.

5.4.3 Community-participation Promoter

A responsible person is required at each center at least in the short term to provide the momentum to get afore-mentioned systems operating in an effective manner. This role is proposed to be filled by experienced CPPs dispatched from Regional Offices in coordination with the center's WSS. The CPPs should work in such a manner that when their support for the project stops, then the sanitary education program continues.

Ideally one CPP would be able to cover two centers, but as there are insufficient numbers of CPPs available and because of the split of the Regions, four are proposed. One to cover Mille and Dupti, one to cover Bati, one to cover Aykel, Debre Tabor, Nefas Mewcha and Werota and one to cover Bure, Chagni, Bichena and Dejen. These workers would need to be coordinated so that one approach can be maintained.

To facilitate their works, a CPP supervisor should be assigned from the central WSSD. The supervisor is expected to be one who was assigned to this Study since he/she is already familiar to such work.

The CPPs should begin to work in the centers with the health centers, schools, religious institutions and sanitary/health committee as soon as they are selected for implementation. Their work will take one day each week in each center for the duration of the Project implementation drop to one day each month in each center for the six months after completion of the engineering works and on an ad-hoc basis over the following months.

The CPPs should be consulted by the construction staff for their opinions and the opinions of the community on the design including style and location of public fountains, community and public latrines and other such facilities. The CPPs should also be consulted by the construction staff for their opinions and the opinions of the community on the operation of the facilities, for example, the opening times of public fountains.

The CPPs will be responsible for coordinating instructions for the community members on the design and operation and maintenance of the water and sanitation systems, as part of the long term sustainability of the facilities. The CPPs will facilitate monitoring activities with the community so that they can monitor the facilities and any changes in sanitary behaviors within the community. The CPP will develop ways of publicizing this information for the benefit of the community and for WSSs, Health Centers, Schools,

Religious Institutions and Sanitary/Health Committee, including reports presented at the regular meetings.

Chapter 6 Reinforcement of Organization

Although the Team basically supports the philosophy of regionalization, the existing functional division among MWR, Water Supply Section in Regional Bureau and WSS, and the existing functions of Ministry of Education, Ministry of Health and municipality regarding sanitation, there are focal points in proposing the reinforcement of organization.

The basic concept in proposing new approach to organization and management of water supply and sewerage/sanitation can be summed up as follows:

1. The planning functions of MWR related to water supply will be enhanced and strengthened for the sole end of helping WSS to have sufficient human, technical and financial resources.

2. Planning functions related to sanitation will be solidly incorporated in the organizational set-up of MWR. Those functions shall not be left inactive. MWR will play a leading role in improving and alleviating the ever-aggravating sanitary conditions of centers by actively fulfilling its proper functions.

3. Training Center will be established under Water Supply Section of regional government, where people will be trained by MWR staff to become water supply technicians and accountants. They will satisfy WSS's needs. The workshop will constitute a part of the center.

4. It is the most important to make WSS financially self-sufficient, which is the over-riding need. The reinforcement of organization and management will be concentrated in this direction. The functions and organizational set-up of WSS will be enlarged and reinforced to fulfill financial self-sufficiency on a stable basis and also to incorporate sanitation functions, step by step.

5. Sanitary/Health Committee will be established in every center as mentioned in "5.4 Basic Plan of Sanitary Education and Implementation Programme". Members of the committee will coordinate in promoting the construction of toilets facilities, preparation of emptying equipment, selection and construction of treatment/disposal sites, promoting people's awareness on sanitation, and getting the people motivated for sanitation activities.

6. Community management of public fountains to be installed in future is recommended on conditions that community people are in favor of it (Refer to "6.3 Community Building/Participation and WID"). A person representing the community will be nominated by the community and approved by WSS.

7. Also, it is proposed that community toilets be managed by the community along with the public fountain where both are located closely (Refer to "6.3 Community Building/Participation and WID").

8. More females will participate in the water supply and sanitation organizations including WSS.

6.1 Organization and Management of Water Supply

MWR will be the central governmental organ in charge of water resources on the national scale including the planning on water supply and sanitation in regional urban centers. Water Supply Section of a regional government will be the supervising body of the implementation of the plans worked out by MWR for WSS's. WSS in a center will operate and maintain the water supply and sanitation facilities constructed and handed over by the government.

6.1.1 MWR (Ministry of Water Resources)

Basically the existing organizational set-up seems fine and all right. However, in light of the fact that whether people of the country can enjoy a reasonable level of water supply or not depends on the good and far-sighted planning of MWR, it is proposed that planning functions be strengthened and reinforced. Planning shall be done for the sake of WSS's over the whole country. It will be on a long-term basis spanning 10 years or so.

Under the new organizational set-up of MWR, Planning and Project Department appears to perform planning functions. The department is composed of Planning & Evaluation Team and Project & Policy Study & Evaluation Team. The background and functions of the newly created department are not known. Therefore, no comment or evaluation is possible on it. However, it is proposed that the department have four divisions. They will be Demand Projection and Facility Planning Division, Financial Planning Division, Personnel Planning Division and Monitoring & Evaluation Division.

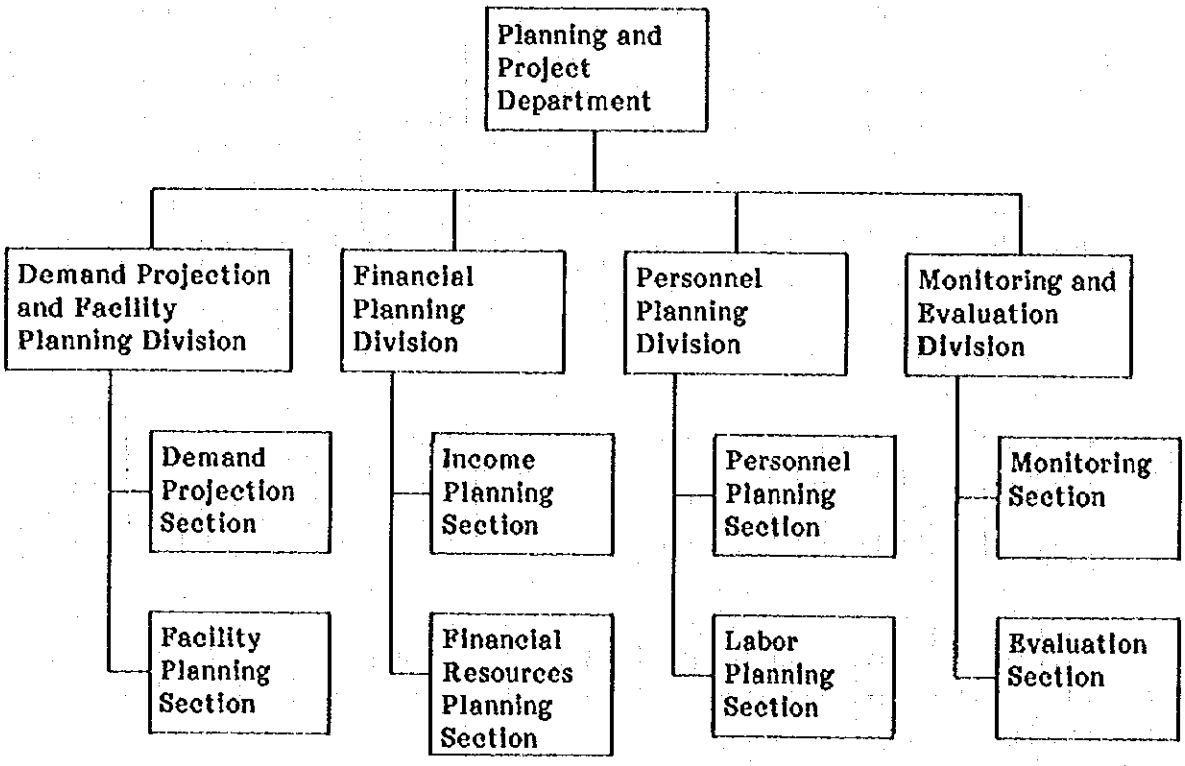

Figure 6.1.1 Proposed Organization Structure of Planning and Project Department of MWR

Demand Projection and Facility Planning Division will be consisted of Demand Projection Section and Facility Planning Section. Financial Planning Division will be divided into Income Planning Section and Financial Resource Planning Section. Personnel Planning Division will be comprised of Personnel Planning Section and Labor Planning Section. The information from Personnel Planning Division will be respected in the formulation of personnel plan in the proper decision-making organization. Monitoring & Evaluation Division is the same division as it existed before.

(1) Demand Projection and Facility Planning Division

Demand Projection Section will perform demand projection of water supply for all the areas over the country in the future years. Demand means the required volume of water production. The required volume of water production derives from the required volume of water consumption. The required volume of water consumption depends on the size of population, the scale of commercial/industrial activities, service ratios and the per capita water consumption. Therefore, the projection of these variables is the most important.

Based on demand projection Facility Planning Section will work out the plans for the construction/rehabilitation/replacement of water supply facilities such as dams, groundwater sources, pumping stations, reservoirs, treatment plants, transmission pipelines and distribution pipelines.

(2) Financial Planning Division

Income Planning Section will perform income projection for WSS's over the whole country in the coming years. The projection will be based on the number of domestic, commercial/industrial and institutional beneficiaries, their unit water consumption, water tariffs and charges, etc. The projection of the number of beneficiaries and their unit water consumption will be based on the projections in Demand Projection Section. This Incoming Planning Section also deals with projection of expenditures. Expenditures will include operating expenses, depreciation, interest payment, etc. The double entry accounting system will be introduced in calculating expenditures.

Financial Resources Planning Section will prepare financial requirements to construct/rehabilitate/replace water supply facilities for all WSS's over the country in the future years. The requirements will be based on the projections in Facility Planning Section. The financial resources to satisfy the requirements will be self-financing, grant and loan.

(3) Personnel Planning Division

Personnel Planning Section will work out personnel requirements for all WSS's in the years to come. The requirements will be based on the projections in Demand Projection and Facility Planning Division. Based on the requirements, the plans for recruitment & assignment and training & education will be mapped out. Labor Planning Section will make remuneration and general welfare plans. Remuneration will comprise basic salaries, incentives and retirement benefits. The plans will derive from the projections in Financial Planning Division.

(4) Monitoring & Evaluation Division

Monitoring & Evaluation Division will have Monitoring Section and Evaluation Section. Monitoring Section will monitor the realization/implementation of the plans prepared in the preceding three divisions. Evaluation Section will evaluate what Monitoring Section monitored and come up with remedial steps.

6.1.2 Water Supply Section (Former Regional WSSA)

Under the existing organizational set-up, Water Supply Section provides technical, personnel, financial, equipment & supply, operation & maintenance and water supply services to WSS's concerned. It is under Water, Mine and Energy Bureau or Water Resources Bureau of the Regions.

It is understood also that Water Supply Section functions as the executing body of water supply facilities construction projects.

The Team basically supports the existing functions of Water Supply Section. However, it is proposed that the relationships between Water Supply Section and MWR be strengthened in some way or another (institutionally or otherwise) because the regional government may sometimes face limitations/constraints in terms of technology, manpower, finance and information for matters of water supply and sanitation.

Water Supply Section will be the supervising body of the implementation of the plans worked out by MWR for WSS's. That is to say, it will see if the plans are implemented satisfactorily and if not, it will report to MWR and take remedial steps in accordance with the directions from MWR.

It will also function as the coordinating organ for WSS's under its jurisdiction. In other words, a rich WSS will assist a poor WSS through its good office in technical, personnel, financial, supply and other terms.

It will approve the water tariffs determined by the WSS and report to MWR (Currently WSS does not have any authority of revising the water tariff).

To satisfy the ever-widening activities of WSS, a training center is required under Water Supply Section. Eligible MWR staff will be dispatched to the center. Students will be trained to become technicians, accountants and sanitary experts. Also workshop is required there for the on-the-job training as well as for its original purpose.

6.1.3 WSS

WSS is the executing body of the daily water supply services to the population and commerce/industry in a center.

The existing organizational set-up of WSS is theoretically composed of the manager, customer services, administration, finance, urban water supply & sewerage operation and maintenance and rural water supply & sanitation operation and maintenance.

Although the Team basically supports the objective and the present organizational structure of WSS, the organization shall be strengthened taking into consideration the current vicious situation of finance and management resources. In this Study, the position and role of WSS in the over-all organizational set-ups are going to be increasingly enhanced and reinforced.

Every WSS visited was very serious in the daily management of water supply services. At the same time, it was revealed that WSS's with a few exceptions suffer from serious shortage of financial resources, equipment & supplies and qualified manpower. They are mostly financially in a precarious condition, which limits the acquisition of necessary materials, equipment and workforce. The latter in turn works to aggravate financial performance. Thus, they are trapped in a vicious circle and they strive very hard to strike a balance passively under such circumstances.

It would be essential for them to get out of such a situation. There are two essentials to remedy the situation: one is to increase the production of water, thus lifting the per capita consumption of water to the level people desire and another is to introduce a water tariff system where unit water price increases progressively as water consumption increases and also where water payment of a household will occupy a reasonable percentage of its income. If both conditions were met, financial and, therefore, managerial situation of all WSS's concerned would be greatly improved. Further, it would be important for WSS to adopt the double entry accounting system so that it may have enough fund to expand its activities.

Also, WSS will have the power to revise water tariff, dismiss or employ its staff and launch on new investment subject to Water Supply Section's approval, those of which are currently rest with Water Supply Section in Regional Bureau. And, WSS will financially stand on its own feet.

Thus, its theoretical organizational set-up may be basically as it is, however its functions will be necessarily more diversified as briefly explained below and its manpower will be increased. The proposed organizational set-up of WSS is shown in Figure 6.1.2.

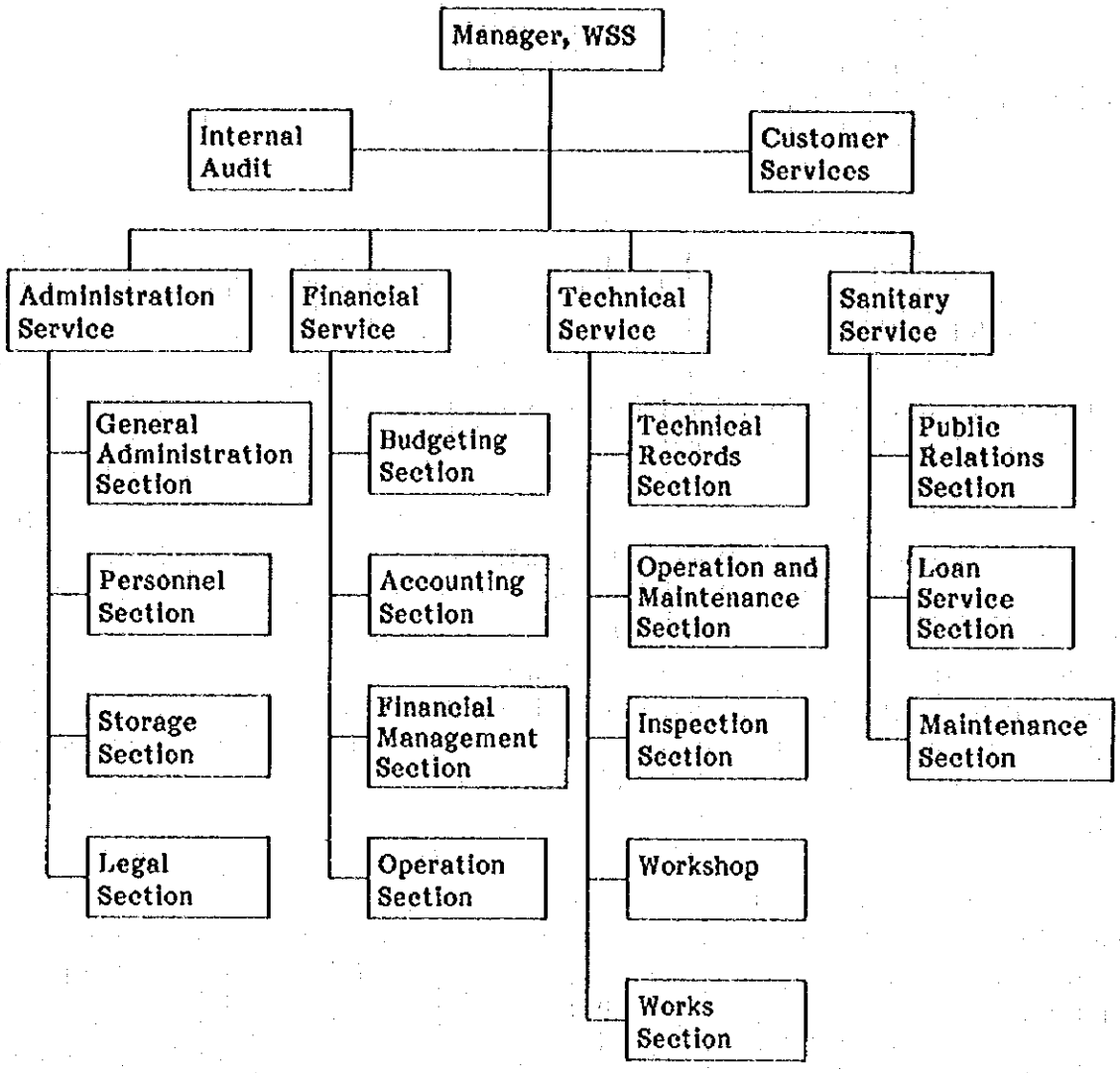

Figure 6.1.2 Proposed Model Organization Set-up of WSS

There will be four services under Manager of WSS: Administration, Financial, Technical and Sanitary Services (Regarding the last one, it will be explained in 6.2). Also, Internal Audit and Customer Services will be directly connected to the Manager.

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 & collection and cash water selling.

Technical Service covers Technical Records, Operation and Maintenance, Inspection and Works Section, 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. are taken care of by the section of the same name. Inspection of the above-mentioned facilities is done by the section of the same name. Repairing and manufacturing belong to Workshop. Works Section takes care of rehabilitation, replacement and construction of facilities.

The proposed organization of WSS is an ultimate and exemplary one to be realized in the target years of 2005/2010. The actual organization will gradually expand starting from the existing one.

If the majority of people in a town strongly favor the management of water supply facilities by themselves, Water Committee will be established and entirely take over the functions of WSS. The committee will stay under Water Supply Section of Regional Bureau.

6.2 Organization and Management of Sanitation

6.2.1 MWR (Ministry of Water Resources)

The time is still not ripe for the introduction of sewerage to the Eleven Centers concerned. What MWR as the authorities in charge of sewerage/sanitation should do now for them would be to promote the construction of sanitary facilities such as toilets, drainage, dumping sludge and refuse disposal sites, as well as to promote the diffusion of sanitary education practice in close cooperation with related organizations such as Ministry of Health, Ministry of Education and so on.

Followings are the focal points regarding sanitation related set-up:

1. Along with Ministry of Education, Ministry of Health, municipality and other related organs, it will intensify public relations activities by way of health centers, schools, WSS, community, etc. as a member of Sanitary/Health Committee.

2. It will establish a new regulation where a low interest rate loan with a long repayment period will be provided to individual household to help install septic tank toilets. For this purpose, it will project the number of clients based on the forecast of population and service ratio for all the towns in the country. And, the financial resources will come from Finance Ministry.

3. It will estimate/project the needs for the construction of drainage for all the towns in the country.

4. It will keep the records on and project the number and dissemination ratio of sanitation facilities by type for every town of the country.

To perform the above-mentioned functions, a new department will be introduced and established in MWR.

6.2.2 Water Supply Section

Water Supply Section of Regional Bureau is an executing agency of MWR's plans regarding sanitation facilities.

It will supervise the construction of sanitary facilities such as septic tank toilets, drainage facilities and so on.

6.2.3 WSS

WSS (Water Supply Service) will be renamed Water Supply and Sanitation Service (abbreviation will be the same) because it will be newly in charge of sanitation-related services. In the same way Water Committee will be renamed Water and Sanitation Committee. They will be as listed below:

1. Provide information and public relations services to help people to get involved in sanitary activities and to install toilet facilities.

2. Provide loan/subsidy to clients for the installation of septic tank toilets. Keep the related records.

3. Prepare vacuum trucks to regularly empty toilets.

4. Regularly clean and maintain drainages.

A new organization by the name of Sanitary Service will be introduced and established in WSS to take care of above functions (Refer to Figure 6.1.2).

Sanitary Service will be comprized of Public Relations, Loan Service and Maintenance Sections. Public Relations Section will be in charge of the above item 1. Item 2 will be assigned to Loan Service Section. Maintenance Section will take care of items 3 and 4.

6.2.4 Sanitary/Health Committee

As mentioned in "5.4 Basic Plan of Sanitary Education and Implementation Programme", a committee related to sanitation is newly required to improve sanitary condition, promote sanitary education and get the people motivated for sanitation related activities. For this purpose, Sanitary/Health Committee will be established in each of Eleven Centers. Members will be representatives from schools (Ministry of Education), the health center (Ministry of Health), municipality, Woreda council, MWR, Water Supply Section, WSS, Commercial Bank of Ethiopia (Finance Ministry), community, etc. The committee session will be convened regularly to discuss the way to promote people's sanitary awareness, to promote the installation of toilets, to acquire emptying equipment, to determine treatment/disposal sites and to evaluate the accomplishments.

6.3 Community Building/Participation and WID

Community development has mostly been an approach followed by rural development practitioners. It is developed from the concept that development of a community can not be initiated from outside the community, if it is to be sustained in the long term. It is based on the belief that it is unethical to challenge or effect change in a society from the outside. Change of gender relations for example requires a motivation for change from within the male and female membership of the society in order to alter the gender inequalities they consider to be present as they wish. Change can therefore only be facilitated from the outside with the consent of members of that society.

This development principal is one which is desirable in urban contexts in addition to rural locations. Alongside their water and sanitation related activities, the CPPs will be ideal agents for facilitating these changes as experienced by the experimental sanitary practice. The suggestions in the Sanitary Education Manual is intended to be used by the CPPs to facilitate this work in a developmental and participatory way, providing them with materials and ideas which they may not have been introduced to prior to this Study.

6.3.1 Community Building

Some principles developed for rural settlements are specific for small rural settlements, however, in small urban settlements such as the Eleven Centers there are principles of rural development which are appropriate. The primary principle is that of people taking action to affect their own living environment.

In many of the Study centers there has been a degree of dependency syndrome. This was felt most strongly in Bati, and other areas where there has been a history of relief aid. Relief agencies themselves are now working towards a "developmental approach to relief" avoiding direct handouts wherever possible, and expecting people to do at least something for relief food and non-food items and to get people to take more initiative for themselves.

Lessons from the above experience are pertinent to the Study. Giving of facilities or resources without individuals taking their own initiatives in the work will encourage dependency. Followings are the focal points to get the community involved, built and participated:

(1) Utilization of Community's knowledge and information in Project Implementation

Although this Study has referred to the opinion of the communities in specifying the design and location of public fountain, as carried out in Mille, the involvement of the community in the specific design and location of water and sanitation facilities has not always been done due mainly to time constraint.

Exercises of involving in the specific design and the selection of locations for the various facilities are extremely motivating factor. It provides them with a feeling of involvement and provides empowerment. The community, particularly women and also girls must be

involved in confirmation of the water supply and sanitation facilities design, system and devices at the commencement of the implementation stage.

> On one hand, to undertake these activities at feasibility stage raised much expectations. The motivational factor is diminished with waiting time before implementation, and contrary even worse, the activities could plant defiance into the community if the Project should not be implemented because of low feasibility, lack of the fund, political issues and etc.

(2) Unification of managers and users

It is more efficient and sustainable if the managers and the principal users of a facility are identical. Women and to a lesser extent girls are the main users of water both for collection and for activities in the household (Men and boys in Mille, Dupti and Aykel are to be included in this group also). These users of water should therefore be adequately represented in the management of the facilities. As women and girls are not traditionally viewed as managers of facilities like water supply systems, they will require special support to facilitate their participation in roles of management or maintenance. Women in group meetings requested that they share the roles with men, and be given training in support of these functions. Men agreed with this idea. WSS may also need support in order to facilitate this process.

(3) Community Management

To get the community motivated and empowered, it is very efficient if the management and operation of facilities are made by the community itself. In this regard, "Community Management of Public Fountain" and "Community Management of Community Toilet" are proposed.

According to the household survey, the majority of people are in favor of the public fountain managed by the community. It is because that WSS does not, on the community's side, appear to be performing its proper role exemplified by short opening hours, short supply of attendants, thus leaving the facility unfunctional for a long period.

On the WSS side, the operation and maintenance of public fountains often present a headache because the income from them is not mostly commensurate with the personnel and other cost involved. Those problems could be resolved once the management of public fountains are left to the hands of the community. It is therefore proposed that community management be introduced for public fountains to be built in future subject to the community's consent. A representative selected by the community will be approved by and registered in WSS. WSS will provide technical and other assistance as need arises.

Although majority tend to have individual toilet, community toilet could be an option for the relatively poor people who can neither access nor control the source for the construction of the individual toilet. As mentioned before, a community toilet has been constructed in Werota and Bati each.

In the construction of the toilets, one CPP had been assigned in each community of Werota and Bati. It was observed that the two communities organized as users of the experimental toilet became motivated rapidly with a little hint given by the CPP. Several meetings had been held on the issues regarding membership of the users, election of the coordinator representing the community as well as the responsible dealing with account with the initiation of the CPP.

During the meetings, the community had decided their own way of operation and maintenance based on their consensus, including payment allocation among the members. For initial investment of community toilet construction, it may be difficult to be achieved without any support from related organizations in the form of subsidy or long-term loan. However the two communities could be a good example for the community building, should the initial investment be supported.

(4) Payment Policy

One critical component of development is the issue over payment for work undertaken. A Payment Policy should be fixed prior to implementation of any program activities. There are three theories of thought from which to decide:

- Volunteerism
  The theory behind volunteerism assumes that money for a program budget is limited and that if the program is to be implemented or taken over by a government organization then the budget will be minimal. Even when workers have been told not to expect payment, they will expect some sort of remuneration. For example, there was a tendency for the students, performed sanitary education street theater, to expect remuneration for the activity despite the assumption made by the Team and the Headmaster for the activity to be a voluntary activity for the benefit of the community. Certain factors help to maintain momentum for voluntary work, these include seeing results which benefit the individuals themselves directly or indirectly. They will develop a spirit of self help and see that with minimal resources they can affect changes to their lives.

- Local Rates of Pay
  The second theory depends on the idea that when a work needs to be done, it should be remunerated either in kind or in monetary terms. As soon as payment for any job is given in a project, then other workers should also receive payment. The level of payment should be appropriate for local conditions and sustainable. Such additional money is good for the individual and good for the local economy.

- High Rates of Pay
  The third theory is based on the concept that high payment for work will get a job done fast and to required specifications. Immediately payment for a job commences, the level for payment for all activities is set. Workers will expect to receive that amount of money in return for work, whether their work is related to the original project or not. The emphasis then remains as doing something for personal economic gain.

All theories have their followers, but it is generally agreed that the principles of volunteerism or local wages are closest to the principles of community development projects. However inconsistencies by gender or by task must be avoided. (There were some projects that women have been expected to work as volunteers for which men have previously received payment.)

It is recommended that future implementation establishes a policy of volunteerism in terms of community participation, and this could include voluntary community contributions of labor for the construction of facilities, involvement of the beneficiaries in the exact site locations and designs of facilities, a monitoring function for reporting the condition of those facilities and for motivational and education support mechanisms. This policy can only be sustained with other motivating factors. Where the information generated through community level activities is allowed to direct the shape of the program, those people can see the power they have to change their environment for their overall benefit. This is one of the most motivating factors associated with any development program. From it other changes beyond the narrow remit of water and sanitation can be tackled, including perceived injustices of ethnicity and gender.

6.3.2 Women in Development

Women's current ability to earn status, respect and money for their families is lower than that of males in a number of respects in Ethiopia. Religious education and religious leadership positions provide personal status and income and status for the family of males who enter these establishments (Christian and Muslim). In this way, only males can bring status of this kind to a family. Females tend to have lower academic opportunities. This is likely to stem from lower expectations of their parents over their performance and distribution of more household activities to girls which prevent them from performing to their full capacity in their studies. Girls receive more status from their marriage partner than from their own academic or career achievements. As a result females have lower earning ability than males, and tend to be in lower status jobs like housework, cooking, making alcohol, petty trading and so on.

As detailed earlier in this report, a typical household in the Study centers would generally share access and control of resources like a "shared pot" but ultimately this is determined by the earning power of the individual household members. Where men earn the majority of the money, they have the greatest degree of control over that money. Where women earn the money they control that money in the household. Women headed households have lower incomes and it can be assumed that they have lower access to resources and facilities than male headed households. The ratio of female headed households in Eleven Centers is very high. The level of female headed households in Ethiopia is not known but can be assumed to be about 30% (a globally high figure due to war and famine).

Women are generally involved in water collection and care-taking of family hygiene and sanitation. Where they are earning the money they can control this. In other households they must make joint decisions with men and so men must also be convinced of any activity which requires resources, including latrine building and payment for piped water.

Water and sanitation programs are good starting point for raising community development issues, including gender issues. However in the implementation there are often failures from which this Project ought to learn. There has been a tendency for men to be elected onto water committees while women with adequate support and training could be equally effective and sometimes more effective because of their traditional domestic roles. In water projects globally there has been a tendency for men to be assigned financially rewarding "technical" roles such as caretakers, plumbers and surveyors which women could also carry out and for projects to expect the cleaning and "soft" activities to be carried out on a voluntary basis. These are the roles that women tend to be assigned to and hence women miss out on the financial benefits of the Project and are expected to donate scarce time and energy for no financial gain.

It is vital that all roles which are involved with this Project are treated in a consistent manner regarding both selection, support and remuneration. Lesser levels of these elements degrades any activity and devalues the person who fulfills that role. The Project should therefore include the following:

(1) Encourage diversity of roles

Encourage women to fulfill roles usually carried out by men e.g. committee membership, sanitary educators and surveyors. For this, female community members will require mobilization and support/training for these roles both from the program and from their peers.

Encourage men to fulfill roles usually carried out by women, e.g. cleaners of public fountains and latrines. For this, men will have to be encouraged from peers and program personnel.

(2) Equity

Treat each role with equal value by providing the same level of remuneration for all roles in the Project and also providing equal levels of management support from program personnel.

(3) Income generation

Encourage income generating activities for both men and women, particularly those which encourage improved sanitation behaviors, e.g. training carpenters in construction of replicable appropriate latrines, training unskilled men and women in the construction of soakaways and rubbish disposal pits, and in local soap-making. Increased levels of income available from these activities can be used as a motivator to local crafts people to market latrines and other sanitary facilities which will encourage a cleaner and more sanitary environment.

(4) Gender orientation

Provide gender awareness orientation for all members of the Project staff in order to sensitize them fully to the issues involved. Gender training needs to be available for male and female members of staff and the community in order for them to see the importance gender has in the community and the implications gender has on the program. Members of staff should also be encouraged to take gender issues seriously perhaps through a series of guidelines on equal opportunities or gender sensitivity, including some type of penalty for non-compliance.

Chapter 7 Project Implementation

7.1 Executing and Responsible Agencies

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

MWR is to be responsible for the planning, design, bidding and supervision of the Project works, and keep 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.

7.2 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 geographical relationship among centers.

First stage	:	Preparation in 1996	
Second stage	:	Aykel, Debre Tabor, Nefas Mewcha and Werota	Group 1
		Chagni, Bure, Bichena and Dejen	Group 2
		Dupti, Mille and Bati	Group 3

7.3 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 (see Appendix-7). WSSA'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, pipe and reservoir. Also, fuel, cement and other local materials made of imported raw 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.

The required consulting engineers are as follows:

- Design stage		(68M/M)
Chief civil engineer	(Team Leader)	1 × 10 = 10
Civil engineer	2 × 8	16
Pipeline engineer	2 × 10	20
Pump engineer	1 × 4	4
Mechanical engineer	1 × 3	3
Electrical engineer	1 × 3	3
Deep weel engineer	1 × 9	9
Building engineer	1 × 3	3
- Construction supervision stage		(108M/M)
Chief civil engineer	(Team Leader)	1 × 24 = 24
Civil engineer	2 × 24	48
Mechanical engineer	2 × 10	20
Electrical engineer	1 × 10	10
Building engineer	1 × 10	10
Economist cum Administrative export	1 × 6	6

- Engineering Cost (11 centers) (68 + 108M/M) × 130,000 = B22,880,000

Total project costs regarding water supply in years of 2005 and 2010 are summarized in Tables 7.3.1 and 7.3.2 respectively and the detailed cost shown in Appendix-7.

Table 7.3.1 Total Project Cost of Water Supply for Target Year 2005 in Thousand Birr

No.	Description	F.C.	L.C.	Total
1	Project			
1-1	Dupti	10,078	8,546	18,624
1-2	Mille	6,286	4,157	10,443
1-3	Bati	11,082	5,439	16,521
1-4	Werota	13,985	8,777	22,762
1-5	Aykel	13,138	6,340	19,478
1-6	Debre Tabor	20,097	10,579	30,676
1-7	Nefas Mewcha	13,968	7,248	21,216
1-8	Chagni	14,270	8,852	23,122
1-9	Bure	11,404	8,159	19,563
1-10	Bichena	10,609	6,162	16,771
1-11	Dejen	8,633	5,324	13,957
	Sub-total	133,550	79,583	213,133
2	Vehicles and office equipment	2,200	110	2,310
	Total	135,750	79,693	215,443
3	Price escalation	8,100	4,827	12,927
	Ground total	143,850	84,520	228,370
	Project cost Br 200,477,000		(¥ 3,426 million)	
	Supporting cost by WSSD Br 27,893,000			

Table 7.3.2 Total Project Cost of Water Supply for Target Year 2010 in Thousand Birr

No.	Description	F.C.	L.C.	Total
1	Project			
1-1	Dupti			11,681
1-2	Mille			5,649
1-3	Bati			7,448
1-4	Werota			6,988
1-5	Aykel			7,427
1-6	Debre Tabor			9,629
1-7	Nefas Mewcha			8,302
1-8	Chagni			8,560
1-9	Bure			7,915
1-10	Bichena			7,688
1-11	Dejen			7,858
	Sub-total			89,145
2	Transportation cost for construction equipment			1,800
	Total			90,945
3	Price escalation			38,197
	Ground total			129,142
				(¥ 1,937 million)

In this Study, sanitary improvement was also designed and required costs are summarized in Table 7.3.3. 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 7.3.3 Total Project Cost for Sanitation in Thousand Birr

No.	Description	2005	2010
1	Dupti	1,611	455
2	Mille	1,313	443
3	Bati	1,656	450
4	Werota	1,656	450
5	Aykel	1,421	443
6	Debre Tabor	1,968	450
7	Nefas Mewcha	2,063	450
8	Chagni	1,626	450
9	Bure	1,699	448
10	Bichena	1,553	448
11	Dejen	1,753	440
	Total	18,319	4,927

Chapter 8 Financial Analysis

8.1 Basic Plan of Collecting Water Charge and Accounting System

8.1.1 Basic Plan of Collecting Water Charge

Water charge is the function of water consumption and water price. That is, it is calculated by multiplying water consumption by water price.

The more a household consumes water and the higher water price is, the more the household pays for water.

However, there is a limit for a household to pay for water. The World Bank recommends that the maximum limit of water charge be 4% of household income.

The average water consumption per household for house connection owners, yard connection users and public fountain users in the Eleven Centers in the target years of 2000, 2005 and 2010 was estimated based on water demand projection in Chapter 4.

Likewise, the average monthly household income for the respective type of clients was estimated based on the results of the socio-economic questionnaire survey conducted by JICA. It was premised that household income will go up by 3% every year.

Regarding water price, it was decided that house connection owners, yard connection users and public fountain users will pay 4%, 4% and 2% of their income respectively for water in the target year of 2010.

From household income and the share of water payment to income water price automatically results for respective type of clients.

It so happened that the difference in household income between house connection owners and yard connection users is greater than the difference in water consumption between them. It means that when both of them pay 4% of their household income as water charge, water price for the former is greater than the latter.

That is to say, house connection owners cross-subsidize yard connection users under the proposed water tariff.

Also, it turned out that the difference in household income between connection owners/users and public fountain users is often greater than the difference in water consumption between them. It follows that when both of them pay the same percentage of their household income as water charge, water price for the former is greater than the latter. What is proposed is not the same percentage, but 4% for the former and 2% for the latter.

That is to say, connection owners/users cross-subsidize public fountain users basically in a dual manner under the proposed water tariff.

In the intermediate target years of 2000 and 2005, the share of water charge in income will be less than 4% and 2% for connection owners/users and public fountain users respectively.

Water price for house connection owners will be applied for non-domestic clients also as they are usually bulk water consumers and more affordable.

8.1.2 Accounting System

Introduction of the double entry accounting system is recommended in the preparation of financial statements.

Under the system water price will include not only the ordinary operation and maintenance cost, but also depreciation and the payment of interest besides tax and profit.

This is the standard way practiced all over the world. Besides, it is the only way to show the true picture of financial conditions of an entity.

By so doing WSS will turn out to be in a better position in the long run in financial management.

8.2 Proposed Water Tariff

Water tariff in the future years is proposed for the Eleven Centers as shown below:

Table 8.2.1 Proposed Water Tariff (Unit : birr/m^3)

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
House Connection Owners	3.26	3.03	3.06	3.01	3.15	3.67
Yard Connection Uses	2.03	1.80	1.94	2.25	2.45	2.23
Public Fountain Users	1.51	0.89	1.05	1.04	1.11	1.66

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
House Connection Owners	3.50	2.93	3.00	3.43	3.00
Yard Connection Uses	2.31	2.14	2.07	2.31	2.16
Public Fountain Users	0.82	1.33	0.76	1.48	1.06

Water price for house connection owners is applied for non-domestic customers too.

Tariff is different among the centers because water consumption and average income of the three types of clients are different from center to center.

Roughly speaking, it can be said that the proposed water price per m^3 for house connection owners is around 3 birr, for yard connection users around 2 birr and for public fountain users around 1 birr.

Willingness to pay for water supply services was asked of the people in the Eleven Centers in the socio-economic survey, but the resultant amount was too low, ranging between 2 to 3 birr per month only, in every center to be used for future water price planning probably because of their deep dissatisfaction with the existing services.

The existing water price is 1 birr per m^3 in most centers. It is too low to cover the O & M cost in WSS's. In the event the services are improved in the overall manner so that they will satisfy people's water needs, it is likely that they will accept the proposed water tariff.

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 for each of Eleven Centers in the target year of 2005 are shown in Table 8.2.2.

Water payment derives from water consumption and water price. And ratio of water payment to income is gotten by dividing water payment by household income.

According to the table, the average monthly household income across the Eleven Centers in 2005 works out to 958 birr, 437 birr and 184 birr for house connection owners, yard connection users and public fountain users respectively.

The average shares of house connection owners, yard connection users and public fountain users in the same year are calculated at 11.7%, 35.0% and 40.9% respectively.

Similarly, the average water consumption per household per month is 10.6 m^3, 6.2 m^3 and 2.7 m^3.

The average water payment per household per month is 33.6 birr, 13.5 birr and 2.9 birr.

Further, the average ratio of water payment to income comes to 3.5%, 3.0% and 1.7% in 2005 for the respective types of clients.

These are the background information related to water tariff.

Table 8.2.2 (1) Water Consumption and Payment per Household in 2005

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
1. Average Monthly Household Income (birr)						
House Connection Owners	988	850	1,011	912	847	1,051
Yard Connection Uses	439	305	406	445	485	455
Public Fountain Users	242	140	161	166	183	217
2. Share of Households (%)						
House Connection Owners	20.4	13.1	15.5	10.1	6.0	9.2
Yard Connection Uses	38.1	41.0	49.2	40.3	16.0	32.4
Public Fountain Users	29.9	45.9	28.4	49.6	59.8	24.6
3. Water Consumption/Household/Month (m^3)						
House Connection Owners	9.6	9.8	12.1	11.0	9.6	9.9
Yard Connection Uses	5.7	5.8	7.1	6.4	5.6	5.8
Public Fountain Users	2.4	2.5	3.0	2.8	2.5	2.6
4. Payment for Water Supply/Household/Month (birr)						
House Connection Owners	31.2	29.7	37.0	33.0	30.1	36.4
Yard Connection Uses	11.5	10.4	13.7	14.5	13.7	13.0
Public Fountain Users	3.7	2.2	3.1	2.9	2.7	4.3
5. Ratio of Water Payment to Income (%)						
House Connection Owners	3.2	3.5	3.7	3.6	3.6	3.5
Yard Connection Uses	2.6	3.4	3.4	3.2	2.8	2.9
Public Fountain Users	1.5	1.6	1.9	1.8	1.5	2.0

Source: JICA

Table 8.2.2 (2) Water Consumption and Payment per Household in 2005

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen	Average
1. Average Monthly Household Income (birr)						
House Connection Owners	992	845	943	1,076	1,026	958
Yard Connection Uses	474	401	464	524	407	437
Public Fountain Users	119	198	142	261	195	184
2. Share of Households (%)						
House Connection Owners	7.2	7.1	11.7	14.5	13.5	11.7
Yard Connection Uses	25.5	32.7	33.8	34.8	41.7	35.0
Public Fountain Users	66.0	29.4	47.2	31.6	37.4	40.9
3. Water Consumption/Household/Month (m^3)						
House Connection Owners	10.3	10.6	11.8	10.0	11.8	10.6
Yard Connection Uses	6.0	6.2	6.9	6.3	6.9	6.2
Public Fountain Users	2.7	2.7	3.1	2.8	3.1	2.7
4. Payment for Water Supply/Household/Month (birr)						
House Connection Owners	35.9	31.1	35.5	34.5	35.5	33.6
Yard Connection Uses	13.9	13.3	14.4	14.6	15.0	13.5
Public Fountain Users	2.2	3.7	2.3	4.1	3.2	2.9
5. Ratio of Water Payment to Income (%)						
House Connection Owners	3.6	3.7	3.8	3.2	3.5	3.5
Yard Connection Uses	2.9	3.3	3.1	2.8	3.1	3.0
Public Fountain Users	1.8	1.8	1.6	1.6	1.7	1.7

Source: JICA

8.3 Income of Water Supply

The major income source of water supply services is as every one knows 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) x (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% for all the Eleven Centers.

There is the second revenue source. It is 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 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.

Income of water supply in the target years for the Eleven Centers is summarized in Table 8.3.1.

The Eleven Center average of water charge revenue comes to 47 thousand birr in 1995. It is expected to go up to 381 thousand birr or 8.1 times as much in 2000, 674 thousand birr or 14.3 times as much in 2005 and 1,181 thousand birr or 25.1 times as much in 2010.

Likewise, the Eleven Center average of total revenues works out to 61 thousand birr in 1995. It is expected to grow to 430 thousand birr or 7.0 times as much in 2000, 763

thousand birr or 12.5 times as much in 2005 and 1,331 thousand birr or 21.8 times as much in 2010.

The Eleven Center average of the share of water charge revenue in the total revenues is calculated at 77% in 1995. In the future years it is expected to be around 89%.

The combined total revenues of the Eleven Centers amount to 667 thousand birr in 1995, which are projected to increase to 4,726 thousand birr, 8,393 thousand birr and 14,643 thousand birr in 2000, 2005 and 2010 respectively.

Table 8.3.1 (1) Planning of Revenues (Unit : thousand birr)

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
(Year 1995)						
1. Water Charge	50	47	90	59	44	10
2. Technical Service Charge	1	1	25	4	0	7
3. Meter Rent	-	-	9	-	0	2
4. Others	0	1	7	2	0	12
Total	51	49	131	64	44	31
(Year 2000)						
1. Water Charge	443	179	358	575	172	747
2. Technical Service Charge	34	10	21	44	12	37
3. Meter Rent	11	4	13	20	2	15
4. Others	10	4	8	13	4	16
Total	498	197	400	652	190	815
(Year 2005)						
1. Water Charge	922	325	601	975	336	1,237
2. Technical Service Charge	81	22	49	81	34	74
3. Meter Rent	23	8	22	33	7	28
4. Others	20	7	13	22	8	27
Total	1,046	362	685	1,111	385	1,366
(Year 2010)						
1. Water Charge	1,818	600	897	1,697	646	2,043
2. Technical Service Charge	149	42	42	138	68	128
3. Meter Rent	48	15	28	55	18	48
4. Others	40	13	20	38	15	44
Total	2,055	670	987	1,928	747	2,263

Note: "-" = Included in "Others" if any.
Source: JICA

Table 8.3.1 (2) Planning of Revenues (Unit : thousand birr)

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
(Year 1995)					
1. Water Charge	38	59	54	23	48
2. Technical Service Charge	8	6	2	7	7
3. Meter Rent	-	-	5	-	6
4. Others	11	4	6	5	8
Total	57	69	67	35	69
(Year 2000)					
1. Water Charge	401	456	304	310	247
2. Technical Service Charge	21	42	23	29	15
3. Meter Rent	8	20	11	10	8
4. Others	9	11	7	7	5
Total	439	559	345	356	275
(Year 2005)					
1. Water Charge	702	819	500	612	390
2. Technical Service Charge	40	73	42	65	28
3. Meter Rent	15	31	18	21	13
4. Others	15	19	11	14	8
Total	772	942	571	712	439
(Year 2010)					
1. Water Charge	1,249	1,363	848	1,202	626
2. Technical Service Charge	73	115	68	122	43
3. Meter Rent	27	50	29	40	20
4. Others	27	30	19	27	14
Total	1,376	1,558	964	1,391	703

Note: "-" = Included in "Others" if any.
Source: JICA

8.4 Financial Analysis of Water Supply

8.4.1 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.

(1) O & M cost

Seven types of O & M cost can be identified.

The first is electricity cost. Electricity to be required in the future years has been projected for each of the Eleven Centers. Electricity cost is calculated by multiplying electricity requirements in kwh by electricity charge per kwh.

The combined electricity cost of the Eleven Centers in the future years is shown below:

Table 8.4.1 Combined Electricity Cost (Unit : thousand birr)

Item	1995	2000	2005	2010
Electricity Cost (A)	105	371	616	1,028

The second is fuel cost. Fuel (oil) to be required in the future years has been projected for each of the Eleven Centers. Fuel cost is calculated by multiplying fuel requirements in liter by fuel charge per liter.

The combined fuel cost of the Eleven Centers in the future years is shown below:

Table 8.4.2 Combined Fuel Cost (Unit : thousand birr)

Item	1995	2000	2005	2010
Fuel Cost (A)	64	145	246	416

The third is disinfection cost. The chemical (hypochlorite) to be required in the future years has been projected for each of the Eleven Centers. Disinfection cost is calculated by multiplying chemical requirements in kg by the price of the chemical per kg.

The combined disinfection cost of the Eleven Centers in the future years is shown below:

Table 8.4.3 Disinfection Cost

Item	1995	2000	2005	2010
Disinfection Cost (1,000 birr)	11	33	55	93

The fourth cost is personnel cost. The number of personnel to be required in the target years has been projected for each of the Eleven Centers based on the projected water production. Personnel cost is calculated by multiplying the number of personnel by the average renumeration per employee. It is recommended that the average monthly remuneration per worker 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 combined personnel cost of the Eleven Centers in the future years is shown below:

Table 8.4.4 Combined Personnel Cost

Item	2000	2005	2010
Personnel Requirements	318	376	479
Remuneration/Worker (birr/month)	481	481	481
Personnel Cost (1,000 birr)	1,835	2,170	2,765

The fifth is installation cost of connections. The number of connections to be newly installed in the target years has been projected for each of the Eleven Centers. This cost is calculated by multiplying the number of connections by the average installation cost per connection. Installation cost per connection is estimated at 488 birr on average.

The combined installation cost of connections of the Eleven Centers in the future years is shown below:

Table 8.4.5 Combined Installation Cost of Connections

Item	1999/2000	2001/05	2006/10
Connections to be Newly Installed	774	1,582	2,650
Installation Cost/Connection (birr)	488	488	488
Installation Cost of Connections (1,000 birr)	378	772	1,293

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 combined purchase cost of water meters of the Eleven Centers in the future years is shown below:

Table 8.4.6 Combined Purchase Cost of Water Meters

Item	1999/2000	2001/05	2006/10
Water Meter to be Newly Installed	774	1,582	2,650
Purchase Cost/Water Meter (birr)	276	276	276
Purchase Cost of Water Meter (1,000 birr)	214	437	731

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.

The combined other cost of the Eleven Centers in the future years is shown below:

Table 8.4.7 Combined Other Cost

Item	2000	2005	2010
Other Cost (1,000 birr)	298	430	633

The estimated O & M cost in the target years for each of the Eleven Centers is as follows:

Table 8.4.8 Estimated O & M Cost (Unit : thousand birr)

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
O & M Cost						
1995	60	38	132	53	23	78
2000	295	171	288	425	210	401
2005	490	260	411	577	337	577
2010	757	417	466	840	564	842

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
O & M Cost					
1995	80	72	102	72	68
2000	298	450	268	256	211
2005	404	635	366	401	267
2010	606	913	533	652	371

The Eleven Center average of O & M cost comes to 70 thousand birr in 1995. It is expected to go up to 298 thousand birr or 4.3 times as much in 2000, 430 thousand birr or 6.1 times as much in 2005 and 633 thousand birr or 9.0 times as much in 2010.

The combined O & M cost of the Eleven Centers amount to 775 thousand birr in 1995, which are, as shown below, projected to increase to 3,273 thousand birr, 4,725 thousand birr and 6,961 thousand birr in 2000, 2005 and 2010 respectively:

Table 8.4.9 Combined O & M Cost

Item	1995	2000	2005	2010
O & M Cost (1,000 birr)	775	3,273	4,725	6,961

(2) 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 estimated initial cost by phase for each of the Eleven Centers is as follows:

Table 8.4.10 Estimated Initial Costs (Unit : thousand birr)

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
Initial Cost						
Phase 1 (for 2005)	18,624	10,443	16,521	22,762	19,478	30,676
Phase 2 (for 2010)	11,681	5,649	7,448	6,988	7,427	9,629
Total	30,305	16,092	23,969	29,750	26,905	40,305

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
Initial Cost					
Phase 1	21,216	23,122	19,563	16,771	13,957
Phase 2	8,302	8,560	7,915	7,688	7,858
Total	29,518	31,682	27,478	24,459	21,815

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 works was assumed to be 50% for 1997/2008 and the remaining 50% for 1998/2009.

The combined initial cost of the Eleven Centers by item is as follows:

Table 8.4.11 Combined Initial Cost (Unit : thousand birr)

Item	Foreign Components	Local Components	Total
1. Phase 1			
1) Construction Cost	108,178	50,731	158,909
2) Engineering Cost (12% of 1))	19,069		19,069
3) Contingency (5% of 1) + 2))	6,269	2,572	8,841
Sub-Total	132,802	54,017	186,819
4) Buildings		22,135	22,135
5) WSSD's Management Cost (2% of 1) + 2) + 3) + 4))		4,179	4,179
Sub-Total		26,314	26,314
6) Vehicles & Equipment	2,310		2,310
Total	135,112	80,331	215,443
7) Water Purification Units (included in total)	110	165	275
2. Phase 2			
1) Construction Cost			73,673
2) Engineering Cost (10% of 1))			7,367
3) Contingency (10% of 1) + 2))			8,104
Total			89,144
Grand-Total			304,587

Note: Phase 1 means the plan aiming at year 2005, while Phase 2 means plan aiming at year 2010.

8.4.2 Projection of Financial Statements

Income statement and fund statement were projected for 30 years starting in 1996 for each of the Eleven Centers.

In doing so, the following conditions were initially assumed:

* External Loan for Initial Cost
  Ratio of Loan : 100%
  Grace Period : 10 years
  Repayment Period : 30 years
  Interest Rate : 1%

* Central Government Subsidy to WSS
  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. Such cost will be borne by the Ethiopian government and WSS will pay it back on the same repayment terms as in the case of external loan.

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

Further, inflation was not considered.

In evaluating the financial statements for the Eleven Centers, 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 were selected as representative managerial indicators. The results are shown below:

Table 8.4.12 Representative Managerial Indicators

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
Revenues/Expenditures (%)	199.5	117.0	140.8	172.6	92.8	195.1
Working Capital/Revenues (%)	56.9	20.6	32.5	47.6	-4.7	52.6

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen	Average
Revenues/Expenditures (%)	155.6	127.0	111.4	169.8	127.1	146.2
Working Capital/Revenues (%)	39.7	27.5	23.9	43.5	24.3	33.1

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%.

However, when one thinks of adverse circumstances such as revenue shortage, cost overrun and the delayed progress of works, the ratio of revenues to expenditures and the ratio of

working capital to revenues should be around 130% and 30% respectively for the sake of safety.

In comparison with the above standard levels, the values of the two indicators are too low for Mile, Aykel, Chagni, Bure and Dejen. Especially, the values do not satisfy even the first standards for Aykel.

Also, the values are too good for Dupti, Werota, Debre Tabor, Nefas Mewcha and Bichena. The values for Bati can be considered standard ones.

After repeated simulations, the following governmental subsidy was finally decided for each of the Eleven Centers.

Table 8.4.13 Governmental Subsidy

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
Subsidy to Initial Cost (%)	50	90	80	60	100	55
Item	Nefas Mewcha		Chagni	Bure	Bichena	Dejen
Subsidy to Initial Cost (%)	75		85	95	65	85

Under the above conditions the final values of the two managerial indicators were calculated:

Table 8.4.14 Managerial Indicators

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
Revenues/Expenditures (%)	152.4	130.3	140.8	144.3	127.4	148.3
Working Capital/Revenues (%)	40.7	30.0	32.5	35.0	27.5	34.7

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen	Average
Revenues/Expenditures (%)	146.4	133.3	133.3	144.1	136.9	139.8
Working Capital/Revenues (%)	35.2	31.6	39.8	32.1	30.3	33.6

As the table shows, all the values satisfy the required levels except those for Aykel. To increase the values for the center is not possible because they are worked out under the condition of 100% governmental subsidy.

It tells that WSS in every center concerned will be financially sound and stable in terms of earnings as well as solvency in the years to come, if all the above-mentioned conditions, estimates and assumptions are met.

Chapter 9 Project Evaluation

9.1 Economic Evaluation

9.1.1 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 center.

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 Team calculated the time to be reduced annually for the whole town in each of the Eleven Centers 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:

Population in a center is projected to increase by 5.9% per year on average. At present only 26.5% of people in a center use either house connections or yard connections on average. The time spent for water fetching is negligible for them. The remaining 73.5% spend much time every day fetching water from either public fountains (46.4%) or springs/rivers (27.1%).

In the "without project" case, those using piped water are expected to increase only by 2% per year on average due to water supply facility constraints. It means that those using either public fountains or springs/rivers - especially the latter - will progressively go up in terms of percentage as well as the number year by year.

In the "with project" case, on the other hand, population to use either public fountains or springs/rivers is projected to decrease to 33.7% (25.1% for the former and 8.6% for the latter) in 2010.

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

Table 9.1.1 Time and Daily Frequency of Water Collection

Users	Time spent at a time (min.)	Daily frequency (times)	No. of persons at a time
(Dupti)			
Public fountains	36	2.3	1.1
Springs/rivers	158	1.5	1.2
(Mille)			
Public fountains	38	2.5	1.1
Springs/rivers	77	1.8	1.1
(Bati)			
Public fountains	30	3.0	1.3
Springs/rivers	90	0.9	1.4
(Werota)			
Public fountains	77	2.9	1.1
Springs/rivers	71	1.5	1.1
(Aykel)			
Public fountains	84	2.1	1.3
Springs/rivers	126	2.0	1.4
(Debre Tabor)			
Public fountains	18	2.6	1.1
Springs/rivers	78	1.7	1.1
(Nefas Mewcha)			
Public fountains	66	2.6	1.1
Springs/rivers	102	1.9	1.4
(Chagni)			
Public fountains	30	2.5	1.3
Springs/rivers	54	2.0	1.5
(Bure)			
Public fountains	30	3.0	1.4
Springs/rivers	60	2.4	1.4
(Bichena)			
Public fountains	174	2.1	1.3
Springs/rivers	150	1.5	1.4
(Dejen)			
Public fountains	102	2.2	1.2
Springs/rivers	132	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 1% to 3% every year.

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

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

Table 9.1.2 Time Value for Water Collection

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
(Dupti)	334	4.5	16	0.1546
(Mille)	223	4.6	16	0.1010
(Bati)	306	6.2	16	0.1028
(Werota)	262	6.3	16	0.0866
(Aykel)	182	5.5	16	0.0689
(D. Tabor)	248	5.7	16	0.0906
(N. Mewcha)	202	5.9	16	0.0713
(Chagni)	203	6.1	16	0.0693
(Bure)	253	6.8	16	0.0775
(Bichena)	324	6.2	16	0.1089
(Dejen)	312	6.8	16	0.0956

The results are shown in Table 9.1.3.

Table 9.1.3 Saved Time and Benefit

Year	Saved Time (thousand hours)	Benefit (thousand birr)
1996	0	0
1997	0	0
1998	0	0
1999	3,474	331
2000	6,486	617
2001	8,540	816
2002	10,323	1,025
2003	12,981	1,244
2004	15,382	1,473
2005	17,909	1,714
2006	21,279	2,042
2007	24,762	2,379
2008	28,352	2,727
2009	32,084	3,085
2010	35,935	3,455
2011	35,935	3,455
2012	35,935	3,455
2013	35,935	3,455
2014	35,935	3,455
2015	35,935	3,455
2016	35,935	3,455
2017	35,935	3,455
2018	35,935	3,455
2019	35,935	3,455
2020	35,935	3,455
2021	35,935	3,455
2022	35,935	3,455
2023	35,935	3,455
2024	35,935	3,455
2025	35,935	3,455
Total	756,532	72,733

9.1.2 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 multipler 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 Chapter 8.) 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.

9.1.3 Economic Evaluation

Based on the data calculated in the above-mentioned way, cost benefit streams were prepared for the period of 30 years for each of the Eleven Centers. As a result, the following was made clear:

Table 9.1.4 Cumulative Cost/Benefits (Unit : thousand birr)

	Cumulative Cost	Cumulative Benefits	Difference	Ratio (%)
	A	B	C = B - A	D = B / A
(Dupti)	6,993	15,569	8,576	223
(Mille)	2,973	2,950	-23	99
(Bati)	4,089	2,440	-1,649	60
(Werota)	6,693	5,611	-1,082	84
(Aykel)	4,023	5,788	1,765	144
(D. Tabor)	6,842	6,816	-26	100
(N. Mewcha)	5,089	5,402	313	106
(Chagni)	6,727	5,187	-1,540	77
(Bure)	3,753	3,233	-520	86
(Bichena)	4,511	15,175	10,664	336
(Dejen)	2,863	4,560	1,697	159
Total	54,556	72,731	18,175	133

As the table shows, cumulative benefits are greater than cumulative cost in Dupti, Aykel, Nefas Mewcha, Bichena and Dejen. That is, for these five centers - especially Bichena and Dupti - time benefit resulting from project implementation is marked, being greater than personnel cost of WSS.

In other centers cumulative cost is less than cumulative benefits.

In Mille, Werota, Debre Tabor, Chagni and Bure cumulative benefits come near to cumulative cost. That is, for these five centers time benefit resulting from project implementation is as big as comparable to the personnel cost of WSS.

In Bati cumulative benefits are 60% of cumulative cost. That is, for this center time benefit resulting from project implementation is itself substantial, coming to more than half the personnel cost of WSS, but limited compared to other centers.

The combined cumulative cost and cumulative benefits of the Eleven Centers for 30 years come to 54,556 thousand birr and 72,731 thousand birr respectively. It means benefits are 133% of cost at the discount rate of zero.

That is to say, speaking of the Eleven Centers in a combined way, time benefit resulting from project implementation is considerably greater than the personnel cost of WSS's.

The combined cost benefit streams of the Eleven Centers are shown in Table 9.1.5.

Table 9.1.5 Cost Benefit Stream

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	1267	1267	331	-935
5	2000	0	1410	1410	617	-793
6	2001	0	1469	1469	816	-653
7	2002	0	1528	1528	1025	-503
8	2003	0	1587	1587	1244	-343
9	2004	0	1645	1645	1473	-172
10	2005	0	1703	1703	1714	11
11	2006	0	1814	1814	2042	228
12	2007	0	1923	1923	2379	456
13	2008	0	2033	2033	2727	693
14	2009	0	2143	2143	3085	943
15	2010	0	2252	2252	3455	1203
16	2011	0	2252	2252	3455	1203
17	2012	0	2252	2252	3455	1203
18	2013	0	2252	2252	3455	1203
19	2014	0	2252	2252	3455	1203
20	2015	0	2252	2252	3455	1203
21	2016	0	2252	2252	3455	1203
22	2017	0	2252	2252	3455	1203
23	2018	0	2252	2252	3455	1203
24	2019	0	2252	2252	3455	1203
25	2020	0	2252	2252	3455	1203
26	2021	0	2252	2252	3455	1203
27	2022	0	2252	2252	3455	1203
28	2023	0	2252	2252	3455	1203
29	2024	0	2252	2252	3455	1203
30	2025	0	2252	2252	3455	1203

9.2 Financial Evaluation

Regarding detailed information on revenues and cost, refer to Chapter 8.

9.2.1 Initial Trial on Subsidization and FIRR

Initial cost itself is too huge for the WSS in any of the Eleven Centers to bear.

Therefore, it was assumed initially that the central government would provide subsidy to each of the Eleven Centers 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 Chapter 8 under such an assumption, cost benefit streams were prepared for 30 years starting in 1996 for each center.

Using them, financial internal rate of return (FIRR) was calculated. The results are as shown below:

Table 9.2.1 Summary of Financial Internal Rate of Return

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
FIRR (%)	8.3	1.9	4.6	7.3	-	8.3

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen	Total
FIRR (%)	5.5	3.3	0.9	6.9	2.7	5.2

The combined cost benefit streams of the Eleven Centers under the above subsidy assumption are shown in Table 9.2.8. Using them, financial analysis was conducted. As a result, FIRR worked out to 5.2% as shown in the above table.

Generally speaking, FIRR in the country should be equal to or more than 10%. However, in consideration of the nature and objective of the Project the level is too high and cannot be adopted.

After repeated simulations involving sensitivity analysis and projection of financial statements, it was finally concluded that it would be proper and reasonable if FIRR worked out to around 4% so far as the Project is concerned.

In comparison with the above standard level, FIRR's are too low for Mille, Chagni, Bure and Dejen. FIRR for Aykel cannot be worked out because cumulative cost is greater than cumulative benefits.

On the other hand, FIRR's are too high for Dupti, Werota, Debre Tabor, Nefas Mewcha and Bichena. FIRR for Bati can be considered a standard one.

9.2.2 Final Results on Subsidization and FIRR

To arrive at the proper and reasonable levels of FIRR, repeated simulations were conducted regarding the degree of subsidization for most of the above centers.

As a result, the following subsidy scheme was finally worked out and adopted:

Table 9.2.2 Proposed Subsidy Scheme

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
Subsidy to Initial Cost (%)	50	90	80	60	100	55
Item	Nefas Mewcha		Chagni	Bure	Bichena	Dejen
Subsidy to Initial Cost (%)	75		85	95	65	85

Under the above conditions the final values of FIRR were calculated as shown under:

Table 9.2.3 Final FIRR based on the Subsidy Scheme

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
FIRR (%)	3.8	4.6	4.6	3.9	6.1	3.7
Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen	Total
FIRR (%)	4.4	4.4	4.1	3.8	4.2	4.0

FIRR for Aykel is by 2 points above 4%. However, the value was eventually adopted after evaluating projected financial statements and the results of sensitivity analysis.

The combined cost benefit streams of the Eleven Centers are shown in Table 9.2.9. Using them, financial analysis was conducted. As a result, FIRR worked out to 4.0% as shown in the above table.

9.2.3 Sensitivity Analysis

(1) For Each Center

To see how the values of FIRR will be affected under different circumstances, sensitivity analysis was conducted for the Eleven Centers. Four cases were assumed:

Table 9.2.4 Assumptions of Sensitivity Analysis

Item	Conditions	
1. Case 1	Benefits	: -10%
2. Case 2	Initial Cost	: +10%
3. Case 3	Progress of Construction	: 1997=70% 1998=30%
4. Case 4	Progress of Construction	: 1998=70% 1999=30%

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

In the base case detail design will be done in 1996, 50% of construction works will be done in 1997 and the remaining 50% in 1998. The results are shown below:

Table 9.2.5 Results of Sensitivity Analysis

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
FIRR (%)						
Base Case	3.8	4.6	4.6	3.9	6.1	3.7
Case 1	2.6	2.6	3.0	2.6	3.4	2.5
Case 2	3.1	4.0	3.9	3.2	5.6	3.0
Case 3	3.9	4.8	4.9	4.1	6.5	3.9
Case 4	3.0	3.9	3.8	3.0	5.8	2.7

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
FIRR (%)					
Base Case	4.4	4.4	4.1	3.8	4.2
Case 1	3.0	2.7	2.6	2.4	2.5
Case 2	3.7	3.8	3.5	3.1	3.5
Case 3	4.6	4.8	4.4	3.9	4.5
Case 4	3.5	3.7	3.5	2.9	3.4

The above table shows that under any adverse circumstances conceivable the values of FIRR maintain the level of more than 1%, which is the assumed interest rate of external loan.

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

(2) Eleven Centers Combined

When the Eleven Centers are combined together, FIRR works out to 5.7%.

Three cases were assumed:

Table 9.2.6 Assumptions of Combined Analysis

Item	Conditions	
1. Case 1	Benefits	: -10%
2. Case 2	Initial Cost	: +10%
3. Case 3	Progress of Construction	: 1997=25%
		1998=45%
		1999=30%

In Case 3 detail design will be done in 1996.

Under the above conditions, the following results were obtained:

Table 9.2.7 Result of Combined Analysis

Item	Results	Difference from Base Case
Base Case	FIRR: 4.0%	-
Case 1	FIRR: 2.6%	-1.4%
Case 2	FIRR: 3.6%	-0.4%
Case 3	FIRR: 3.7%	-0.3%

In the base case detail design will be done in 1996, 50% of construction works will be finished in 1997 and the remaining 50% in 1998.

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

Case wise, the shortage of revenues will deal the strongest negative impact on the financial feasibility of the Project, followed by cost overrun and, then, the delayed progress of works.

Table 9.2.8 Cost Benefit Stream

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	4004	790	4795	679	-4116
2	1997	30068	805	30873	690	-30182
3	1998	30068	820	30888	702	-30186
4	1999	0	3025	3025	2871	-155
5	2000	0	3272	3272	4609	1337
6	2001	0	4106	4106	5445	1339
7	2002	0	4260	4260	6120	1860
8	2003	0	4415	4415	6795	2380
9	2004	0	4569	4569	7470	2901
10	2005	0	4724	4724	8145	3421
11	2006	0	5889	5889	9532	3643
12	2007	1621	6157	7778	10706	2928
13	2008	8104	6425	14529	11879	-2649
14	2009	8104	6692	14797	13053	-1743
15	2010	0	6960	6960	14227	7267
16	2011	0	4733	4733	13698	8965
17	2012	138	4733	4871	13698	8827
18	2013	138	4733	4871	13698	8827
19	2014	0	4733	4733	13698	8965
20	2015	0	4733	4733	13698	8965
21	2016	0	4733	4733	13698	8965
22	2017	0	4733	4733	13698	8965
23	2018	0	4733	4733	13698	8965
24	2019	0	4733	4733	13698	8965
25	2020	0	4733	4733	13698	8965
26	2021	0	4733	4733	13698	8965
27	2022	0	4733	4733	13698	8965
28	2023	0	4733	4733	13698	8965
29	2024	0	4733	4733	13698	8965
30	2025	0	4733	4733	13698	8965

Table 9.2.9 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	5061	790	5851	679	-5173
2	1997	34472	805	35277	690	-34587
3	1998	34472	820	35292	702	-34590
4	1999	0	3025	3025	2871	-155
5	2000	0	3272	3272	4609	1337
6	2001	0	4106	4106	5445	1339
7	2002	0	4260	4260	6120	1860
8	2003	0	4415	4415	6795	2380
9	2004	0	4569	4569	7470	2901
10	2005	0	4724	4724	8145	3421
11	2006	0	5889	5889	9532	3643
12	2007	2059	6157	8216	10706	2490
13	2008	10295	6425	16719	11879	-4840
14	2009	10295	6692	16987	13053	-3934
15	2010	0	6960	6960	14227	7267
16	2011	0	4733	4733	13698	8965
17	2012	138	4733	4871	13698	8827
18	2013	138	4733	4871	13698	8827
19	2014	0	4733	4733	13698	8965
20	2015	0	4733	4733	13698	8965
21	2016	0	4733	4733	13698	8965
22	2017	0	4733	4733	13698	8965
23	2018	0	4733	4733	13698	8965
24	2019	0	4733	4733	13698	8965
25	2020	0	4733	4733	13698	8965
26	2021	0	4733	4733	13698	8965
27	2022	0	4733	4733	13698	8965
28	2023	0	4733	4733	13698	8965
29	2024	0	4733	4733	13698	8965
30	2025	0	4733	4733	13698	8965

9.3 Organizational Evaluation

In the central level, strengthening of Planning Project Department was proposed. Task allocation was cleared in the regional level and the relationship between the central and regional was proposed to be strengthened. Those proposed set-up was made without imposing any drastic change of the existing ones, thus the proposed ones are expected to be realized without difficulty.

In center level, there will be four services under Manager of WSS; namely Administration, Financial, Technical and Sanitary Services, with Internal Audit and Customer Services. The proposed is an ultimate and exemplary one to be realized in the target years of 2005/2010. The organizational set-up could be realized without difficulty, because the actual organization is to be gradually achieved starting from the existing one with adding sections under the services and the staff.

Followings are the proposed organizational/institutional measures and those evaluations:

- Stronger and more direct connections between the central water supply and sanitation organization and its regional counterpart are required institutionally or otherwise.

- It is no exaggeration to say that whether the water supply and sanitary conditions in the centers in the whole country will be properly and successfully managed and maintained or not depends upon whether MWR performs its planning functions in a desirable manner. Therefore, the organizational/functional reinforcement of Planning and Project Department was proposed in this Study. The Department will be composed of four division, namely Demand Projection and Facility Planning Division, Financial Planning Division, Personnel Planning Division and Monitoring and Evaluation Division.

- The regional water supply and sanitation organization is the executing organ of the centrally or regionally planned projects and the supervising body of WSS activities. To perform its functions in an expected way, it is necessary for the organization to have and train a required extent of skilled manpower. Therefore, the establishment of Training Center in each Region was proposed. A substantial number of technicians such as electricians, mechanics and water meter technicians, accountants, etc. will be trained there. The trained manpower will meet the organization's own need as well as WSSs' requirement.

- It is essential for WSS to be given the decision-making power regarding water tariff, personnel management, execution of small-scale rehabilitation or new works, purchasing of equipment and supplies, etc. Approval will be given by the regional organization, and it will be reported to the central organization.

- The fundamental conditions for WSS to have a successful financial performance are to have a sufficient supply of water on one hand and to have a reasonable level of water price on the other. Both conditions are hopefully expected to be satisfied through the Project. If WSS has a successful financial performance, then the accompanying difficulties WSS is now suffering from will be eventually overcome.

- The planning functions regarding sanitation the same as in case of water supply will be introduced in the central organization. The organization in charge will have a long range quantitative plan for the progressive dissemination of on-site sanitation facilities for the centers over the whole country.

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

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

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

- Construction of community toilets will be promoted. Financial resources may come from the community itself or other sources. Sanitary/Health Committee and WSS will assist in the acquisition of fund.

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

Summing up, the following evaluation of the above-mentioned organizational measures can be made:

- Planning and execution of water supply & sanitation projects will be streamlined and properly effectuated.

- Skilled manpower requirements at both the regional and WSS levels will be satisfied.

- WSS will stand on its own feet institutionally, financially and technically.

- Sanitation will institutionally occupy its proper position to fulfill the urgent needs for sanitary improvement of the centers.

- Community will take care of water supply & sanitation to the extent it is capable of.

- As a result, people in the centers will come to be satisfied with both water supply and sanitation services.

9.4 Technological Evaluation

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

In the Project, several number of boreholes are newly required and those are located with certain distance from each other or sometimes away from another. Therefore, mobilization is due required for the daily operation of those boreholes. In this regard,

transportation must be strengthened by means of vehicle or motorbike, otherwise well attendant is additionally required in the number.

In Bure, spring water will be continuously adopted as it has been in order to meet the water demand. In this case, water quality analysis shall be employed in daily inspection, composed of mainly turbidity and biological aspects. The same manner of water quality analysis should also be adopted in Dupti because the water is from shallow wells.

In some centers such as Mille, Dupti and Aykel, which are classified as rural or satellite, WSS office shall be set-up in those center to maintain and operate the facilities as planned.

9.5 Environmental Impact Assessment (EIA)

Currently, there are not Ethiopian laws or regulations which stipulate that development activities represented as a project require an EIA prior to the approval of the project. However, the procedure to establish the EIA is going on within the relevant authority as of 1995.

In this Study, initial environmental examination (IEE) firstly had been carried out throughout Phase I study and supplemented during the field survey of Phase II, based on the "Guideline of Environmental Consideration for Groundwater Development" prepared by JICA. IEE conducts preliminary assessment in terms of social environment, natural environment and public nuisance, as summarized in the scoping format of Table 9.5.1. The scoping format categorizes the environmental components with a classification such as:

A; Advance impact is expected by the Project,
B; Negligible impact is expected by the Project,
C; The impact is Unknown at present, and
D; Enhancement is expected by the Project.

No advance impact classified "A" above is shown on the format, and most components are expected to undertake negligible impact from the Project. Also enhancement is expected in some components such as economic activities, public health and hygienic condition.

The components classified as "C" are identified as the ones to be considered for EIA. The result of EIA is described below, and no negative environmental impact is expected except groundwater quality in Dupti. Although the water supply system in Dupti may be expected to use Awash river, the shallow groundwater was adopted as an emergency mitigative measure because continuous supply of chlorine and proper O&M of infiltration scheme to be required in case of Awash river are considered to be very difficult at present. Therefore, the shallow groundwater in Dupti should be utilized with the monitoring of the quality and problems to be claimed by the population.

9.5.1 Vested Rights

Although the facilities planned are small in the scale, a part of dwelling and commercial areas, and such properties as houses and trees might be affected, to which compensation shall be made in accordance with government regulation. With consideration above, facilities have been so planned that such circumstance be avoided as much as possible in the design stage. With reference to the outcome of GEP survey, probable water sources had been planned away from dwelling areas, and new reservoir sites planned nearby existing ones or away from dwelling areas, from which little effect is expected. Also, main distribution lines had been designed alongside existing roads to avoid any considerable resettlement.

Afar people customarily states their own land right despite the fact that the land is officially owned by the state. In Mille and Dupti, conveyance pipeline from the source to reservoir could be expected to cross the Afar areas, which are located mainly at outskirt of the centers. Although it is very difficult to identify the Afar area because of their nomadism, due consultation shall be made prior to the commencement of the construction work. Since the effect is expected only during pipeline installation, any conflict could be avoided by the prior consultation.

There are water vendors whose income source relies on selling water in all Eleven Centers. Except Dupti, most water vendors are private connection holders who are classified into relatively wealthy people. Although those vendors are very reluctant to give the amount of the income from selling water, the income is conjectured to occupy a part of their whole income. Therefore, the loss of vending water is not expected to give any considerable effect. In Dupti, considerable number of water vendors, who fetch water from Awash river and sell to the town dwellers, were observed during the field survey. The income of those vendors relies on mostly vending the water, therefore they would lose their income by the Project. However, the loss of income could be covered if they altered the way of fetching water from Awash river to public fountains, which are to be increased in number, and vending the water.

As mentioned above, any vested right in terms of properties, land right and vending water could not be seriously affected by the Project.

9.5.2 Public Health and Hygienic Condition

The improved water supply will increase the quantity of waste water. If the drainage system was not accompanied, it could lead to unhygienic condition and leave people vulnerable to water-borne diseases.

In this Study, sewerage is regarded as a component of the Project and not as a mitigative measure. During field survey, the areas had been delineated, which were suffering from poor drainage condition at present and also toilet condition had been investigated. Based on those assessment, the improvement of drainage and toilet had been proposed in this Study. Disposal of spillage water at public fountains has also been designed in such manner of soakaway pit or connecting to an existing drainage. With the implementation above,

public health and hygienic condition could be enhanced rather than negative impact by the Project.

9.5.3 Accidental Damages to Existing Facilities

Although construction of pipeline network and reservoir may be expected to give damages accidentally to the dwellers and existing facilities, such cases have not been reported based on the previous construction experiences. Under proper supervision of the construction, such damages can be avoided or reduced to negligible level even if any.

9.5.4 Soil Erosion

Judging from the construction scale, little soil erosion is expected both during and after the construction. Although minor soil erosion may be expected in case of sandy and silty formation of the land such as Dupti and Mille, such erosion has not been reported in noticeable level based on previous construction experience. It is also recommended that construction work be carried out during dry season not only to facilitate the construction work but also to reduce the soil erosion as much as possible.

9.5.5 Groundwater Quality and Quantity

The current water source of Bure and Aykel is a spring, and there are minor springs undertaken for drinking water in most centers. There may be a possibility that the existing springs could be affected due to over-exploitation of groundwater by this Project. However, with reference to the scheme mentioned below, employed in the design of this Project, it is expected that any noticeable effect to the existing springs could not be arisen.

The location of new boreholes has been designed with a distance from the existing springs enough to avoid any influence to the water table for the existing ones.

The maximum of groundwater extraction in this Project has been designed to be within the recharge in five year return period of drought for the centers having small aquifer such as Bati, Aykel, Debre Tabor, Nefas Mewcha, Bure, Bichena and Dejen. This concept enables the new well designed in this Project to avoid noticeable over extraction of groundwater, leaving the springs unaffected.

Groundwater in Dupti has already shown such problems as sodium, iron, chloride, fluoride, nitrate and sulfate. Among those, chloride and fluoride are the serious ones with the fact that between 40 and 50 % of children had shown mottling of their teeth and a number of patients claiming kidney problem was ranked at 6th in Tendaho hospital during the field survey in February 1995.

Although the groundwater in Dupti has great potential in terms of quantity, the water supply system utilizing groundwater could increase the problem mentioned above. Therefore, it is recommended that the source of the water supply be shifted from the groundwater to shallow groundwater nearby Awash river. During the period of using the groundwater, monitoring for mottling of teeth and kidney problem be made.

9.5.6 Land Subsidence

Foundation in Amhara Region is mainly composed of Basalt lava which is not expected any land subsidence by excessive pumping. Mille in Afar Region is also formed with Basalt lava for its foundation. No report for land subsidence caused by pumping groundwater has been notified during field survey. Therefore, no perceptible land subsidence by exploiting groundwater will be expected in centers of Amhara Region and Mille.

Dupti's foundation is composed of sediment. Although no perceptible land subsidence has been reported until now, minor land subsidence might be caused by excessive pumping if the foundation contains thick clay strata. According to the lithology of two boreholes drilled in Dupti, the strata between ground-level and 20-30 m below the ground-level are mainly composed of clay layers, then the strata become gravel layers as the depth increases (see below).

Borehole	Wollo I		Wollo II	
Depth (m)	GL		GL	
	5	Silty clay	5	Silty clay
	10		10	
	15	River deposit	15	Gray colored clay
	20	(clay)	20	----------
	25	Silty clay	25	
	30	----------	30	Clayey sand
	35	Clayey gravel	35	and gravel
	40	Basaltic gravel	40	
	45		45	Clay with
	50	Sandy gravel	50	volcanic
	55	with clay	55	aggregate
	60		60	
	65	Coarse sand	65	Silty clay & sand

Note; The boreholes above were drilled in 1976.

Based on the lithological information above, no noticeable subsidence is expected as long as the groundwater is to be exploited over about 30 m depth below the ground-level. In case the groundwater is exploited from shallow aquifer located within 30m from the ground level, land subsidence may be expected. However the designed shallow wells are located away from residential area, therefore the subsidence will not affect any residential area.

9.5.7 Traffic Nuisance

In most centers, a water distribution pipeline had to be designed to cross a road. During the installation, the work interrupts traffic and causes nuisances especially if the road is such trunk ones in Mille, Dejen and Werota. Based on the site investigation, two installation methods were identified; namely to install the pipe through existing drainage

under across the road, and to install half of the pipe first and then the remainder by shift. The shifting installation method usually requires one day work.

In this design, pipe installation across road has been designed with the former method (through existing drainage) as many places as possible. Therefore any traffic nuisance to be caused by the installation of pipelines could be avoided, and even in the case that the sifting installation method is employed, the nuisance could be acceptable judging from the installation term of just one day.

Table 9.5.1 Scoping Format for Initial Environmental Examination

Environmental Components	Classi-fication	Description
1. Social Environment		
1.1 Resettlement	B	The facilities are small and expected to give no resettlement.
1.2 Economic Activities	D	The economic activities will be enhanced by the water supply and sanitation improvement.
1.3 Facilities	B	The construction work and the facilities have little impact on existing facilities such as schools and hospitals.
1.4 Collapse of Communities	B	Nil. If a water users committee was organized by the community itself to look after the facilities especially public fountains, the community would be enhanced. As well, community toilet, one of the components of this project, would help enhance the community.
1.5 Archaeological and Cultural Heritage	B	Nil
1.6 Vested Rights	C	Compensation shall be given for land and properties if these were affected by the project. Regarding Afar, due attention be paid to their claim of owing the land. Water vendors may lose their income source by the newly supplied water.
1.7 Public Health and Hygienic Condition	D/C	Sanitary improvement will enhance the condition. Drainage system must be accompanied with the improvement of water supply. Treatment be considered for the water containing high fluoride and salinity.
1.8 Waste Disposal	B	During construction works, there will be little waste disposal from the view of the small construction scale. After commissioning, no waste disposal is expected.
1.9 Accidental Damages to Facilities	C	Consideration be paid to the network of pipelines in order to avoid public nuisance to dwellers.

Note) A; Advance Impact, B; Negligible Impact C; Unknown Impact D; Enhancement

continued

Environmental Components	Classi-fication	Description
2. Natural Environment		
2.1 Geographic and Geological Condition	B	No effect is expected to geographic and geological condition.
2.2 Soil Erosion	C	The earth work gives little soil erosion, judging from the construction scale. In case of silty sand formation of the land, minor accidental collapse and/or erosion might be expected.
2.3 Surface Water Quality and Quantity	B	Nil
2.4 Groundwater Quality and Quantity	C	During construction period, no effect is expected to the groundwater. After commissioning, excessive pumping could affect springs and salinity found in Dupti.
2.5 Hydrological Situation	B	No effect is expected to hydrological situation.
2.6 Terrestrial Fauna	B	Nil
2.7 Aquatic Fauna	B	Nil
2.8 Vegetation	B	Little effect is expected to vegetation.
2.9 Climatic Conditions	B	No effect is expected to climatic conditions.
2.10 Aesthetic Condition	B	The facilities would give little change to the condition judging from the size.
3. Public Nuisance		
3.1 Air Pollution	B	Nil
3.2 Water Pollution	B	Nil
3.3 Soil Pollution	B	Nil
3.4 Noise and Vibration	B	The construction works do not give rise to noticeable noise and vibration.
3.5 Land Subsidence	C	Excessive groundwater pumping might cause small scale land subsidence where sediment formation of land is found.
3.6 Odour	B	Nil
3.7 Traffic Nuisance	C	In case of pipeline being laid across road, the traffic will be interrupted.

Note) A; Advance Impact, B; Negligible Impact C; Unknown Impact D; Enhancement

9.6 Indirect Benefit Evaluation

9.6.1 Subdual of Water Born and Excreta Born Diseases

Survey has been made at such medical institutions as hospital, health clinic and health center, during which information has been collected for top ten diseases prevailing in each center.

Among the top ten diseases, such water/excreta born diseases as intestinal parasite and diarrhea had been usually found with high incidence. Also, there may be more patients suffering from those diseases since patients with slight diarrhea, which is the most common water born disease, seem not to show up at medical institutions. Generally, it is said that the effects of poor water supply, unhygienic practice and unsanitary excreta disposal lead to about 70% of total disease incidence in Ethiopia.

With the completion of this Project, those water/excreta born diseases could be subdued and the number of the patients, ranking high at present, could reduce especially for diarrhea. The subdual should be monitored by evaluating the top ten diseases annually at those medical institutions in line with the enhancement of water supply and improvement of sanitary facilities as well as sanitary education practice.

9.6.2 Benefit related to WID

The benefits related to WID are as follows:

By improving the piped water supply to Eleven Centers, the intended benefits will include the significant reduction of time and energy spent in collection of water, particularly for women but also for girls and boys under the age of 15 years. The benefit for boys will appear particularly in Dupti, while for girls in such centers as Aykel, Bichena, Dejen, Werota and Chagni. This will allow women more time for other activities including relaxation or income generation activities, and improved sanitary behaviors. It will allow girls and boys more time for studying.

This should improve the quality of life for these social groups including making the Centers a more pleasant place to live and improving health and well-being of the residents. It will also reduce the amount of time that men and women spend in taking care of sick family members.

By providing people with toilets, women and girls can have privacy which they have not been allowed to have. Also females will be freed from inconvenience peculiar to them in the absence of a proper latrine.

The project will allow the community to determine the positioning and style of water and sanitation facilities, increasing their sense of power over their own environment. In addition, the Project will give women employment opportunities at the implementation as well as the operation and maintenance stages. The employment in the latter is often permanent. Female employment en masse at this stage will contribute to the elevation of female status in society and the business world.

9.6.3 Economic Activities

There are prerequisites for a town to grow economically. Physically, it must have a sufficient level of basic infrastructure such as, road, electricity and water. Socially, it must have, above all, a sufficient educational and medical level.

Road is essential for exchange of materials, finished goods and persons with outside areas. Both electricity and water constitute indispensable components for manufacturing industry. Also, they are a necessity for commercial activities.

A sufficient level of education begets an enlighted type of people with a desire and will for better life. A sufficient medical level makes a healthy people and a healthy people can easily turn a hard working people.

If these five factors are satisfactorily combined, a town is ready for an economic growth.

So far as Eleven Centers are concerned, some of them are not up to the standard regarding some of the four factors excluding water, but most of them suffer from a serious shortage of water.

Therefore, the resolution of water problem through this Project with an added recipe for a resolution of a few more problems may clear the way for a future economic growth of a center.

Water has especially strong impacts on manufacturing industry such as food & beverages, chemicals, mineral products, iron & steel and machinery & equipment, hotels, restaurants & bars, and hospitals. In an event water is sufficiently supplied through this Project, a center's economic activities may be stepped up centering on them.

9.6.4 Others (Religion & Tribe)

In general, the level of access to water and sanitation currently existing for Muslims and Christians is almost the same over Eleven Centers. The level of income for these two religious groups is also similar.

As a result, the benefits of the Project are likely to permeate to all ethnic groups and religious groups at a similar level, with some exception. The benefits of time and energy savings allow time for other things, an improved level of health and well-being, and increased feeling of power over their own lives.

Those centers, which is expected to have different level of benefits, are such as Bati, Werota, Nefas Mewcha and Debre Tabor.

In these centers, the following differences are expected:

- The improvements in sanitation will particularly help the poor and Muslims who at present have less access sanitation facilities. This should have the effect of improving their health status and release more time for other activities.

- The improvements from the sanitary education program, particularly with the minority ethnic groups and religions will ensure that benefits are shared equally.

All of these benefits will have to be monitored with segregated data collection and analysis to ensure that the changes are positive to all social structures within those four centers mentioned above.