Government of Egypt
Governorate of Fayoum

Government of the Netherlands
Ministry of Foreign Affairs
Directorate General for International Cooperation

FAYOUM GOVERNORATE

MASTERPLAN
DRINKING WATER SUPPLY
and WASTE WATER

VOLUME II

DRINKING WATER SUPPLY

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EL AZAB WATER WORKS and
FAYOUM SANITATION DEPARTMENT
in cooperation with

IWACO
Consultants for Water & Environment
Rotterdam
The Netherlands

DHV
DHV Consultants
Amersfoort
The Netherlands

ECG
Engineering Consultants Group S.A.
Cairo
Egypt

FAYOUM GOVERNORATE

MASTERPLAN

DRINKING WATER SUPPLY AND WASTEWATER

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LIST OF ABBREVIATIONS

CAPMAS	Central Agency for Public Mobilisation and Statistics
DCE	Darwish Consulting Engineers
DGIS	Directorate General for International Cooperation
DHV	Consulting Engineers, Amersfoort, The Netherlands
ECG	Engineering Consultants Group (Cairo)
FaDWS	Fayoum Drinking Water and Sanitation Project
FID	Fayoum Irrigation Department
GOE	Government of Egypt
GOF	Governorate of Fayoum
GON	Government of The Netherlands
IWACO	Consultants for Water and Environment, The Netherlands
MOH	Ministry of Health
NOPWASD	National Organisation for Potable Water and Sanitary Drainage
ORDEV	Organisation for the Reconstruction and Development of Egyptian Villages
USAID	United States Agency for International Development
WHO	World Health Organisation

l/cd	liters per capita per day
PE	population equivalent
O&M	operation and maintenance
M&E	Mechanical and Electrical (Equipment)

markaz	centre; district capital
Local unit	Municipality
ezbah	hamlet
zaribah	animal shed inside the house

H.C.	house connection
P.T.	public tap

LE	Egyptian pound
RoR	Rate of return

AC	Asbestos cement
PVC	Polyvinyl chlorine
RC	Reinforced concrete
CI	Cast iron

CHAPTER 1

INTRODUCTION

1.1 GENERAL

In the scope of the Egyptian-Netherlands development cooperation programme, the Fayoum Drinking Water and Sanitation Project is being executed. The project aims "to improve the drinking water and sanitation conditions in the Fayoum governorate to such an extent that it has a long lasting impact on the public health and the well being of the population of the governorate." One of the outputs of the first phase of the project is a masterplan for drinking water supply and wastewater.

The general objective of the masterplan is to provide an integrated strategy for the development of the drinking water and wastewater sector in the Governorate of Fayoum. Technical, institutional and socio-economic aspects are integrated in the plan.

In concrete terms, the masterplan aims at formulating short and medium term programmes for :

a) Water supply and wastewater infrastructure development (investment programmes);
b) Institutional capacity building programmes (cost recovery, organisation development, human resources development).

This volume presents the Masterplan for Drinking Water Supply, covering projected future developments in the drinking water sector to provide for the needs of Fayoum's urban and rural population upto the year 2020.

A map of the governorate is presented in figure 1.1.

Three stages in the masterplanning process were considered:

- Preliminary Masterplan (July 1992);
- Draft Final Masterplan (May 1993);
- Final Masterplan (September 1993).

The objective of the preliminary masterplan was to present at an early stage the outline, approach, basic strategy, targets, criteria and preliminary results to the involved parties, in order to obtain comments and inputs.

These inputs were then incorporated in the Draft Final Masterplan. Especially the financial and organisational chapters of this draft plan, which were not yet included in the Preliminary Plan, were thoroughly discussed.

A general agreement on the contents of the masterplan has now been reached and is laid down in this Volume.

1.2 APPLIED METHODOLOGY

1.2.1 Phasing of masterplanning activities

Four main stages of activities can be identified in the masterplanning process (see figure 1.2):

a) Review of existing situation

An overall physical plan for the Governorate for future land use, physical or economic development appeared to be unavailable. However, a drinking water and wastewater masterplan for Fayoum City is available. Valuable use could also be made of the "Fayoum Environmental Profile", which provides a general picture of the Governorate (ref. 1).

In line with the regional approach for masterplanning - which is discussed in section 1.2.3 of this introduction - the project adopted a combination of approaches for primary data collection.

- At regional level, a careful study and analysis of the El Azab water production and distribution facilities was made. Organisational and financial assessments of the water utility were included.
- At village level, data collection included a rapid assessment of all Local Units in the governorate, and an in-depth study in five pilot villages, in order to obtain insight in socio-economic, water supply and wastewater conditions.
- In addition, comparative studies were made with water supply organisations in other governorates.

The results of all data collection are summarised in chapter 2. Relevant details are provided in the annexes (Vol.IV) and in FaDWS technical reports, which are referred to where applicable.

b) Needs assessment and identification of sector requirements

During this stage of the masterplanning process the present conditions are compared with future needs and targets. Based on this, sector requirements can be identified. The water supply needs assessment is presented in chapter 3 and technical options are elaborated in chapter 4 (including an environmental impact assessment). Financial and organisational requirements are dealt with in chapters 6 and 7.

c) Strategic planning

The first phase programme (up to the year 2000) is outlined in chapter 5. This includes a list of specific priority projects. Plans for cost recovery and institutional development are presented in chapters 6 and 7.

Figure 1.2. The Masterplanning Process

	PROCESS STAGE	OUTPUT	AIMED AT
A.	REVIEW OF EXISTING SITUATION	VARIOUS FaDWS TECHNICAL REPORTS	PROVIDING BASIC DATA
B.	NEEDS ASSESSMENT	PRELIMINARY MASTERPLAN	BASIC AGREEMENT ON PLANNING APPROACH AND TARGET SETTING
C.	STRATEGIC PLANNING	DRAFT FINAL MASTERPLAN	AGREEMENT ON INVESTMENT PLAN, ORG. DEVELOPMENT PLAN AND COST RECOVERY STRATEGY
		FINAL MASTERPLAN	APPROVAL BY GOF AND NOPWASD
D.	PRIORITY PROJECT FORMULATION	PRELIMINARY DESIGNS AND COST ESTIMATES	PREPARATION OF FUNDING REQUESTS

d) Priority project formulation

This stage, which will follow the approval of the Final Masterplan, results in preliminary designs and cost estimates for short term priority projects, which can be utilised for funding requests.

1.2.2 Planning horizon

The planning horizon for the masterplan is approximately thirty years (1992 - 2020). Investment and organisational development programmes cover a much shorter period: 7 to 10 years. The following approach for planning has been adopted:

- Investment requirements and organisational and financial development plans are determined in detail upto the year 2000.
- Because most of the investment works (such as treatment plants and pipelines) have a much longer lifetime, the design horizon is also longer. For example, a new water distribution pipeline shall normally cover the requirements for some 15 years to come, in order to avoid too frequent replacements. An appropriate assessment of medium term requirements - upto 2010 - is therefore necessary.
- Any new work shall take possible future extensions into account. Of specific importance are the spatial planning and reservations of sufficient space for future extensions. Therefore, a sketch of long term requirements - in the year 2020 - is provided.

The planning process therefore starts with an estimate of long term requirements. The medium and short term needs are subsequently assessed with an increasing degree of detail. In this way the uncertainty with regard to - especially -the longer term demographic developments can be obviated appropriately. The approach also incorporates the principle that, by the time the first short-term investment programme has been implemented, an updated second phase investment programme shall be made, adjusted to actual developments.

1.2.3 Regional approach

The methodology takes as a starting point that water supply and sanitation improvements in Fayoum have to be based as much as possible on a regional concept rather than on a single village approach. The choice for a regional approach has been made for the following reasons:

- the water supply system of El Azab (the organisation responsible for water supply in Fayoum) is regional. Nearly the whole governorate is supplied from one central treatment plant by a distribution network covering the entire governorate;

- the approach for phased planning, as explained above, can only be adopted successfully when long and medium term needs assessments are made on a governorate-wide scale. For these longer term needs, detailed information for each

village (of which there are 160 in Fayoum, plus 1600 hamlets) is not required. Collection of detailed and reliable village data at this stage would consume a disproportional amount of time and resources. Only in the detailed design phase the availability of site-specific information is required.

Although Fayoum City is excluded from the Terms of Reference for the FaDWS project, it appeared to be impossible to neglect the developments in the city. In this masterplan it is foreseen that Fayoum City will continue to rely on water supply from El Azab. A future merged water supply (and wastewater) utility is also a serious option for Fayoum.

1.2.4 Scenarios

Masterplans often present a few alternative scenarios on how to reach a certain future situation.

In this masterplan only one scenario is presented, which is based on supporting studies analysing various possible alternatives. The following remarks can be made:

- the water demand analysis in the masterplan could have been based on the official CAPMAS population projection, which aims at a sharp decrease of the population growth rate from 3% at present to 0.4% after the year 2015. Since this is a disputable scenario, a more conservative decrease of population growth has been assumed;

- conservative targets are also used for future per capita water consumption rates. Setting the targets higher would mean that the required investments, which are already considerable, would become even higher. This is not considered realistic;

- the future water demands are related to developments in the sewerage sector. Several scenarios have been analyzed which show that - on the short term -the implications for variations in water demands are not large;

- several water supply options such as centralised versus decentralised water production have been analyzed and recommendations are made;

- an organisational development plan with phased targets and alternative cost recovery scenarios are provided;

- identified projects are ranked according to priority. The pace of implementation of these projects will be determined by the finance actually available. A possible investment plan is provided.

1.2.5 Relation with wastewater masterplan

The strong links and interdependency between the supply of drinking water and the disposal of wastewater are fully acknowledged in this masterplan.

There is clear evidence that water consumption in Fayoum is closely related to available wastewater facilities. If these facilities are poor, water consumption is limited; if they are in good shape, water consumption is significantly higher (see section 2.3.2). In most rural areas of the Governorate the poor on-site sanitation facilities allow only a rather modest piped water consumption of an average 50 l/cd for HC owners.

Improved wastewater facilities (sewers, improved pits and desludging facilities) may double piped water consumption in the served areas through increased per capita consumption levels and additional demand for HC's.

A close link between the water supply and wastewater plan has therefore been observed.

There is a significant gap between water supply and wastewater provisions to date, and care should be taken that the gap between the two service levels does not widen even more. In the two masterplans a balance is therefore struck between the development in the two sub-sectors; the plans are attuned to each other. It implies that, after a period of 7 to 10 years - when it is hoped that major portions of the first phase investment plans have been implemented - an evaluation of the developments in the two sub-sectors is required and an adjustment of the plans is to be made.

CHAPTER 2

EXISTING WATER SUPPLY SITUATION

This chapter provides a summary of data collection on existing water supply conditions in Fayoum Governorate. A brief description of the supply area is provided first after which water production, distribution, delivery and the organisational/financial aspects are reviewed. Finally a consumers profile is provided and the chapter concludes with priorities for improvements in four fields: technical, financial (cost recovery), organisational and consumers priorities.

2.1 SUPPLY AREA

2.1.1 General

The supply area dealt with in this masterplan basically covers the entire Governorate of Fayoum. El Azab supplies the whole area with drinking water, excluding some 50% of the requirements of Fayoum City, which has its own treatment facilities and organisation. The total 1992 population in the supply area, including Fayoum City, amounts to 1,859,000 inhabitants.

Some water is also supplied to the western part of the Governorate of Beni Suef, but this supply will soon stop when a new treatment plant in that governorate is brought into operation. A masterplan for the water supply of Fayoum City was prepared in 1988 with USAID assistance (ref. 2), of which the first phase is presently being implemented.

Two towns in the Governorate administer and manage their own water supply: Fayoum City (including production) and Senoures (distribution only). The rest of the governorate is fully administered and managed by El Azab. The separation of water supply responsibilities between Fayoum City and the rest of the governorate is historical.

The piped water supply provided by El Azab and the Fayoum City water supply form the only source of drinking water in the entire area, except for some dug wells along irrigation channels.

Extensive data collection has been carried out to obtain insight into the condition of the water supply system, of which the results are summarised below.

2.1.2 Population

The population data of the 1986 CAPMAS census have been used as a basis for the plan. Present population figures are estimated by applying the same average population growth rates as those of the period 1976-1986 (which was estimated as 3.1% per year). The 1992 population, calculated in this way, is given in table 2.1.

Detailed population data and projections upto year 2020 are provided in annex A.1.

Table 2.1. Estimate of 1992 population

Markaz	Area	Population
Fayoum	Fayoum City	255,000
	Rural Areas	281,000
Tamiya	Tamiya Town	35,000
	Rural Areas	190,000
Senoures	Senoures Town	66,000
	Rural Areas	247,000
Ibshway	Ibshway Town	42,000
	Rural Areas	382,000
Etsa	Etsa Town	33,000
	Rural Areas	328,000
Total Urban Areas		431,000
Total Rural Areas		1,428,000
Total Fayoum Governorate		1,859,000

source: extrapolation of CAPMAS census of 1976 and 1986 (see annex A.1)

Fayoum City and the four Markaz (or district) capitals are classified as urban area. All other villages, which also include villages of up to 30,000 inhabitants, are classified as rural.

The settlement sizes and the number of settlements are shown in table 2.2

Table 2.2 Settlement sizes and frequency in Fayoum (1992)

Category	Number	Pop. range	Total pop.	% of pop.
Fayoum city	1		255,000	14
Markaz towns	4	33-66,000	176,000	9
Big villages	25	15-33,000	403,000	22
Small villages	132	< 15,000	668,000	36
Ezbah's	1605	< 1,000	357,000	19
TOTAL	±1765		1,859,000	100

Ref: annex A.1.

Population statistics are available with Local Units and attached villages as smallest units. The population of ezbah's is included in these statistics and is estimated at 25% of the rural population.

2.2 WATER PRODUCTION AND DISTRIBUTION

2.2.1 Water production

Capacities and Actual Supply

Most of the water is supplied from the El Azab treatment plant, located centrally in the area. See figure 2.1.

The first production unit at this plant was commissioned in 1940, with a capacity of 400 l/s. The plant was expanded in 1963 and again in 1988, while an upgrading has recently been completed. The total production capacity in 1992 is 1500 l/s. See table 2.3.

Table 2.3. Production Capacities, El Azab (1992)

Year of installation	Name of plant	Installed capacity (l/s)	Storage capacity (m^3)
1940	Patterson	500 (after upgrading)	3,500 (underground) 6,300 (elevated)
1963	Bamag	500	4,000 (underground)
1988	Intersigma	500	4,000 (underground)
since 1981	Compact units	425	2,800
Total installed capacity		1925 l/s	11,500 (effective)

The measured average supply from the treatment plant is estimated at 1190 l/s (or 103,000 m^3/day). During peak months, the average supply is some 10% higher. Peak hour flows (in these months) reach 1500 l/s. For a more detailed assessment of the actual production, we refer to Annexes A.2, A.3 and the FaDWS report on the Water Balance (ref. 3).

Since 1981, 17 compact treatment units have been constructed at the fringes of the Fayoum governorate (taking water from the irrigation channels) to reduce pressing water shortages in these areas. Each unit has a working capacity of 25 l/s, and is scheduled to operate for a 16 hour period per day.
The actual production of the compact units is much lower, due to shorter production hours per day. Analysis of electricity consumption revealed that the units are operated - on average - for 6 to 6.5 hours per day only, reducing the average daily production to 9,500 m^3/day (see also ref. 3).
During one month in the winter, when irrigation channels are set dry for maintenance, the units cannot be operated.

Storage

The El Azab plant has three underground storage reservoirs with a total capacity of 11,500 m^3. Two hours of water production can be stored.

Fourteen of the compact units have reservoirs of 200 m^3 each, also good for two hours production.

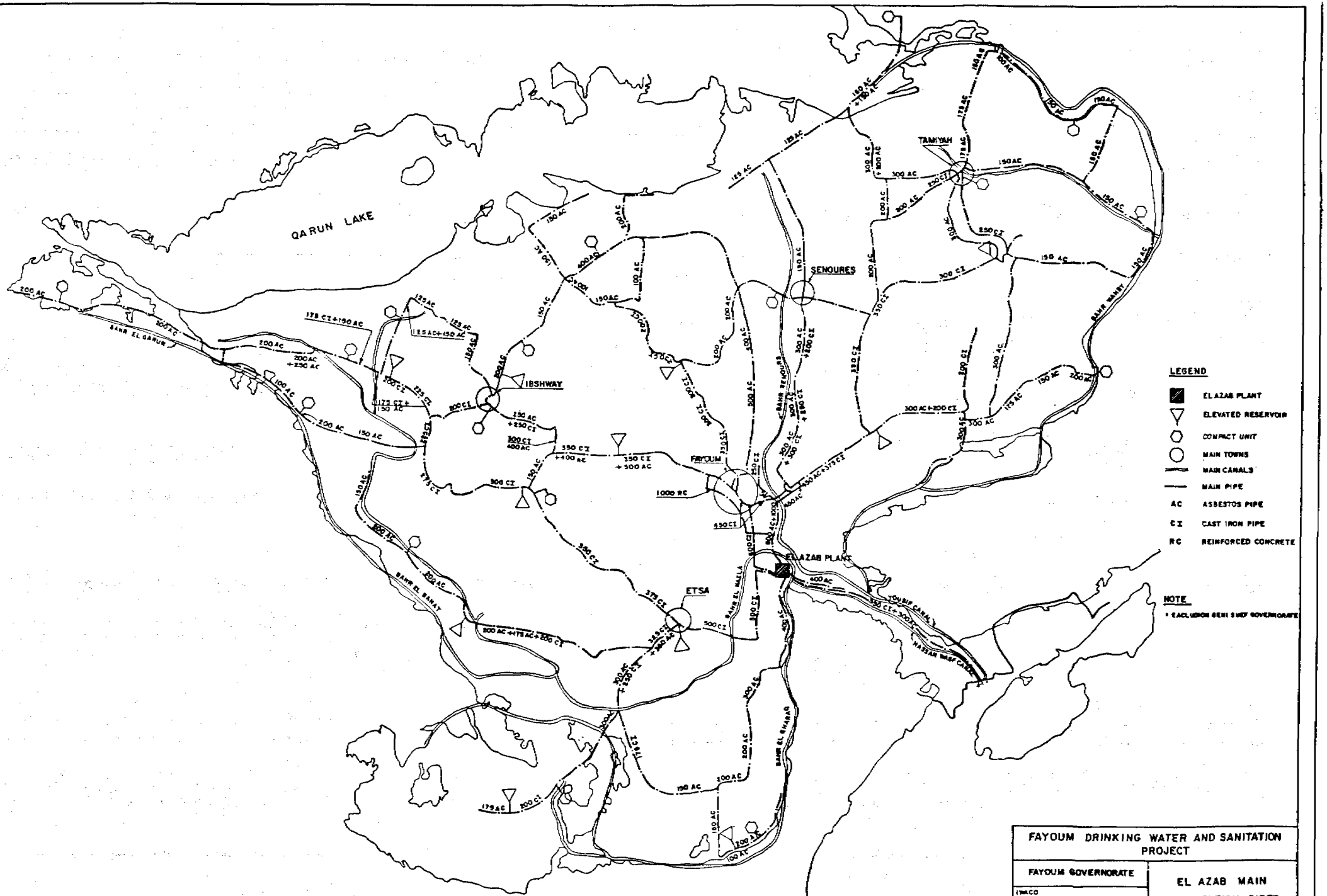


Figure 2.1. Water Supply Systems Fayoum Governorate

In the 1940-ies, twelve elevated reservoirs with a total volume of 6,300 m^3 were constructed of which the location is shown in figure 2.1. The water towers have not been in use for a long time now because pressures in the distribution mains are insufficient to fill them.

Structural Condition

A description of the treatment plant at El Azab and the compact units is presented in annex A.2. The main plant functions reasonably well, but rehabilitation of certain elements is necessary. Much of the mechanical and electrical equipment of the older units will need to be overhauled or replaced in the near future. Concrete work needs repair at many locations.

The seventeen compact treatment units are erected in steel and often include sophisticated metering and control. Maintenance is limited to indispensable parts and many appurtenances do not function.

The structural condition of the twelve water towers is generally good. If it is considered to bring them into operation again, it will be necessary to replace the piping work.

Water quality

The raw water for water production is abstracted from irrigation channels: at El Azab from the large Bahr Hassan Wasef; the seventeen compact units from smaller canals further downstream in the depression. Raw water quality can be described as good for the production of drinking water: low solids contents, chemical composition within tolerable limits and low bacteriological pollution. In annex A.2 some data of previous years are included. The applied treatment processes are adequate. The laboratory of El Azab has a continuous programme to monitor both raw and treated water.

In addition to the current standard water quality monitoring activities, attention should also be given to the following:

1) the possibility of pollution of the raw water source(s) by pesticides, heavy metals or other non-detectable (i.e. by El Azab laboratory) contaminants,

2) the health risks involved with the chlorination of insufficiently treated water with too high organic contents. Chlorine and organic substances may form carcinogenic compounds.

3) the possibility of ingress of ground or surface water into the distribution system due to leaks and non-continuous supply.

These aspects shall be dealt with during detailed design phases.

2.2.2 Water distribution

A detailed description of the distribution network is provided in annex A.3. Here a summary is presented.

Pipelines: lengths and materials

Three categories can be distinguished in the distribution system:

1) the trunk mains
2) the branches, and
3) village distribution systems

The trunk mains distribute the water from the central treatment plant over the entire Governorate. Their total length is 870 km.
Most trunk mains have diameters of upto 600 mm: Only recently, 1000 mm diameter mains were installed. The "trunk mains" include pipes of 100 to 150 mm diameter, where these form an integrated part of the main distribution network.
Of the trunk mains, 223 km are in cast iron (CI) and 633 km in asbestos cement (AC). The remainder is in prestressed concrete or steel.

Most of the CI pipes date from the 1940's. Extensions were made in AC, also as parallel lines to older pipes. The CI pipes are often considerably corroded - mostly internally but in certain areas also from the outside - resulting in high friction losses and frequent breakages.

The branches convey the water from the main distribution lines to isolated villages. They are mainly of 100 to 150 mm diameter and have a total length of some 135 km, mostly in AC.

The village distribution systems distribute the water inside the towns and villages. Diameters are typically 50 to 150 mm. Material is predominantly PVC. Their total length is estimated at 120 to 250 km.

Water distribution over supply zones

The water produced at the centrally located plant of El Azab is distributed over the governorate in several supply zones, as illustrated in figure 2.2.

The zones are defined as areas that are supplied at one location and from one trunk main. The zones do not necessarily coincide with the administrative boundaries between the districts of the same name, or with the distribution areas operated by the various maintenance centres of El Azab.

Table 2.4. shows the comparison of the actual average water distribution over the different zones with the theoretical water demands in each zone (i.e. the total supply divided proportionally over the population in the respective zones). It shows that the water is not distributed equally; Tamiya and part of Senoures receive relatively more water than the other areas (around 50% more).

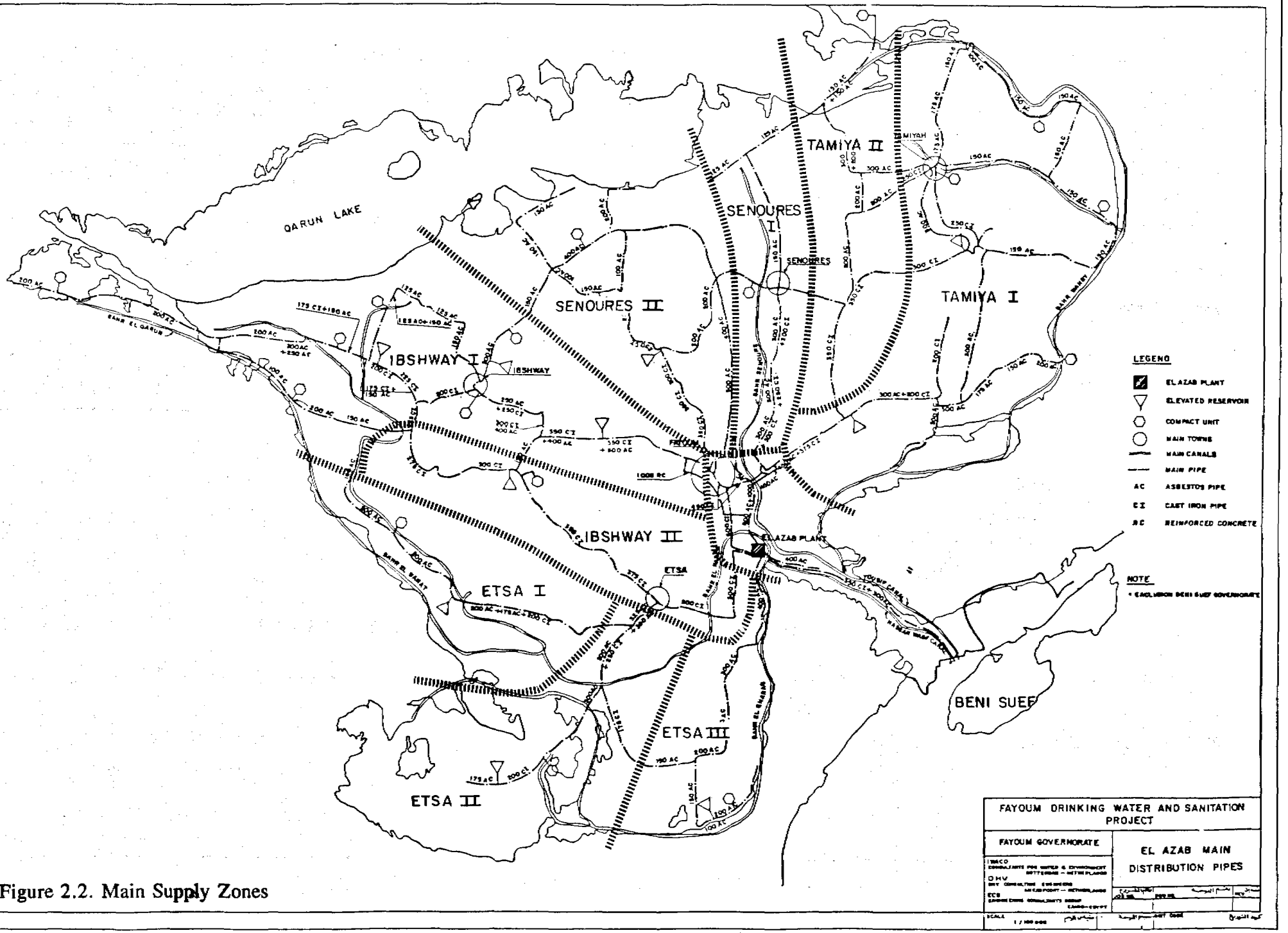


Figure 2.2. Main Supply Zones

water is not distributed equally; Tamiya and part of Senoures receive relatively more water than the other areas (around 50% more).

Table 2.4. Distribution of water over supply zones

SUPPLY ZONE	SUPPLIES			DEMANDS (***)	SUPPLY/ DEMAND
	by El Azab (*) (m^3/day)	Compact Units (**) (m^3/day)	Total Supplies (m^3/day)	(m^3/day)	
TAMIYA I, II	17,911	3,168	21,079	13,369	1.6
SENOURES I	5,288	567	5,855	7,445	0.8
SENOURES II	12,356	819	13,175	9,567	1.4
IBSHWAY I	12,467	3,168	15,635	16,299	1.0
IBSHWAY II	12,667	1,359	14,026	17,963	0.8
ETSA I, II					
ETSA III	1,067	513	1,580	2,962	0.5
EL AZAB	6,641		6,641	10,467	0.6
FAYOUM CITY	28,978		28,978	28,978	1.0
BENI SUEF	3,204		3,204	3,204	1.0
ARMY CAMP	2,244		2,244	2,244	1.0
TOTAL	102,822	9,594	112,416	112,499	1.0

(*) Supplies are measured average day supplies through trunk mains
(**) Supplies are estimates based on yearly electricity consumption
(***) Demands proportional to population distribution

Water distribution inside the zones

Inside each zone, the water is not distributed in proportion to the demands. At the upstream ends of the zones pressures are generally good and supply reliable. At the downstream ends, pressures are often insufficient and frequent cuts in the supply are experienced.

The unequal distribution of water within each zone has two main causes: 1) the higher pressures at the upstream parts which allow higher consumption rates in these areas and 2) the often insufficient capacity of the pipes to convey the water to the downstream ends of the zones.

Pressures in the distribution system

Figures 2.3 and 2.4 show examples of pressures in the distribution network and indicate the poor service level at the fringes of the supply area. Shown are normal supply conditions (figure 2.3) and the situation when compact units are not in operation; typical for the month of January during the irrigation winter closure (figure 2.4).

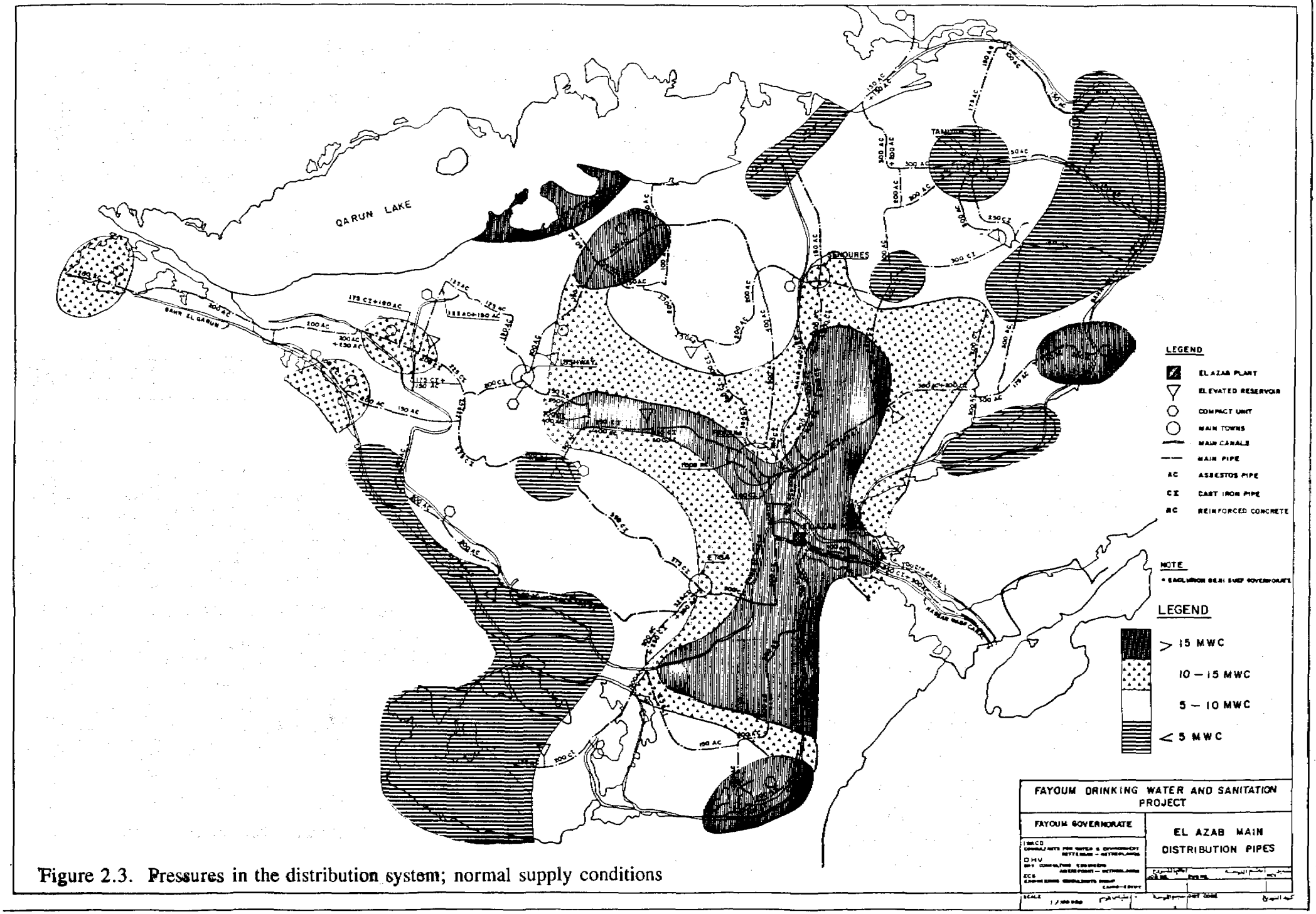


Figure 2.3. Pressures in the distribution system; normal supply conditions

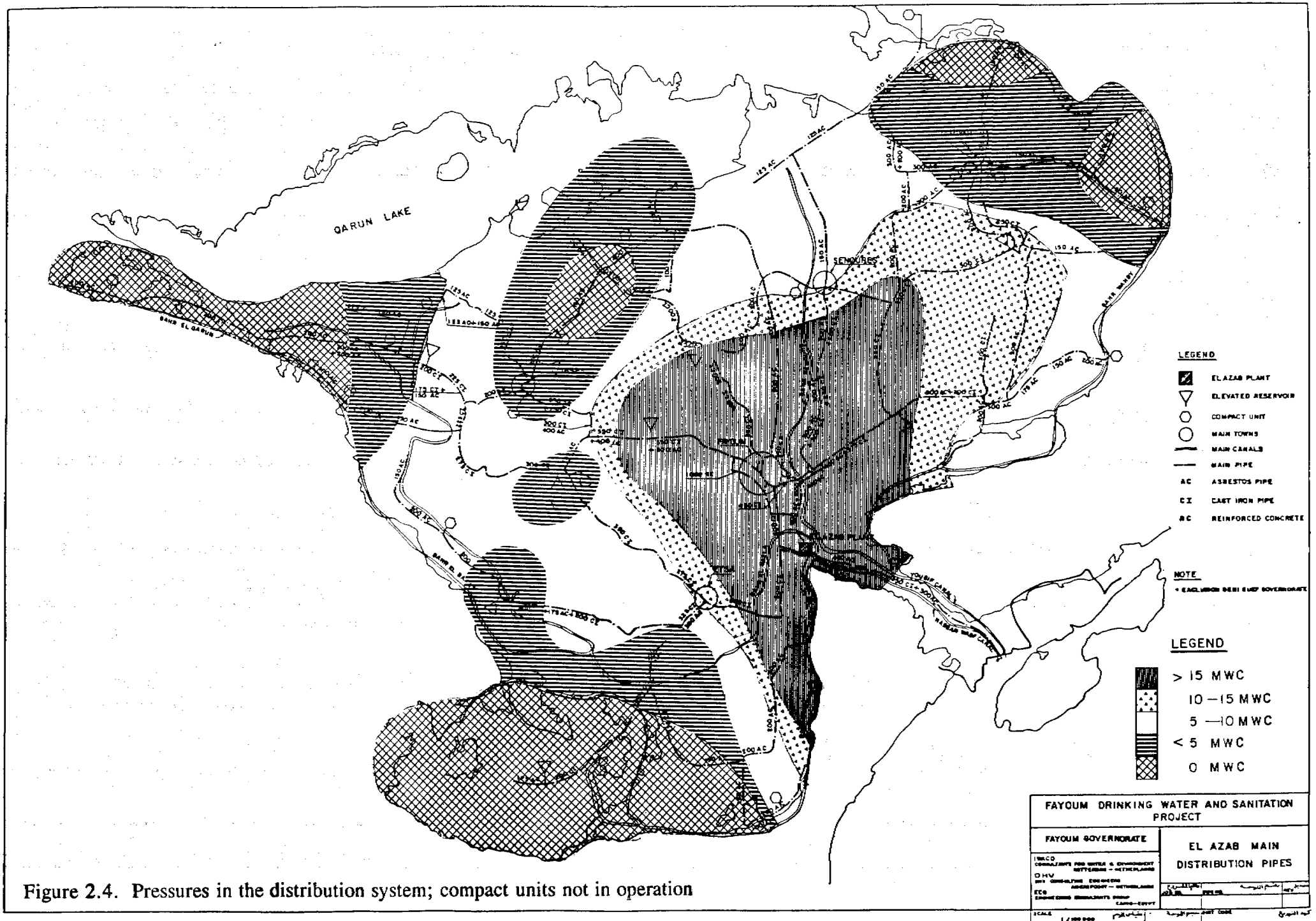


Figure 2.4. Pressures in the distribution system; compact units not in operation

The poor service level is confirmed in household surveys. In villages that are located in low pressure zones people complain about insufficient water. Frequent cuts in the supply are also reported.

Flow capacities of distribution mains

Although the distribution network has been expanded gradually over the past decades to follow the increases in water demands (also by laying parallel lines), the flow capacity of many sections of the network is not sufficient (i.e. diameters are too small). Figure 2.5 shows these sections. The capacity of pipe sections with a total length of 45 km is not sufficient to transport the water under normal supply conditions; i.e. when compact units are in operation. If these units do not operate, then the total length of pipes with insufficient capacity is 137 km. As a consequence, pressure losses in these pipe sections are very high.
Most other lines work near to their capacity.

The situation is aggravated by leaks, blockages and suspected air pockets in many of the lines. El Azab is now carrying out an extensive measuring campaign on its network to detect these lines and to carry out remedial works. The campaign, initiated by the FaDWS project, will gradually give more detailed insight in the functioning and shortcomings of the distribution network, and enables an effective formulation of rehabilitation works.

2.2.3 The water supply system of Fayoum City

Although Fayoum City has its own water supply system, it still relies heavily on water produced by El Azab.

The system of Fayoum city has been developed separately from the El Azab (or rural) system, and is presently being expanded. A new treatment plant (300 l/s) is being constructed at the old Kohafa Water Works compound, bringing the total production capacity at 600 l/s. New storage capacity (3 water towers and a ground storage tank with a combined volume of 24,000 m^3) and new distribution pipes are being added.

Around 50% of the present water demand of Fayoum City is now supplied from El Azab (average 337 l/s). After completion of the ongoing project in Fayoum City, part of the present supply from El Azab will temporarily become available for the rest of the Governorate, but will - in the near future - be required again for the city. The city's masterplan sets the year 2000 demand at 900 l/s, which is 300 l/s more than the newly available production capacity (ref. 2).

Although the city's masterplan foresees in a further expansion of the Kohafa treatment plant to meet these demands, there are no concrete plans to realise these works before the year 2000.

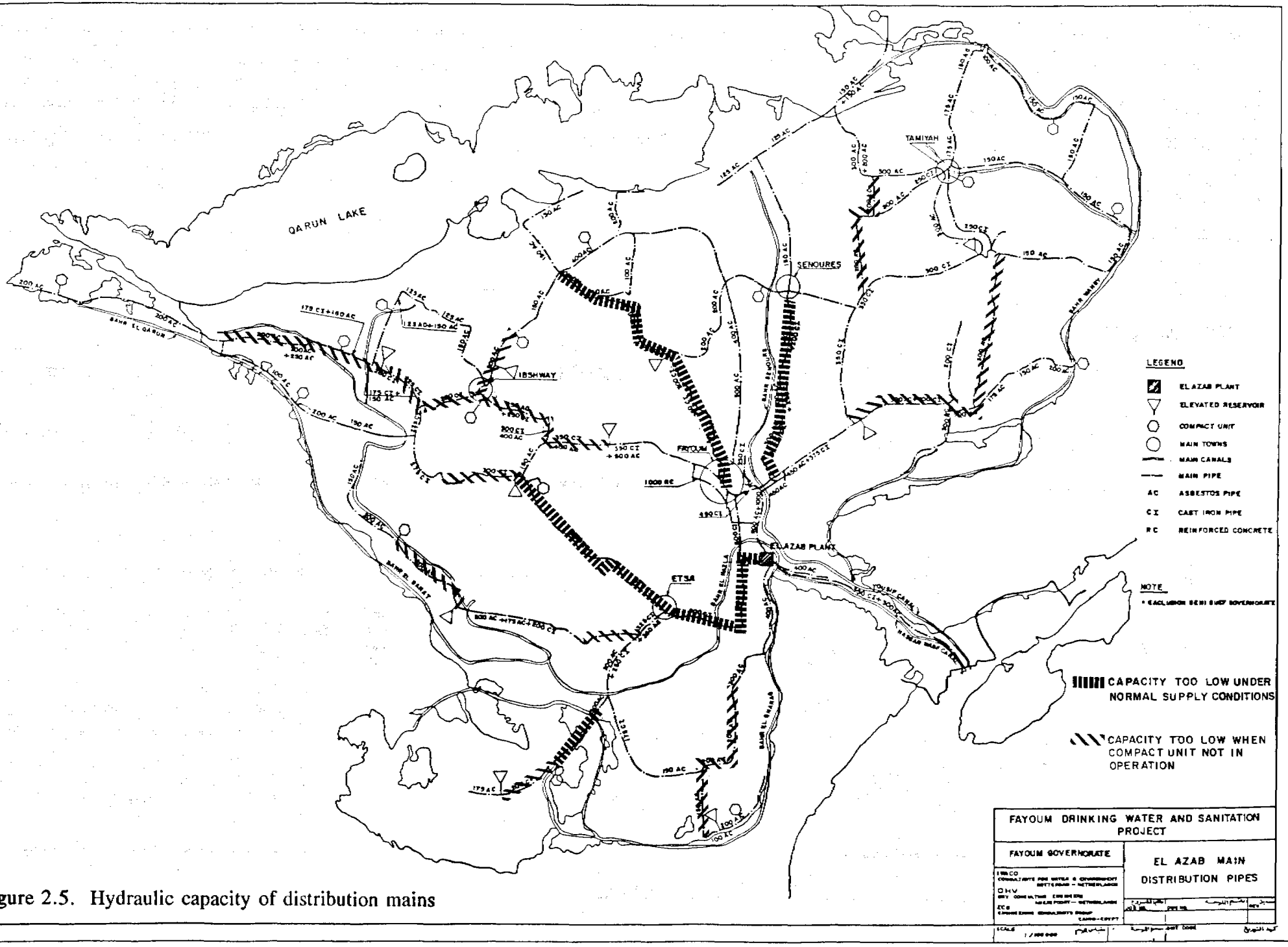


Figure 2.5. Hydraulic capacity of distribution mains

2.3 WATER DELIVERY

Water delivery by El Azab may be categorised as follows:

- bulk supplies to third parties
- supply to house connections
- supply to public taps
- non-domestic supplies
- unaccounted-for water

Below the categories are described in some more detail and a water balance for the El Azab Water Works is drawn up. A detailed description and analysis is presented in a separate FaDWS technical report (ref. 3).

2.3.1 Bulk supply to third parties

In addition to the supply to rural Fayoum, El Azab supplies bulk quantities of water to Fayoum City, to the governorate of Beni Suef and to an army camp.

The supply to Fayoum City is the largest and varies between 50 l/s (night flows) and 500 l/s (peak hours). Yearly average supplies, based on flow measurements in the main distribution pipes in 1992, are as follows:

Supply to Fayoum City	337 l/s
Supply to Beni Suef	37 l/s
Supply to large institutions	26 l/s

Total to Third Parties	400 l/s

2.3.2 Supply to house connections

Number of connections and coverage

El Azab administers some 82,500 house connections in the governorate. In addition, there are approximately 43,000 connections in Fayoum City, administered by the city's water supply organisation. Table 2.5 provides a summary for the Governorate.

The average number of users per house connection is estimated at 8, which is a figure based on several surveys.

Table 2.5. Water supply coverage by house connections in Fayoum governorate
Summary for the Governorate

MARKAZ	Population 1992	House conn. 1992	% population coverage
FAYOUM			
Total urban	255,406	43000	92.6
Total rural	280,634	15404	43.9
Total	536,040	58404	67.1
SENOURES			
Total urban	66,152	8400	95.2
Total rural	247,045	15398	51.6
Total	313,198	23798	60.8
IBSHWAY			
Total urban	41,518	2450	47.2
Total rural	381,591	13258	27.8
Total	423,109	15708	29.7
TAMIYA			
Total urban	35,047	2207	50.4
Total rural	190,396	7838	32.9
Total	225,444	10045	35.6
ETSA			
Total urban	33,161	1340	32.3
Total rural	328,350	16237	39.6
Total	361,511	17577	38.9
TOTAL URBAN (incl. Fayoum City)	431,285	57397	80.6
TOTAL RURAL	1,428,016	68135	38.5
TOTAL BY EL AZAB	1,603,895	82532	41.2
GRAND TOTAL	1,859,301	125532	48.2

Overall coverage with house connections in Fayoum Governorate amounts to 48% (including the towns). In the rural areas alone about 39% is served. This coverage is not distributed equally over the Governorate, which is illustrated in figure 2.6. Villages at the fringes of the supply area have a significant lower coverage; often far below 30%.

Aggregated at local unit level, coverage by house connections ranges between a maximum of 93% (Fayoum City) to a minimum of 7% in the village of Menshat El Gamal in Tamiya District (see figure 2.7).

There has been a substantial increase in the number of house connections in the period between 1985 and 1988 (35,000 new connections in three years). After that the Governorate has put a limit to the number of new connections, because of shortages in the water supply. During the last four years only 15,000 new connections were added.

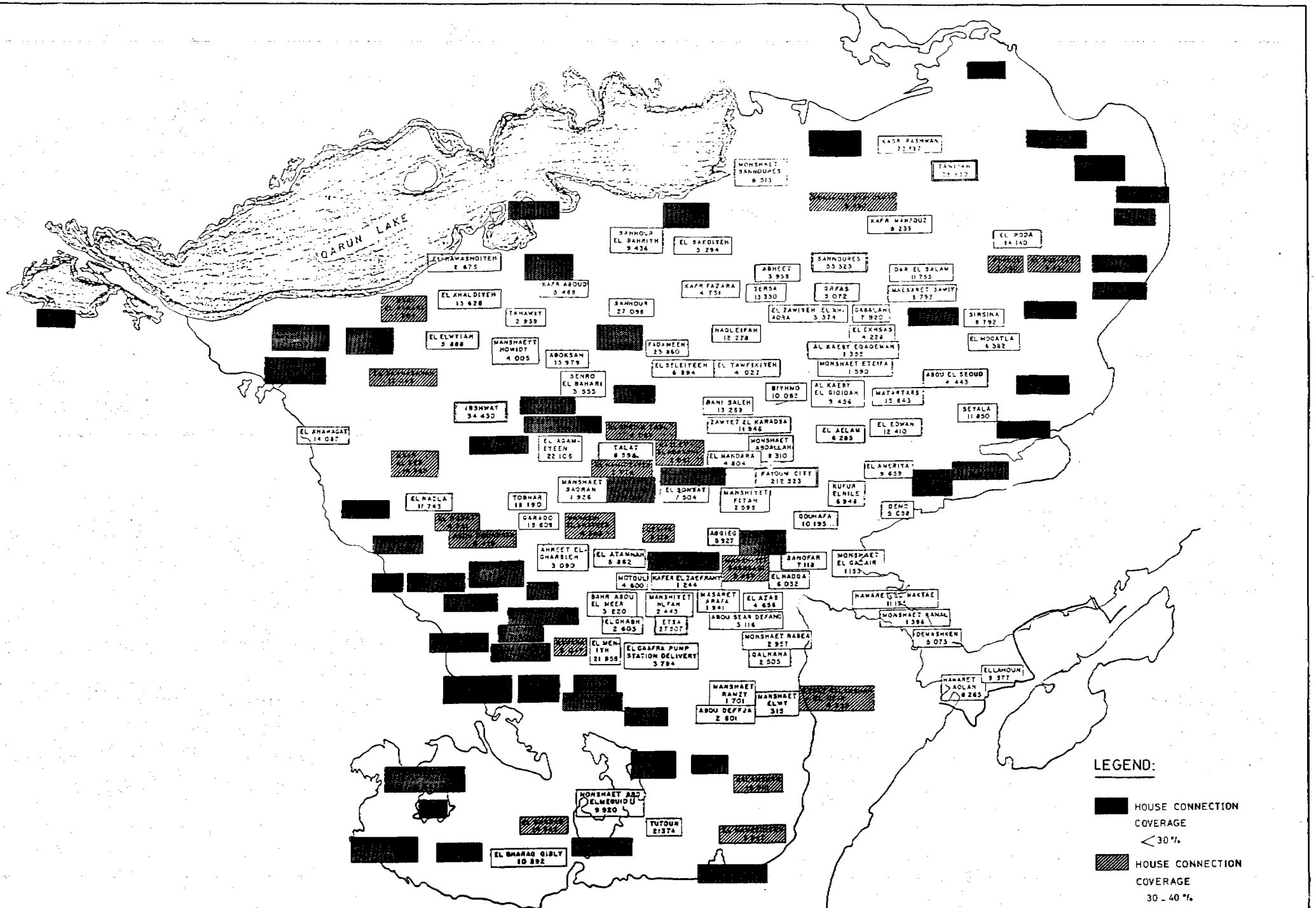
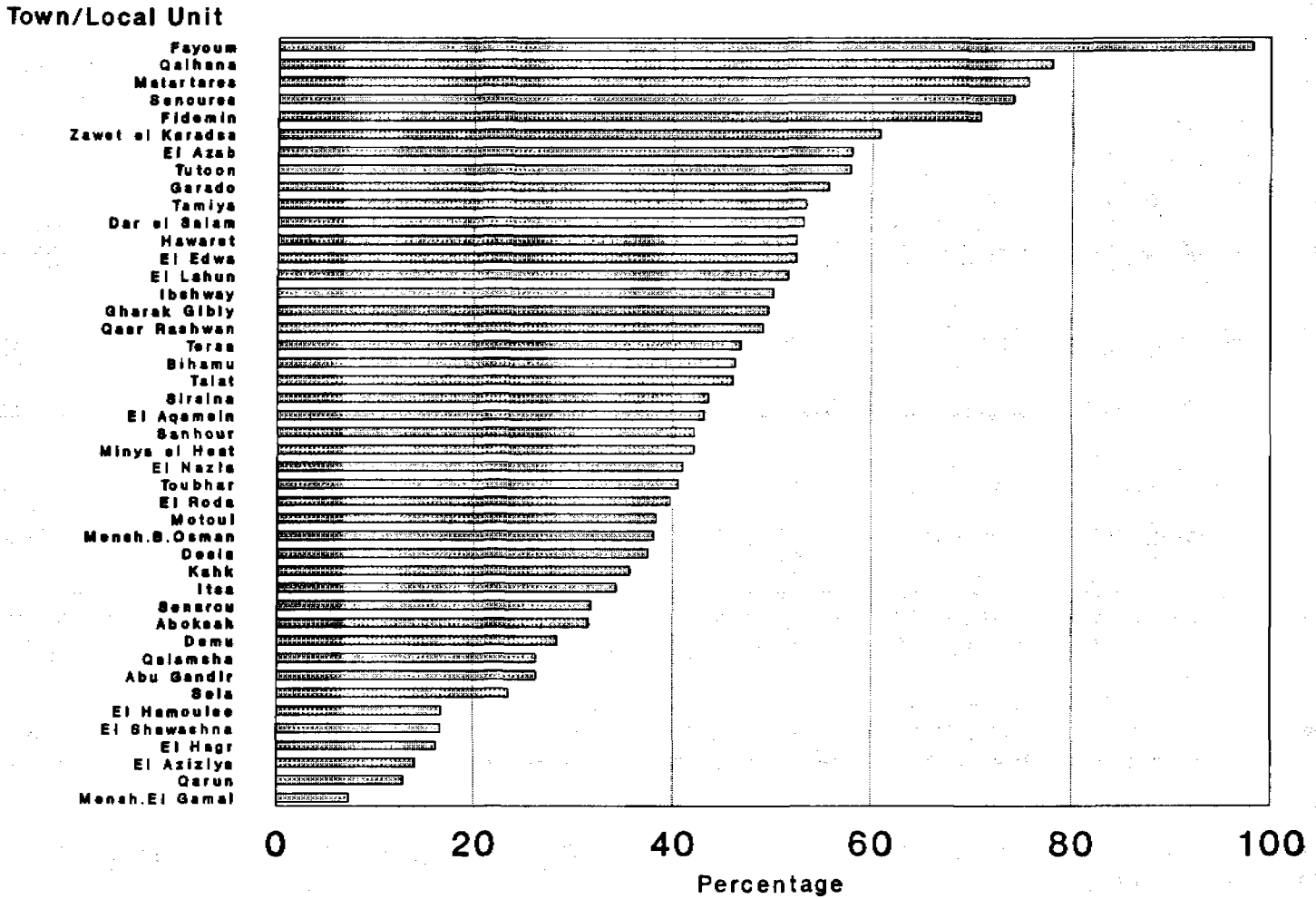


Figure 2.6. Distribution of coverage by house connections

FIG. 2.7 COVERAGE BY HOUSE CONNECTIONS

Local Units Fayoum, 1992



This policy has created a substantial backlog in the provision of house connections, with waiting times for applicants of more than two years. At the same time many illegal connections were made. Detailed information about illegal connections was however, difficult to obtain. The issue needs careful attention during the organisational development phase.

Water consumption through house connections

The assessment of the consumption through house connections is based on the monitoring of in-house water meters in three pilot villages. It gives insight in per-capita consumption, in seasonal variations, relations with in-house plumbing and in geographical variations (for details see: ref. 3). The survey results are summarised as follows:

- The aggregate average per capita consumption through house connections is estimated as 50 l/cd (litre per capita per day). This figure is confirmed by a broader, recently completed water meter survey in Senoures district (June 1993). Lower consumption figures during the winter months are observed.

- There are large variations between the surveyed villages, which are mainly attributed to the mode of wastewater disposal. In areas with a piped sewer system, average per capita consumption may raise to over 120 l/cd. In villages without sewer systems and with high groundwater tables (which restricts the use of cess pits), the consumption is as low as 30 l/cd.

- In sewered areas the consumption at houses with multiple taps increases significantly (upto 140 l/cd).

Table 2.6 summarises the assessment.

Table 2.6 House Connections; Coverage and Consumption

	Year 1992
Coverage by House Connections:	
o number of house connections	82,523
o people per house connection	8
o number of people served	660,000
o % of total population	41%
Consumption through house connections:	
o total consumption, 380 l/s, or	33,000 m^3/day
o consumption per capita (average)	50 l/c. day

* excluding Fayoum City

2.3.3 Public taps

Coverage

Around 41% of the population in the supply area of El Azab is served through house connections. The rest, some 944,000 people, use public taps. It must be noted that, although most of these people have access to a public tap, the use of canals as second domestic water source is common. Surveys in the pilot villages reveal that 70% of public tap users also use canal water.

There are approximately 1800 working public taps in the Governorate. The average number of users per tap is 525, but there are large variations. There are several hamlets of over 1000 inhabitants with only one public tap.

Water consumption through public taps

The monitoring of 15 public taps revealed that the water consumption through a tap is not so much related to the number of users. The average consumption per tap is estimated at 5 m^3/day, resulting in a low average 9.5 l/cd. This includes spillage of water at the tap, which is low. Surveys showed that individual public tap users take some 15 to 20 l/cd home; the lower measured figure of 9.5 l/cd again indicates that there are many people that use the tap less intensively and rely on channel water.

Wastage from public taps without faucets (estimated at 350 to 400) is not included in the consumption figures above. Water loss through these taps may amount to 11,300 m^3/day, which is more than the actual consumption.

Table 2.7 shows the summary of the assessment.

Table 2.7 Public Taps; Coverage, Consumption and Losses

	Year 1992
Coverage by Public Taps:	
o number of public taps	1,800
o people per public tap (average)	525
o number of people served	944,000
o % of total population	59%
Consumption through Public Taps:	
o total consumption, 104 l/s, or	9,000 m^3/day
o consumption per public tap (average)	5 m^3/day
o consumption per capita (average)	9.5 l/c. day
Losses from public taps:	
o number of taps without faucet	350 to 400
o water loss 130 l/s or	11,300 m^3/day

2.3.4 Non-domestic consumption (institutional and commercial)

Small institutional and industrial consumption is estimated at 10% of the domestic demand through house connections.

This category includes water supply to government offices, schools, hospitals, mosques and small industries.

2.3.5 Water balance and not-accounted for water

Table 2.8 gives the present water balance for the supply system, while figure 2.8 illustrates the distribution of water consumption over the various categories graphically.

Table 2.8 shows that an average of 248 l/s remains as unspecified demand. The figure does not include the wastage through public taps, which adds another 130 l/s to the water losses.

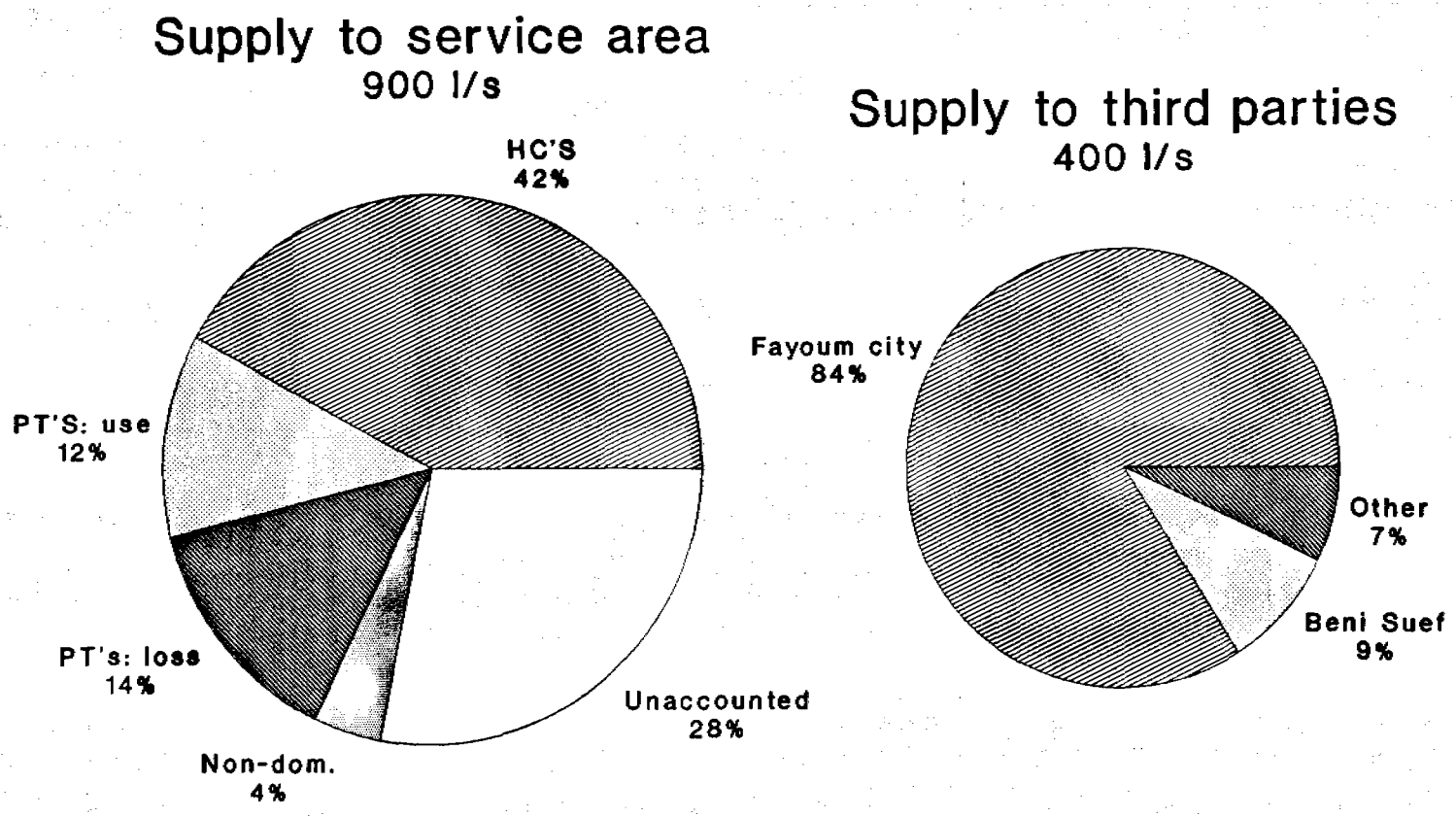
Table 2.8. Water Balance El Azab, 1992

CATEGORY	l/s	m^3/day	(%)
WATER PRODUCTION			
o El Azab Plant	1190	103,100	
o 17 Compact Units	110	9,500	
o Total Production	1300	112,600	
SUPPLY TO THIRD PARTIES			
o Fayoum City	337	29,100	
o Beni Suef	37	3,200	
o Army Camp	26	2,300	
o Total 3rd Parties	400	34,600	
NET SUPPLY TO SERVICE AREA			
o 1300 l/s - 400 l/s =	**900**	**78,000**	**100 %**
WATER CONSUMPTION			
o House connections	380	33,000	42 %
o Public Taps; Use	104	9,000	12 %
Loss	130	11,300	14 %
o Non-Domestic Demand	38	3,300	4 %
o Total Consumption	652	56,600	
NOT-ACCOUNTED FOR			
o 900 l/s - 652 l/s =	248	21,400	28%

(1): volumes of water
(2): as percentage of net supply to service area

This amount of "unaccounted-for" includes uncertainties or inaccuracies in the assessment of the other parameters of the water balance, but represents mainly the estimated water losses through leaks in the distribution system.

FIG. 2.8 DISTRIBUTION OF WATER CONSUMPTION (El Azab 1992)



Leakage in the distribution system is a function of the structural condition of the pipelines, the total length of the system and water pressures. To obtain an impression of the magnitude of the leakage problem, we may compare the situation of El Azab with a survey among British water utilities in the nineteen seventies (ref. 4). El Azab has a - per length of trunk main - loss of 1.0 m^3/h. km. In the British survey this was an average situation.

The losses can also be expressed as function of the number of clients.

Average losses per British service connection in the survey (in areas without active leak control) were 18.6 l/hr. El Azab scores 10.8 l/hr. The conclusion is that El Azab's score is not bad.

If we look at standards used in European water companies, much remains to be achieved however. German standards set acceptable losses at less than 0.3 m^3/h per kilometre of total distribution network (including the distribution networks inside towns). Here, El Azab presently scores 0.75 m^3/h.km. (ref. 5).

2.4 EL AZAB WATER WORKS ORGANISATION

2.4.1 General

El Azab Water Works exists since 1940, when the first surface water purification plant and a regional distribution system, designed by British engineers became operational. During the past 30 years the distribution system expanded and presently covers the entire Governorate. El Azab is therefore a truly regional water supply authority with on the one hand a central plant and headquarters, and on the other hand an integrated regional water supply network, regionally dispersed compact treatment units and maintenance centres in five districts.

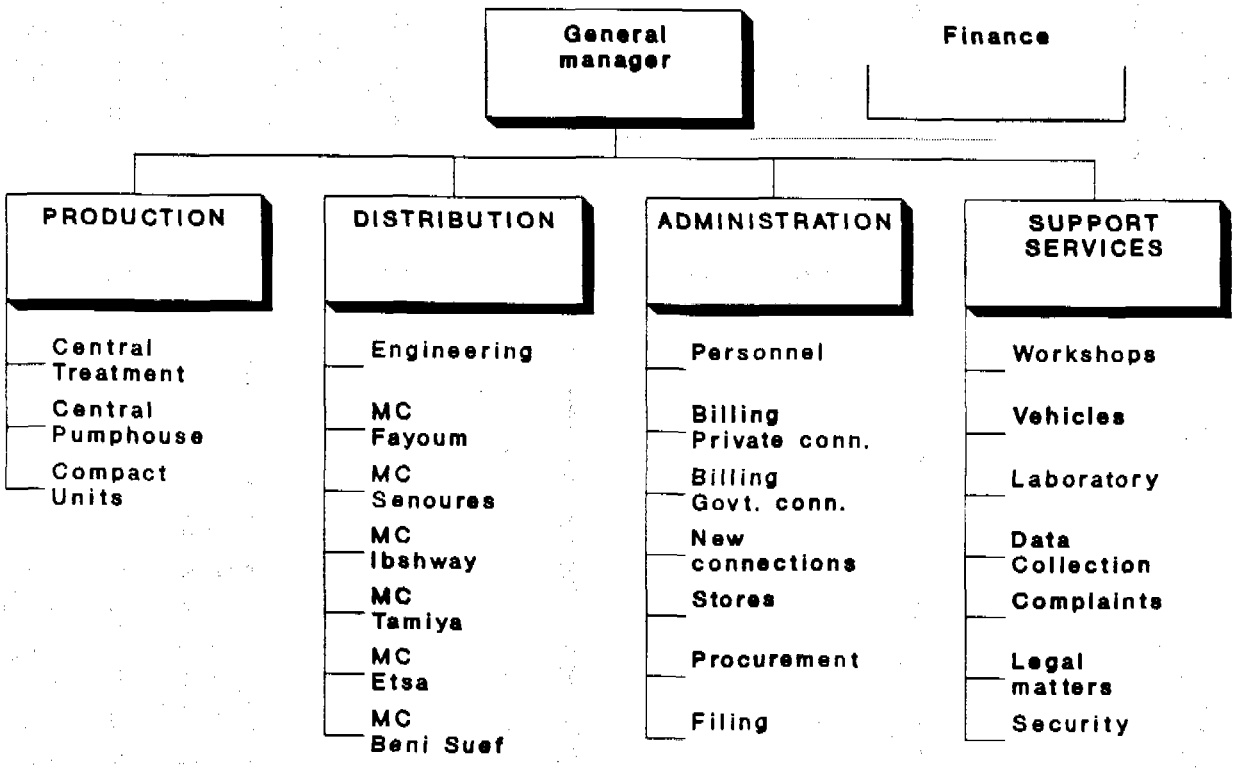
The status of El Azab is 100% governmental. Before 1984 it was owned by the central Government, after that it was transferred to the Governorate of Fayoum, which is responsible for O&M. NOPWASD at the central level is still responsible for the preparation, design and execution of the major investment projects.

El Azab is fully integrated in the governmental administration so it has no institutionally separate identity. Its budget and financial management is subject to the same regulations as any other department within the Governorate. All investment expenditures and a substantial part of the O&M costs are financed from the national government.

2.4.2 Organisation structure

The organisation is managed from a central office with supporting maintenance centres in each district (5 centres), and has a total of 751 employees of which 344 are employed in plant operation, 225 in maintenance and 182 in administration. Figure 2.9 shows the present organisation structure.

FIG. 2.9 ORGANISATION CHART EL AZAB
Situation 1993



Note: Support services is not a separate sector but the mentioned departments are under the direct supervision of the General Manager

The General Manager of El Azab is subordinate to the General Secretary of the Governorate, while the Finance and Accounting Department is subordinate to the Ministry of Finance.

The organisation structure, on paper, does not seem very different from the normal water supply organisation. It has a General Manager and under him the three main departments of production, distribution and administration. The chart does not show that decision making is fully centralised; and there is little room for delegation. Procedures are complicated and involve a large number of steps to follow.

The flow and availability of information in the organisation is limited. Information tends to be outdated or inaccurate, because of the manual administrative system which works slowly. Data collection and recording is minimal, a management information system does not exist.

Personnel and skill structure

Tables 2.9 and 2.10 show the personnel structure of El Azab. The organisation has 751 personnel, of which an estimated 90 are external staff who are not on the payroll of El Azab. They do however, receive bonuses and incentives.

Table 2.9. Personnel El Azab

DEPARTMENT/CATEGORY	EMPLOYEES
GENERAL	**23**
Accounting	15
Complaints, legal affairs, etc	8
ADMINISTRATION DEPT.	**159**
Personnel dept.	27
Procurement & contracts	3
Billing department	69
New connections	9
Stores	13
Security/guards and garden	38
WATER DISTRIBUTION	**179**
Distribution	15
Central maintenance	37
Etsa maintenance centre	32
Tamiya maintenance centre	23
Senoures maintenance centre	30
Ibshway maintenance centre	27
Beni Suef maintenance centre	15
WATER PRODUCTION	**306**
Main treatment	88
Main pump station	61
Compact units	157
ANCILLARY	**84**
Workshop	32
Laboratory	6
Vehicles	46
TOTAL	751

Source: El Azab, 1990

Some typical characteristics may be mentioned:

- The high number of employees working in the compact treatment units. More than 50% of the staff in water production are in the compact units, which only produce 8-10% of the total volume of water. This shows the relative inefficiency of producing water in small units.

Table 2.10. Personnel classification El Azab

Profession	Total	GRADE/CLASS					
		I	II	III	IV	V	VI
Engineers	24	2	5	17			
Technicians	160	3	25	11	121		
Scientists	2			2			
Management	1			1			
Fin. & Acc	3			3			
Clerks	116		9	10	58	12	
Drivers	27		6	2	2	11	6
Skilled workers	119		13	12	8	26	60
Semi-skilled workers	112		4	6	3	9	90
Unskilled workers	97			2	27	24	44
TOTAL EL AZAB	661	5	62	66	219	82	200
EXTERNAL STAFF	90						
GROSS TOTAL	751						

Source: El Azab, 1990

- The major part of the staff is low to semi-skilled and low paid (Government remuneration system).

- Staffing amounts to 9.4 per 1000 connections which is reasonable (6-8 is considered normal). There are however severe shortages of skilled managerial, administrative and technical staff.

For recruitment and appointment of personnel the Governmental system is followed. The Ministry of manpower appoints staff to the Governorates, which subsequently distributes this staff over its departments according to the need. They are appointed according to the Governmental Law No. 47 (1978) on civil employment in the Governmental sector. El Azab cannot recruit independently.

Repair, maintenance and extension practice

Repair of the network is the responsibility of the maintenance centres of El Azab. In case of breakdowns, consumers report to the village Local Unit, who in turn report to the higher level, being the Markaz. In practice, small repairs are done by the village community, which hires a plumber. Major repairs are done by the maintenance centres of El Azab.

Generally, little maintenance is done, repair work having a higher priority. The quality of the repair work is sometimes insufficient. There are different reasons for this performance: lack of funds, lack of skills, lack of spare parts or proper equipment. The lack of funds is likely to be the basic explanation. Salaries as well as expenditures on equipment are far below the required level.

The store appears to be well stocked for distribution spare parts, but the stock of parts for production equipment looks rather erratic. A large section of the store is occupied by waste and discarded materials. There is no lifting truck or other handling equipment.

Purchase procedures are quite complicated; it may take 10 to 15 process steps to obtain a spare part. If the purchase exceeds a certain value, a committee must be formed. Approval of the general manager is required in all cases.

2.4.3 Cost recovery of El Azab Water Works

The financial performance of El Azab is summarised in table 2.11 for the years 1990 and 1992. The operational deficit amounts to about LE 5.1 million in 1992, which is nearly 80% of the total costs. The deficit is covered by Government subsidies and USAID grants. Depreciation is not taken into account.

Table 2.11. Summary financial statement El Azab 1990/1992 (in LE)

CATEGORY	1990	1992
OPERATING EXPENSES		
Salaries and wages	1,600,000	1,900,000
Power	1,300,000	3,100,000
Chemicals	900,000	1,200,000
Materials	300,000	400,000
TOTAL EXPENSES	4,100,000	6,600,000
REVENUES FROM WATER SOLD	1,100,000	1,500,000
OPERATING DEFICIT (covered by Govt. subsidies)	(3,000,000)	(5,100,000)

Source: El Azab (1993)

The costs of electricity and chemicals rose substantially in the period between 1990 and 1992, whereas total water production remained more or less constant. These price increases are due to a reduction of government subsidies. Revenue collection improved considerably since July '92 when meter reading and revenue collection was delegated to the Local Units.

The financial performance of El Azab according to commercial standards is poor, although it should be realized that because of its governmental status, El Azab is not stimulated nor given the possibilities to perform better. The organisation's responsibility is to produce and distribute clean water with installations and facilities which have been financed from the National Government. El Azab receives an annual operating budget and funds for maintenance and urgent replacements.

The fact that El Azab is still a pure governmental organisation limits its financial scope. The revenues are transferred to the Ministry of Finance. In return the ministry provides a budget, which is however insufficient to meet the expenses required. Supplementary budget amounts are coming from USAID.

There exists no relation between the revenue amount collected and the budget allocated. This is certainly not a stimulus to make extra efforts.

As can be seen in table 2.8 as much as 40% of the water produced (1300 l/s) has no price. It comprises a 248 l/s of technical losses and a 234 l/s of water supplied through public taps which is free of charge, plus estimated unpriced water in Beni Suef of some 37 l/s.

About 60% of the water produced is priced, which might have resulted in a potential revenue of LE 2.2 million. However, because of bad debts, incomplete coverage and arrears, the actual revenue was LE 1.5 million in 1992, or 20% of the total costs. The revenue collection efficiency is 60%.

It will be clear that under the present conditions El Azab is not capable of managing the future water supply without continued substantial external financial support. Improvement of cost recovery is therefore one of the priorities.

2.4.4 Comparison of El Azab with other water companies

A comparison with some other Governorates and cities shows that water supply in Fayoum is lagging behind. An overview is shown in table 2.12.

Available production capacity per inhabitant is less than everywhere else, the percentage of house connections is less, the cost price of the water is lowest but cost recovery is also lowest. All this shows that water supply in Fayoum has a backlog compared with other governorates, not only technically but also from the point of view of efficiency and organisational performance.

The comparison between El Azab and Fayoum City moreover shows that El Azab is possibly subsidising the city by supplying cheap bulk water.

2.5 CONSUMERS PROFILE

2.5.1 Introduction

The consumers profile summarised below is mainly based on a customers survey carried out in 1992. For complete details and results of this survey, reference is made to the corresponding FaDWS project report (ref. 6).

Table 2.12. Comparison of key indicators for selected water companies in Egypt

INDICATOR	Unit	RURAL GOVERNORATES					URBAN WATER SUPPLIES			
		BEHEIRA	DAMIETTA	KAFR EL SHEIKH	FAYOUM EL AZAB		FAYOUM *	BENI SUEF *	MINYA *	ALEXANDRIA **
Population		3,400,000	1,500,000	2,000,000	1,600,000		260,000	180,000	220,000	3,800,000
Exist. prod. capacity	l/sec	2,400	2,270	2,500	1,300					
	m^3/day	207,360	196,128	216,000	112,000		32,900	26,000	28,500	2,000,000
Production capacity under construction	l/sec	2,000	1,400	1,800	0		300	300	300	2,500
House connections		220,000	130,000	170,000	82,500		43,000	24,000	30,000	430,000
Personnel		1,300	950	1,200	750		190	130	331	4,000
Avail. cap:										
l/cap.day	present	61	131	108	50	***	127	144	130	526
l/cap.day	after ext.	112	211	186	50		226	288	247	583
% HC		45	61	60	41	%	99	80	82	90
HC's/staff		169	137	142	107		226	185	91	108
Cost price (O&M)	Pt/m^3	21.8	12	25	9.7		7.2	16.3	16.0	11.4
Basic Tariff	Pt/m^3	20	12	15	8.5		6.5	6.5	6.5	11.0
Sewage	%	n.a	50	n.a	n.a.		20	20	20	20
Annual Revenues	LE/yr	16,000,000	6,300,000	8,900,000	1,360,000		555,000	420,000	783,000	56,000,000
Cost recovery	Pt/m^3	21.1	8.8	11.3	3.5		4.6	4.4	7.5	7.7
Cost rec.% (O&M)	%	97.0	73.3	45.2	36.1		64.2	27.2	47.0	67.3

*) Source: PCD Project Evaluation, May '91 (ECG, Cairo)
**) Including demand from industries, port and tourism
***) excluding supply to Fayoum City

A total of 315 households were interviewed in 5 main villages and their 47 hamlets. From all households 58% were interviewed in the main villages, the rest in the hamlets.

Of 315 households 36.5%, has a house connection. These house connections serve in total 1060 persons.

2.5.2 Socio-economic conditions

The survey used four indicators for living standard: the building materials from which the house is constructed, having animals or not, having facilities such as a piped water connection, sanitation and electricity, and finally having electrical appliances and household assets. No income nor expenditure questions were asked. Availability of household facilities is shown in table 2.13. The variation between villages is substantial.

Table 2.13. Availability of Household facilities

Total households interviewed: 315 (5 villages, 47 hamlets)		
Facility	% owned	% range (min-max)
Electricity	80.3	58-96
House connection	36.5	31-50
Latrine	46.0	27-75
Cess pit	38.1	10-75
Drainage pipe	10.8	0-35
Kitchen	13.7	1-25

A TV-set is a priority consumer good: 57% of the households in the survey have one. Of other electrical appliances over one-third has a washing machine, and the same number has a refrigerator. Nearly one-quarter has a gas stove and a cassette player.

The rural character of villages is expressed in the use of building materials and the ownership of animals. One-third, or 34%, lives in a mud house, the remainder in a house made of bricks or concrete.
Having a *zaribah* or in-house animal shed is common practice: 48% have this. Only 24% of the households do not keep animals at all, while all others keep at least poultry.

2.5.3 General water consumption pattern

The water consumption pattern in the five Local Units is summarised in table 2.14. Of all water users 36% are owners of house connections, 62% are public tap users and 2% collect their water at their neighbour's connection. Canal water is used as a secondary source by over 50% of the households.

The average consumption of water is 50 l/cd for users of house connections and between 15-20 l/cd for public tap users (see section 2.3). By comparison with public tap users, house connection customers consume 3 times more water from the piped system.

Table 2.14 **Distribution of consumers according to primary and secondary water source in main villages and hamlets**

Habitation	Households		House connection		Public Taps		Water through neighbour		Canal users	
	nr	%	nr	%	nr	%	nr	%	nr	%
Main villages	183	58.1	82	44.8	96	52.5	5	2.7	74	40.4
Hamlets	132	41.9	33	25.0	98	74.2	1	0.8	89	67.4
TOTAL	315	100	115	36.5	194	61.6	6	1.9	163	51.7

Source: ref. 6

2.5.4 House connections

From the consumers point of view the following shortcomings are stated with respect to their piped supply:

- low pressures: 46%
- frequent water cuts: 30%
- no water during the day: 22%
- disposal problems with cess pit: 35%
- no cess pit or drainage pipe: 22%

Therefore, 20% of house connection users say they still need the canal besides their piped supply. In addition, all households with sanitation problems have to limit their water consumption in house.

All house connections are metered of which 40% are read once a year, 30% twice or more a year. The remainder are never read. With respect to the water meters, the following shortcomings have been identified:

- Water meters which are never read: 30%
- House connections which never pay: 26%
- Defective water meters: 30%

Of the house connection owners 13% pay less than LE 15, 24% pay LE 16-25, 18% pay LE 26-50 and 2.6% pay over LE 50 per year. A large percentage of 42% don't know (including the HC's never billed).

The cost of a new house connection has risen substantially over the past ten years. In 1982 the average cost, including water meter, was LE 61. The last three years the average cost for a connection rose from LE 165 in 1989 to LE 205 in 1992, an increase of 60%. Of the respondents, 13% paid more than LE 300 for their connection.

Many households are on a waiting list to receive a household connection. Nearly 50% of the present public tap users would want a house connection and could afford it. The amounts involved in obtaining a connection (LE 200-300) however, are considerable and will be a problem for many households.

The survey shows that there is an immediate potential market with enough buying-power for at least 45,000 house connections. Because Fayoum Governorate has limited the total number of new connections to 100 per six months per district, the demand far exceeds the supply, and waiting times exceed two years.

It should be noted that the restriction on new house connections was lifted in June 1993.

2.5.5 Public taps

Public taps are the primary water source for over half of the consumers in Fayoum Governorate. In the five surveyed villages 62% of the households are dependent on public taps.

Access to safe water in hamlets is severely restricted. Although the average number of users per public tap in rural Fayoum amounts to 500, the number of users in hamlets might rise to 1000 or even more.

Fetching water from the public tap is a women's job. In 79% of the households women collect the water, in 19% daughters and 2% husbands.

Most public taps are in a bad condition, especially those in the hamlets:

- none or a broken faucet: 61 %
- defect platform: 88 %
- no drain or gutter: 79 %
- muddy and dirty environment: 86 %

Most preferred improvements by the users are: cleanliness, smaller distance to house, and more faucets in areas where taps are very crowded.

At present the maintenance centres of El Azab are responsible for the state of the public tap, including repair and cleaning. Asking the women if they are willing to keep the tap clean, most of them agreed. The responsibilities must be clear however. The users do not consider cleaning of the public tap as their responsibility, although cleanliness rank as their highest priority. Taking responsibility for cleaning is considered not allowed.

People also express a desire for "better supervision" of the tap, meaning that the tap should be better maintained. Often people complain that when the public tap is broken it takes far too long to be repaired.

Of all public tap users 38% agreed to pay for tap improvement. 70% prefers to have a house connection, for which two-thirds of them could pay. There are three equally important constraints for getting this house connection:

- one-third would apply, but a piped supply connection is technically impossible because there is no pipe-line in their village yet;

- another one-third is on the waiting list: the present policy in Fayoum Governorate restricts allocations of new connections, resulting in growing waiting lists;
- one-third of households cannot afford the house connection.

The 30% public tap users who explicitly do not want a house connection cannot afford it. Nearly half of the public tap users, 45%, confirm that lack of money or their opinion that a connection is too expensive withhold them from applying for a house connection.

2.5.6 Use of canal water

Of the total population nearly 52% use the canal water as shown in table 2.14.

Of the households with a house connection a substantial part of 20% is also user of canal water, mainly for washing clothes and dishes. More comfort is the main reason for using the canal (i.e. no problems with wastewater disposal).

Over two-thirds of the public tap users, or 72%, use the canal as secondary water source. Public tap users give different reasons for using the canal as a secondary water source:

- negative experiences with the use of a public tap by 57% of the public tap users. These negative experiences include finding the tap too crowded (25%);
- no water at the tap (20%) or the public tap is too far from home (12%);
- positive preference for the canal for washing and bathing by in total 64% of the public tap users.

The present use of canals for washing and bathing is considered a serious health hazard.

2.6 PRIORITIES FOR IMPROVEMENT

2.6.1 Priorities as expressed by the consumers

Priorities for improvements in drinking water supply, as expressed by the consumers can be grouped into two categories: a) Improvements related to house connections; and b) Improvements related to public taps.

Improvements related to house connections

Shortcomings which need urgent improvements are:

- water supply services are often bad: low pressures, frequent water cuts and no water during the day are stated as major problems;
- water use is further restricted because of problems with wastewater disposal (overflowing cess pits or non-existence of a sanitary facility);
- some 20% of the house connection users therefore still use canal water in addition to their piped supply.

The demands for new house connections is high; there is an immediate potential market for at least 45,000 new connections.

Improvements related to public taps

Public tap users mention the following problems which need urgent attention:

- access to safe water is severely restricted because of the often overcrowded public taps (upto 1000 users per tap in many hamlets);
- over two thirds of public tap users still use canal water;
- people prefer smaller distances to the taps, more faucets and cleaner facilities.

A substantial proportion (two-thirds) is willing to pay for improved services at the public taps; while more than two-thirds of the public tap users prefer to have a house connection, but one third of these regard them as too expensive.

2.6.2 Technical priorities

El Azab needs to improve the services to its customers, but faces technical shortfalls in its water supply system. These were identified in the preceding paragraphs, and are summarised as follows:

- total water supply to the service area of El Azab is low. In average only 900 l/s is available for 1.6 million people, which means a per capita supply of less than 50 litres per day;

- pressures in large parts of the supply area, especially at the fringes, are insufficient (below 5 mwc);

- the high demand for new house connections cannot be met because of the present shortage in supply;

- a large portion of the supply is through public taps. Wastage of water through taps without faucets is very high;

- system losses are considerable, but not excessive for such a long and old distribution system. There is a backlog in repair and maintenance;

- the hydraulic capacity of many of the distribution mains is too low to convey the present water supplies (i.e. diameters are too small);

- the hydraulic capacity of the distribution system is further reduced because of the many old and corroded cast iron pipes and bottlenecks in the network;

- although the compact treatment units relieve supply problems locally, their functioning is unreliable because of frequent cuts in their operation and the complete close down during one month per year, when irrigation channels are set dry;

- however, the operation of compact units needs urgent improvement to relieve short term supply shortages;

- the large treatment plant at El Azab is operated near full production capacity. Repair and overhaul of many components of the plant is required to assure its continuous functioning in the future;

Interventions to solve these problems will constitute an important part of the short term development programme which is outlined in chapter 5. But because any improvements in the system must be compatible with longer term requirements, these will first be determined in chapters 3 and 4.

2.6.3 Cost recovery priorities

With regard to cost recovery, the following priorities can be identified:

- cost recovery will focus first of all on a reduction of the volume of unpriced water, by leakage reduction programmes, rehabilitation of public taps and a possible introduction of payment for public tap water;

- fee collection for water consumption of public taps is a new phenomenon, and can only be introduced after endorsement of the payment policy at the highest level;

- the second priority is to repair or replace non-functional water meters at delivery points, as a basic requirement for water billing. In addition a water management system should be developed;

- the third priority is to upgrade the billing and revenue collection system of El Azab, including the customer database, in order to optimise revenues.

- the fourth priority is that of establishing water tariffs in such a way that El Azab can become financially independent. This requires recovery of O&M costs, depreciation and debt servicing plus an internal cash contribution for investments.

The plan for improving cost recovery is presented in chapter 6.

2.6.4 Organisational priorities

The first priority is to obtain agreement and start preparations for the development of El Azab towards a semi-autonomous water supply utility operating under local government control. The independent El Azab should, in the foreseeable future, obtain the autonomy to:

- independently select, recruit, remunerate and promote personnel, not restricted by existing civil service regulations;
- charge agreed water rates to meet cost recovery requirements;
- contract independently for engineering services, civil works and purchase of equipment and materials.

In order to prepare El Azab for the transformation towards its new semi-independent status, an organisational strengthening programme should be carried out. With the present organisational capacities El Azab is not able to meet the new requirements. The strengthening programme should focus among others on the following aspects:

- preparing organisational restructuring;
- development of regional maintenance centres into Distribution Districts with more responsibilities;
- establishing a new central water meter workshop;
- start with the upgrading of accounting system, personnel management system, billing and revenue collection system, customers services;
- prepare for computerisation of parts of the administrative and technical functions;
- upgrading relevant knowledge by internal and external training courses;
- recruitment of new qualified personnel.

The organisational development plan is presented in chapter 7.

CHAPTER 3

WATER SUPPLY NEEDS ASSESSMENT 1992-2020

3.1 INTRODUCTION

In this chapter, an estimate is made of the quantities of water which El Azab has to supply in the future. The planning horizon of the masterplan is the year 2020, since investments in the water sector are investments with a long life span. The planning period is divided into three phases. Short term requirements are assessed for the year 2000, medium term and longer term requirements till 2010 and 2020 respectively.

In the following paragraphs, estimates are made of population growth and future water demands. For the year 2020 targets are set for service level and consumption rates. A realistic development towards these targets is considered, from which the short term requirements can be derived.

The long term requirements for water supply facilities is assessed in chapter 4. The first phase investment programme is presented in chapter 5. The organisational and financial issues are dealt with in detail in chapters 6 and 7 respectively.

3.2 POPULATION FORECAST

The 1992 population of the Governorate of Fayoum, including Fayoum City, totals approximately 1.85 million people.

The population growth over the past years was high, reaching an average of 3.1% per year over the period 1976 - 1986.

3.2.1 Scenarios for population growth

Three scenarios for future population growth can be considered.

1) If a high scenario is assumed, with a continuous high population growth rate of around 3% per year, then the population of the governorate would amount to well over 4 million people in 2020.

2) An optimistic low scenario is represented by forecasts of the Egyptian Demographic Centre. The Centre expects a stabilisation of the population of Egypt between 2025 and 2030. If this materialises, it would result in a total population in the governorate of Fayoum of approximately 2.8 million people in 2020.

3) An intermediate population growth scenario, with annual growth rates decreasing gradually from the current 3% to 1.5% in 2020. This results in a year 2020 population of 3.4 million.

Figure 3.1 illustrates the three scenario's. For the purpose of this masterplan, the intermediate growth scenario is used. Table 3.1 summarises the population projection for the intermediate scenario for the entire governorate. Annex A.1 gives the projection per administrative unit.

Table 3.1. Population projection Fayoum 1992-2020 - Summary

Markaz	1992	2000	2010	2020
FAYOUM				
Urban	255,406	318,857	398,312	469,130
Rural	280,634	350,352	437,656	515,468
sub-total	536,040	669,208	835,968	984,598
TAMIYA				
Urban	35,047	43,754	54,657	64,375
Rural	190,396	237,696	296,928	349,719
sub-total	225,444	281,450	351,585	414,094
SENOURES				
Urban	66,152	82,587	103,166	121,509
Rural	247,045	208,419	385,273	453,772
sub-total	313,198	391,005	488,440	575,281
IBSHWAY				
Urban	41,518	51,832	64,748	76,260
Rural	381,591	476,389	595,100	700,905
sub-total	423,109	528,221	659,848	777,165
ETSA				
Urban	33,161	41,399	51,715	60,910
Rural	328,350	409,922	512,071	603,114
sub-total	361,511	451,321	563,786	664,023
TOTALS (rounded)				
Urban	431,000	538,000	673,000	792,000
Rural	1,428,000	1,783,000	2,227,000	2,623,000
GRAND TOTAL	1,859,000	2,321,000	2,900,000	3,415,000

3.2.2 Urban, semi-urban and rural population

A distinction has to be made between rural, urban and semi urban areas, because the specific physical development in these areas has significant influence on the expected water demands. Water consumption will increase considerably with the implementation of sewer systems in towns and larger villages, which is accounted for in the forecasts.

The masterplan for wastewater sets targets for coverage with sewer networks, resulting in a gradual increase of the number of villages served with these systems. Separate water demand forecasts are therefore made for these "semi-urban areas", which are defined as all towns and villages in which there are sewer systems. Also the markaz capitals are considered separately.

Fig. 3.1 Population growth Scenarios
Fayoum Governorate 1986-2020

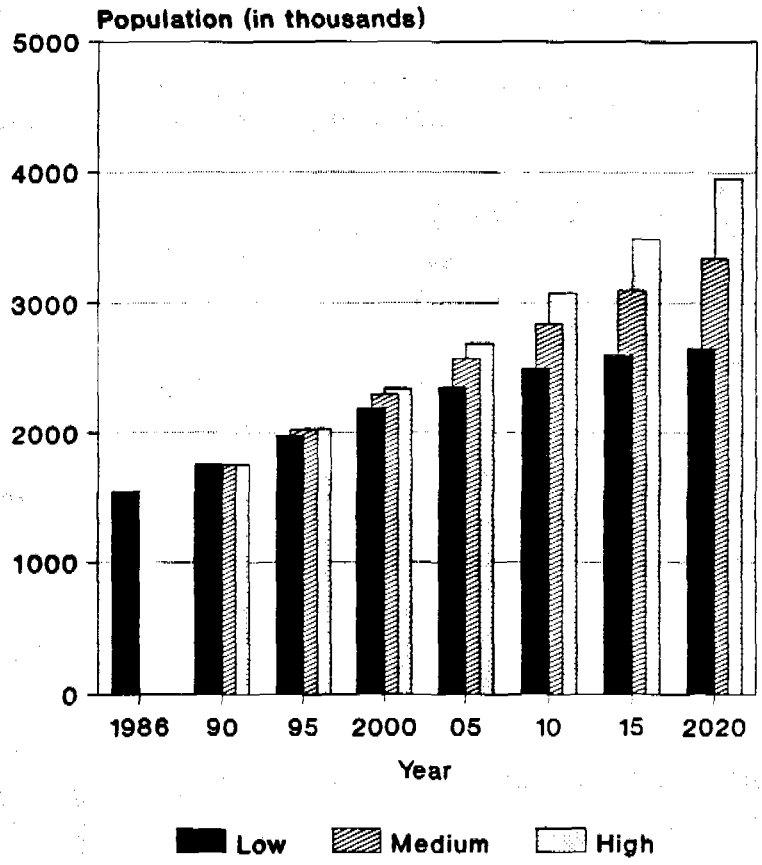


Table 3.2 summarises the projected population distribution over markaz capitals, semi-urban areas and rural areas in the El Azab supply area.

Table 3.2. Population projection for El Azab supply area *)

	CATEGORY	present 1992	projections 2000	2010	2020
	(Fayoum City)	(255)	(319)	(398)	(469)
I	Markaz Capitals	176	220	274	323
II	Semi-Urban (sewered villages)		515	1,245	2,046
III	Small Villages/rural (non-sewered)	1,428	1,267	983	577
	Total (by El Azab)	1,604	2,002	2,502	2,946

*) medium growth scenario

3.2.3 Fayoum City

Fayoum City has not been included in the demand forecast, because it does not - at present - fall under the supply area of El Azab (although there is a bulk supply to the city). Projections have been made earlier under the Provincial Cities Development Project (ref. 7), which will be reviewed briefly in section 3.3.5.

New Fayoum City

There are plans to construct a New Fayoum City in the desert, south of the old city. Development is expected to start after the year 2000, with a first phase of some 150,000 people. Its population will partly come from the projected population growth in the rest of the governorate. The new city has not yet been incorporated in the demand forecasts, because of its relatively small size compared to the entire population of the governorate, and because of uncertainties with regard to actual developments. Moreover, because the new city is very close to the treatment plant of El Azab, water demands can easily be covered in second-phase extensions of the plant.

3.3 WATER DEMAND PROJECTION 1992-2020

3.3.1 Introduction

Future water demand is a function of population forecast, estimates of future per-capita consumption, income distribution and socio-economic developments.

In our projections, the medium scenario for population growth has been used, associated with modest service levels and, hence, moderate per capita water consumption.

note: The future water demands depend on many factors; not only on population growth, but also on variables such as regional economical development, individual ability to pay, progress in the wastewater sector, policies or trends with regard to services though public taps. Several scenarios can be considered and in annex A.4 a few of these are discussed. Here, in the main text, only one scenario is presented which is sufficiently realistic that it can serve to forecast future water production and distribution requirements.

3.3.2 Water consumption projections

User classes

Different classes of consumers are distinguished as shown in table 3.3. Firstly, there is a distinction between private house connections (classes A through E) and public taps (class P). House connections are classified further in two broad categories: those with connections to sewers (A, B and C) and those in non-sewered areas (D and E). A further refinement has been sought by considering the types of housing and in-house water and sanitary facilities. See also annex A.4.

Table 3.3. Consumer Classes

CONSUMER CLASSES		WATER & SANITATION FACILITIES	PER CAPITA CONSUMPTION
CLASS	TYPE OF HOUSING		
A	High class to middle class dwellings	Sewer connection. 3 or more taps, 2 or more WC's	200 l/c.d
B	Middle class of good standards	Sewer connection. Upto 2 taps and generally 1 WC	140 l/c.d
C	Lower to middle; average standards for semi-urban	Sewer connection. Usually 1 tap and a WC	100 l/c.d
D	as for C, rural areas	No sewer connection. Usually 1 tap. Vault, septic tank, or cess pit.	60 l/c.d
E	Low grade dwellings; especially in rural areas	No sewer connection, 1 tap; vault, cess pit or no toilet facility	40 l/c.d
P	Public tap users	No private taps	15- 34 l/c.d

Water consumption rates

Table 3.3 also shows per-capita consumption rates for the various classes. The rates are based on present consumption patterns and on realistic assumptions for service levels. Annex A.4 provides more details. Future increases of the consumption rates per consumer class are not considered in our calculations; future economic development is expressed in a gradual shift from lower to higher consumer classes.

However, the per-capita consumption through public taps is expected to increase gradually, which is justified by an improved service level at the taps (i.e. less users per tap, higher pressures and more reliable supply).

Water losses through public taps are very high at present and are estimated at more than 50% of the gross supply through the taps. These losses are to be reduced considerably through a wastage reduction programme. The net supply and losses are forecasted as follows:

Water supply through Public Taps		1992	2000	2010	2020
Net supply	(l/c.d)	10	15	22	34
Losses	(l/c.d)	12	7	3	1
Gross supply	(l/c.d)	22	22	25	35

Distribution of consumer classes

The expected distribution of consumer classes over the different areas is presented in table 3.4.

Table 3.4 Distribution of Consumer Classes and Demands

			present	projections		
	year:		1992	2000	2010	2020
	DESIGN PROPORTIONS PER CLASS					
I	Markaz Capitals					
	h.c.	class A			5%	10%
	,,	class B		35%	50%	60%
	,,	class C		25%	25%	25%
	,,	class D	63%	10%	5%	5%
	p.t.	class P	37%	30%	15%	0%
II	Semi Urban					
	h.c.	class A				5%
	,,	class B		25%	35%	40%
	,,	class C		25%	25%	25%
	,,	class D		5%	5%	10%
	,,	class E		5%	5%	5%
	p.t.	class P		40%	30%	15%
III	Rural					
	h.c.	class C			10%	25%
	,,	class D	39%	25%	25%	25%
	,,	class E		25%	20%	15%
	p.t.	class P	61%	50%	45%	35%
IV	NON-DOMESTIC DEMAND (% OF H.C. DEMANDS)					
	- small industrial, commerce & institutions		10%	13%	15%	15%
	- large industrial			10%	10%	10%
V	UN-ACCOUNTED-FOR					
	% of production		28%	20%	15%	10%

Public taps will gradually be phased out in the markaz capitals. They will remain in the other areas, especially in the ezbah's. Over the entire governorate it is expected that - in 2020 - still some 17 % of the population has to rely on public taps.

For the interpretation of the expected developments with regard to the distribution of house connections, it must be remembered that classes A, B and C cover houses with sewer connections.

The overall distribution of consumer classes in the Governorate in the year 2000 may be summarised as follows:

- Class A: 0 %
- Class B: 10.3%
- Class C: 9.2%
- Class D: 18.2%
- Class E: 17.1%
- Class P: 45.2%

Non-domestic demands

Non-domestic demands are expressed as a percentage of water consumption through house connections. Large industrial demands have been accounted for separately and represent future demands at industrial zones such as Qom Osheem.

Un-accounted-for water

The present volume of un-accounted-for water is estimated at 28% of the total water delivery to the service area of El Azab. With a continuous effort to minimize leaks in the distribution system, this percentage could be brought down considerably. A reduction to 10% on the longer term would be feasible.

This target has been set considering the increase in the total length of the distribution network and the higher supply levels. Absolute water losses would, with this target, be around 1.5 times higher than the present losses.

Wastage through public taps is not included in this percentage, but is covered in the estimates for water consumption through public taps.

3.3.3 Affordability of future water supply for the consumers

An important determining factor for future water demand is the development of household incomes, and the percentage thereof which could be spent on water and sanitation. The objective is that water supply remains affordable, also for the lowest socio-economic strata. Tariff increases will be unavoidable in order to reach a better cost recovery, but the increase should take the actual income levels into account.

It is recommended that the water bill in the year 2000 should not exceed 2% of the average monthly household income for user classes A, B and C. These households have sewers and may towards the year 2000 be charged with a 60% surcharge on the water bill (see wastewater masterplan). The total bill for water and wastewater will then constitute 3.2% of their income.

For user classes D and E a water bill of maximum 1.5% of the monthly income is considered. These are small consumers without sewer, and in the low income category. Especially for those groups it is important that they can afford piped water in the house.

For public tap users the water bill should not exceed 1% of the household income.

Table 3.5. Maximum amounts to be spent on monthly water bill and maximum average tariffs (related to consumer class) in the year 2000

Class	Water use (l\cd)	HH size	Average day use per HH (litres)	Water Consump. per month per HH (m^3)	Assumed average HH income (LE/mth)	% of HH income spent on water	Max. amount to be spent on water (LE/mth)	Average possible tariff (LE/m^3)
A	200	6	1200	36.0	>550	2	>15.0	>0.42
B	140	6	840	25.2	500	2	10.0	0.40
C	100	6	600	18.0	400	2	8.0	0.44
D	60	8	480	14.4	300	1.5	4.5	0.31
E	40	8	320	9.6	200	1.5	3.0	0.31
P	22	8	176	5.3	<150	1	1.0	0.19

There is a clear distinction between consumer classes D and E (rural, non-sewered) and classes B and C (semi-urban, sewered). The majority of the present house connections belong to D and E, while A, B and C are hardly existing. By the year 2000, however classes B and C are expected to have a share of 20%.

House connections D and E consume less than 15 m^3/month. It is therefore recommended to consider this consumption level as the upper limit for the lowest tariff class where the majority of the small rural consumers can be found certainly up to the year 2000. These consumers should be protected from excessive tariff increases.

From table 3.5 it follows that a progressive tariff can be applied for water consumption over 15 m^3/month. We will come back to this issue in chapter 6, where the abovementioned tariffs shall be considered as maximum affordable tariffs for the year 2000. The assumption is, that with these tariffs water demand will not be adversely affected.

3.3.4 Average water demand

Table 3.6 presents a summary of the calculated water demand projections, based on the assumptions made above.

The steep increase of the consumption through house connections is mainly caused by the gradual shift of more villages into the "semi-urban" category, which will have sewer systems.

It can also be observed that - even with a reduction of the percentage of the population using public taps - the total supply through these facilities will not decrease in the near future. The spillage through public taps however is expected to decrease considerably by implementing wastage reduction programmes.

The total demand, including non-domestic consumption, un-accounted for and supply to third parties, will amount to 400,000 m^3/day in 2020 compared to 113,000 m^3/day in 1992.

Table 3.6. Summary of Average Water Demands (m^3/day)

DEMAND CATEGORY	present 1992	projections 2000	2010	2020
SUMMARY OF DEMANDS (m^3/day)				
House connections	33,000	82,750	160,386	271,732
Public taps including losses	20,300	19,921	21,424	17,810
Small non-domestic	3,300	10,344	24,058	40,760
TOTAL NET DEMAND	56,600	113,015	205,868	330,302
Not-accounted for	21,469	28,254	36,330	36,700
TOTAL GROSS DEMAND (m^3/day)				
incl. un-accounted-for	78,069	141,268	242,198	367,002
OTHER LARGE CONSUMERS (m^3/day)				
Fayoum City	29,100			
Beni Suef	3,200			
Large Institution (army)	2,300	3,000	4,000	5,000
Large Industrial	0	8,275	16,039	27,173
SUB TOTAL (m^3/day)	34,600	11,275	20,039	32,173
GROSS TOTAL	112,669	152,544	262,237	399,175

The supply to Fayoum City is not included in this forecast.

3.3.5 Peak demands

Water production facilities are designed with a capacity to cover peak day demands. The distribution system, including storage facilities, has to be designed on peak hourly demands.

The level of service to water consumers shall improve gradually in the future, resulting in higher peak factors towards the end of the planning period, as shown in table 3.7. In 2020, the peak day flow is thus estimated at 470,000 m^3/day. The peak hour flow will be 33,500 m^3/hour.

Storage requirements in that year would amount to some 20% of the maximum day demand, or to 92,000 m^3 (equivalent to 5 hours production capacity).

The storage capacity (and the capacity of the distribution system) will not cover the fluctuations in demands of the large consumers (such as industries); these consumers are assumed to provide their own storage facilities.

Table 3.7. Peak Demands, to be supplied by El Azab

TOTAL REQUIREMENTS	present 1992	projections 2000	2010	2020
TOTAL DEMAND (m^3/day)	112,669	152,544	262,237	399,715
PEAK FACTORS	applied on gross demand only; see table 3.5			
peak day factor	1.10	1.10	1.15	1.20
peak hour factor	1.15	1.25	1.50	1.75
PEAK FLOWS				
peak day flow, m^3/day	123,936	166,671	298,566	472,575
,, ,, ,, , m^3/h	5,164	6,945	12,440	19,691
peak hour flow, m^3/h	5,939	8,563	18,243	33,453
STORAGE (for gross demand only)	in hours of peak day demand			
factor (hours)	2.2	3	4	5
capacity, m^3	11,500	19,425	46,421	91,750

3.3.6 Demands of Fayoum City

In the masterplan for the water supply of Fayoum City (ref. 2 and 7) a projection of water demands for the city has been made. We have adopted the same projection parameters with a revised population forecast. The demand projection is presented in tables 3.8 and 3.9. The peak day demand for the city in 2020 would amount to 140,000 m^3/day.

Table 3.8. Demand Projection Fayoum City; Design Parameters

		present 1992	projections 2000	2010	2020
POPULATION (* 1000)			medium population growth		
Fayoum City		255	319	398	469
TARGET PERCENTAGES, house connections <-> public taps					
Fayoum City	house conn.	93%	97%	100%	100%
	public tap	7%	3%	0%	0%
CONSUMER CLASSES AND DEMAND FIGURES					
Domestic Demand (l/cd)					
house connection	class A	180	200	220	240
public tap	class P	40	40		

Note: Non-domestic demand and un-accounted for are included in domestic demand

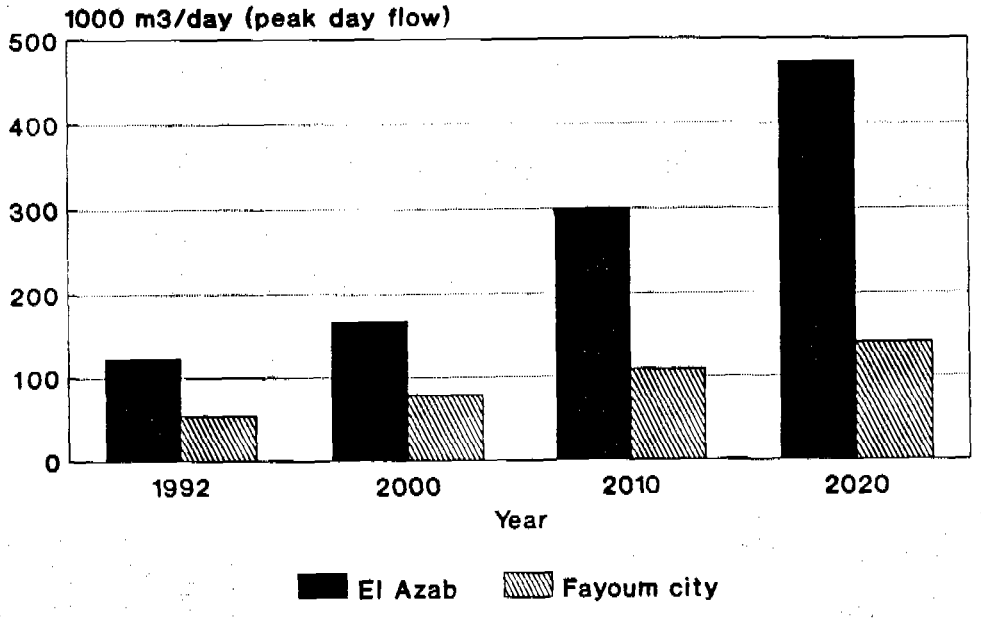
Table 3.9. Demand Projection for Fayoum City, Total Demands

FAYOUM CITY	present	projections		
	1992	2000	2010	2020
DAILY DEMANDS PER CATEGORY (m^3/day)			incl.un-acc.-for	
House connections	42,503	61,886	87,560	112,560
Public taps	755	383	0	0
Total:	43,258	62,269	87,560	112,560
PEAK FACTORS				
Peak day factor	1.25	1.25	1.25	1.25
Peak hour factor	2.00	2.00	2.00	2.00
PEAK FLOWS				
Peak day flow, m^3/day	54,073	77,836	109,450	140,700
,, ,, ,, , m^3/h	2,253	3,243	4,560	5,863
peak hour flow, m^3/h	4,506	6,486	9,121	11,725
STORAGE in hours of peak day demand				
Factor (hours)	7.0	7	7	7
Capacity, m^3	15,771	22,702	31,923	41,038

3.3.7 Conclusion

Total maximum day demands of the El Azab supply area is projected to amount to 473,000 m^3/day or 5,470 l/s in the year 2020. Fayoum City adds another 141,000 m^3/day to the requirements in 2020, as shown in the chart of figure 3.2.

FIG. 3.2 TOTAL WATER DEMANDS FAYOUM
1992-2020



The required water supply facilities for the year 2020 are assessed in chapter 4.

CHAPTER 4

REQUIRED WATER SUPPLY FACILITIES, YEAR 2020

In this chapter an assessment is made of required water supply facilities in the year 2020, taking a staged realisation of these facilities into consideration. Where appropriate, alternatives are discussed.

The assessment will serve as a basis for the first phase investment plan which is presented in chapter 5.

4.1 WATER PRODUCTION

4.1.1 Required production capacities

The maximum day demand determines the required production capacity, which amounts to 473,000 m^3/day or 5,470 l/s in 2020. Fayoum City adds another 1,630 l/s to the requirements.

El Azab

The treatment plant at El Azab presently has a production capacity of 1,500 l/s. In order to prevent deterioration of this capacity, it will be necessary to replace production units of the existing treatment plant before 2020.

The existing plant of El Azab, which will need major rehabilitation works within the planning period, represents an estimated capital value of approximately LE 75 million. It is estimated that 50% of this value - or LE 37.5 million - is required to keep the plant in good order. It should be noted that the estimated value of El Azab is not based on a detailed asset evaluation.

Compact units

The seventeen compact treatment units together have a total installed capacity of 425 l/s.

The compact units provide a solution for the water shortages at the fringes of the water supply system, but their operation is not economic. Although their construction costs are low (approximately half of that of a conventional plant per unit of installed capacity), the life time is short and - as a result - annual depreciation is high. Operation is also relatively expensive (ref. 8). Moreover, the supply from the compact units is unreliable, as they cannot be operated during one month each year when irrigation channels - from where the raw water is drawn - are set dry for maintenance.

It is recommended - synchronous with the expansion of the conventional treatment capacity and improvements of the distribution system - to gradually phase out the compact

units in the Fayoum governorate. It is assumed that by the year 2000 most of the compact units will have been dismantled.

Fayoum City

The water treatment plant of Fayoum City will - after completion of the ongoing works - have a capacity of 600 l/s. Although the water masterplan for the city caters for a further expansion of the treatment facilities (upto 960 l/s in 2000 and 1700 l/s in 2020), it would be more economical not to realise these expansions and to provide the city with water from extensions of the plant at El Azab. Future extensions of the water treatment plant in Fayoum City is therefore not considered in this masterplan.

Summary

In conclusion, by the year 2020, an additional capacity of 5,000 l/s is required, of which some 4,000 l/s is needed for the supply area of El Azab (see table 4.1). The future requirements are graphically shown in figure 4.1.

Table 4.1. Summary of required and existing production capacities.

Location	Presently available	Total required 2020
El Azab	1,500 l/s	5,470 l/s
Compact units	(425 l/s to be abandoned)	
Fayoum City	600 l/s (*)	1,630 l/s
Total	2,100 l/s	7,100 l/s

(*) after completion of the ongoing works in Fayoum City

Assuming that the new production capacity will be constructed in three equal phases, then the total investment value of these works amounts to approximately LE 270 million (1992 prices).

Unit prices of water supply facilities are provided in annex A.5.

4.1.2 Location of treatment plants and choice of technology

Apart from the 17 scattered compact units, the centrally located El Azab treatment plant supplies the entire Fayoum. Long trunk mains run diagonally from this plant into the supply area (see figure 2.1 in chapter 2). These trunk mains represent high investments.

PROJECTED WATER DEMAND AND PLANNED PRODUCTION CAPACITY (1993-2000)

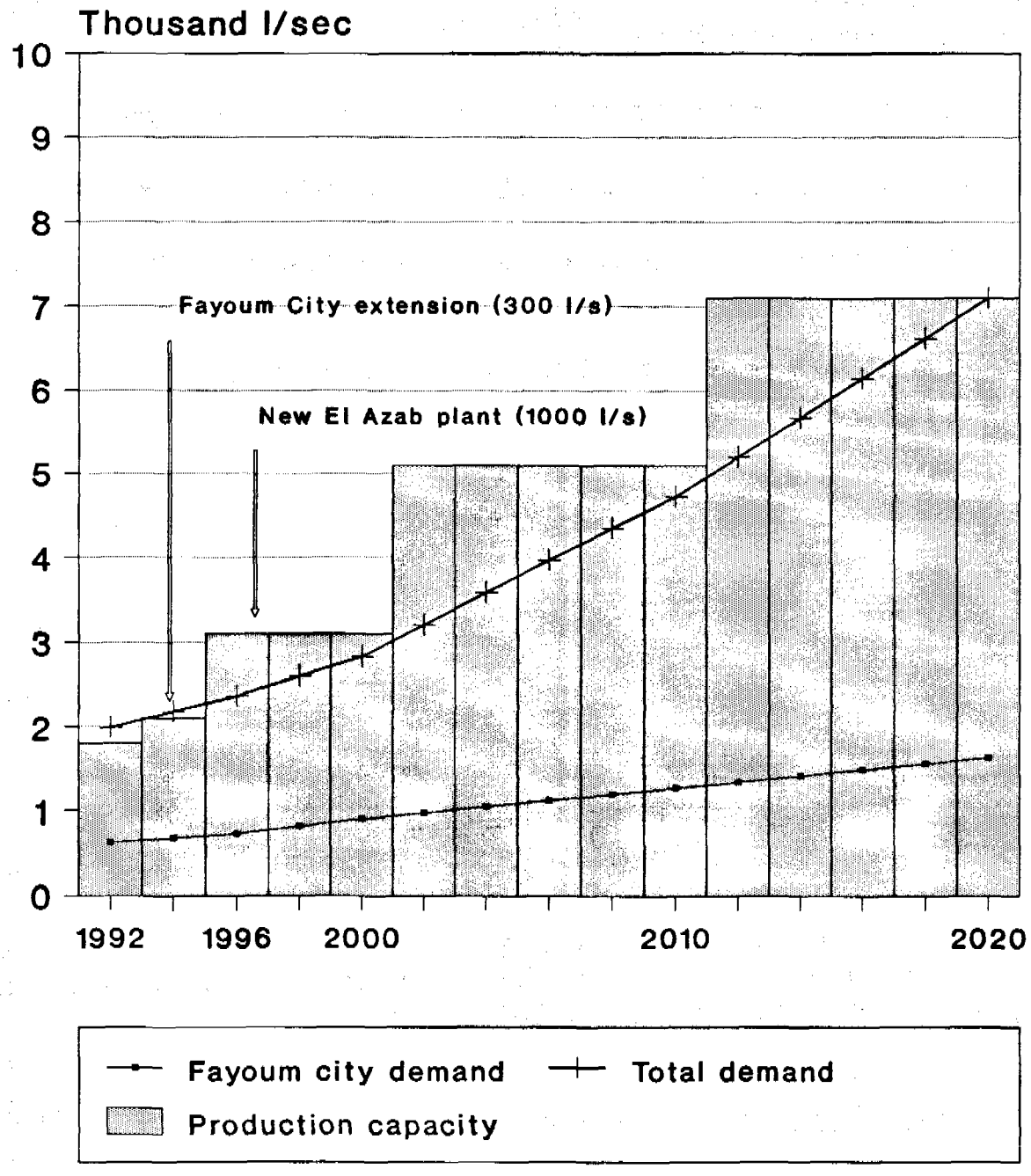


Figure 4.1

Location of treatment plant(s)

Decentralisation of the water production would reduce the costs of the distribution system. This option has been studied in detail. Important parameters in a decision on decentralised or central treatment are:

a. Raw Water Sources

Sufficient quantities of raw water of acceptable quality shall be available at any of the selected locations.

b. Cost of Water Treatment

Decentralised production implicates smaller treatment plants and hence higher costs-per-unit. Alternative treatment technologies (i.e. rapid sand filtration versus slow sand filtration) have been examined. The examination also considered operation costs.

c. Cost of the Distribution System

Decentralised production will reduce the required flow capacity of the trunk mains and consequently reduce the investment costs of the distribution system.

d. Consequences for staged implementation of the investment works.

e. Availability of Land and Electricity, and Accessibility

Two decentralised plants, one at the eastern border of the Fayoum depression and the other at the western border, have been considered. Annex A.6 presents the study on the possibilities for decentralised treatment.

Rapid and slow sand filtration

Treatment by slow sand filtration has been considered as an option for decentralised treatment because of the availability of land at the two locations (the plants could be constructed in the desert). Annex A.7 provides a brief description of the technology.

Slow sand filtration has several advantages, such as:
- lower investment costs, because less mechanical and electrical equipment is needed,
- lower operation costs in terms of power and chemicals,

Disadvantages of slow sand filtration are:

- the need of intensive O&M (i.e. cleaning of the filters),
- large land requirements,
- limited experience with this technology in Egypt.

Conclusion

The main conclusions of the background study on decentralised treatment and rapid versus slow sand filtration are the following:

1) The availability of raw water from irrigation channels is a decisive factor. Two decentralised treatment plants would interfere with irrigation under the present conditions. Decentralised treatment is only possible if the irrigation system is improved at considerable cost. And during the irrigation winter-closure period, it would be difficult to assure a continuous supply of raw water at the treatment plants. Decentralised treatment plants will mean that their functioning depends on policies and developments in the irrigation sector; developments which El Azab cannot control.

2) Decentralised treatment plants are only financially attractive if slow sand filtration is used. Only then, important savings can be realised. If the decentralised plants are rapid filters, no savings can be made; the savings made in the distribution system would be off set by the more expensive smaller plants.

3) Centralised treatment allows for a more flexible phasing of the expansion of both the production capacity and the distribution network. The district of Tamiya for example experiences acute water shortages which are mainly caused by the under-capacity of the trunk mains feeding this area. In anticipation of the extension of the central production capacity, these trunk mains can already be expanded to relieve part of the supply problem in Tamiya. In case decentralised treatment were applied, these trunk mains would not be expanded and the problems at Tamiya would only be solved after completion of the decentralised treatment plants and the trunk mains from this local plant into its supply area.

Ultimately, it has been decided to opt for central water treatment at or near the existing plant of El Azab. The technology applied will be rapid sand filtration.

A potential site has been selected by El Azab: some 3 kilometres south east of El Azab, on desert land along the Bahr Hassan Wasef and the road to Beni Suef (see figure 4.2). The site is adjacent to the planned New Fayoum City. The site area now available (16 ha.) is sufficient to meet land requirements upto the year 2020. Adjacent areas have to be reserved for further expansions, which can be accommodated in the spatial planning for New Fayoum City.

4.1.3 Raw water source

The availability and quality of raw water has been considered in the study of alternative locations and technologies for water treatment. Here we provide a summary of the condition at the El Azab plant.

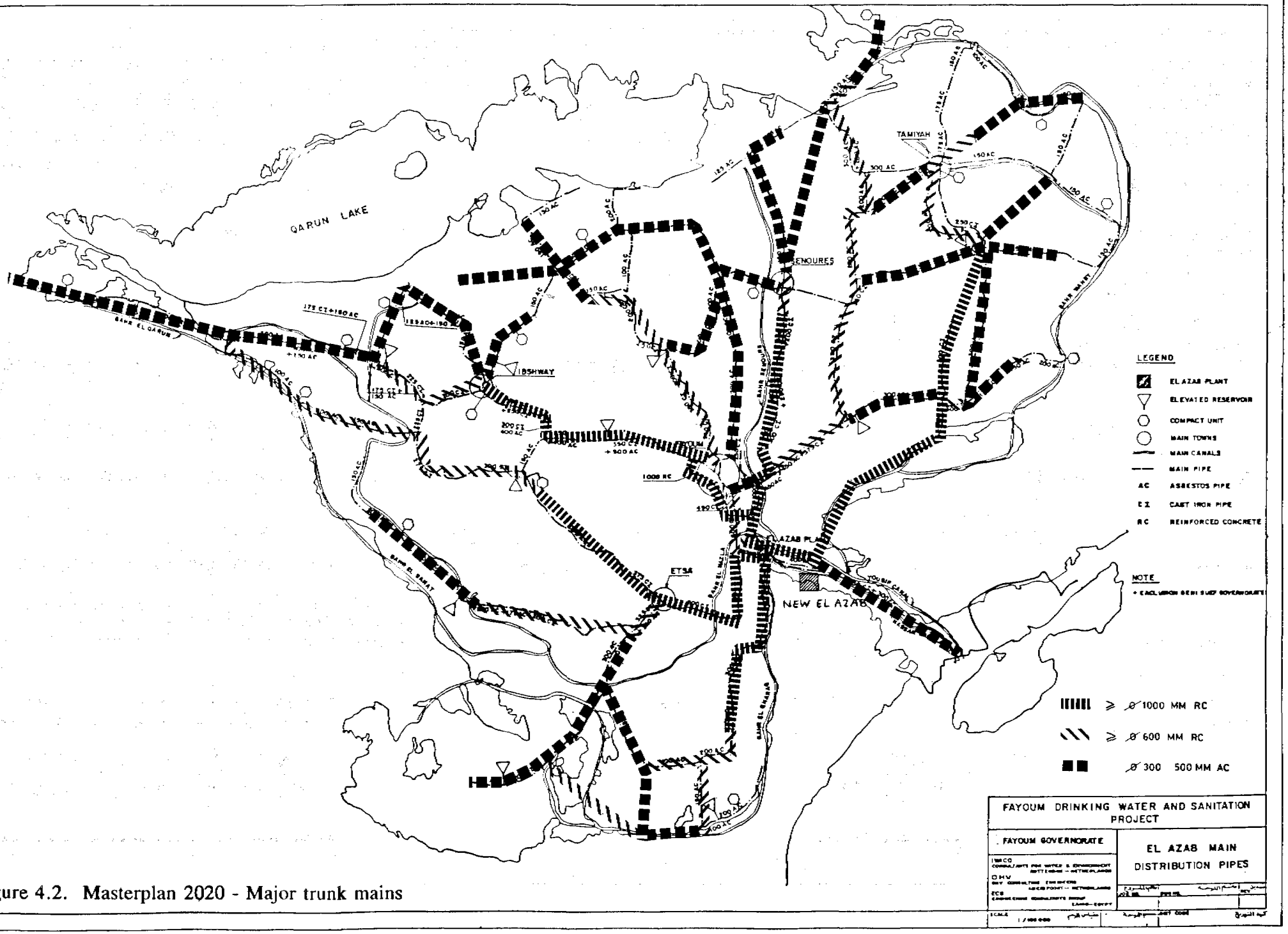


Figure 4.2. Masterplan 2020 - Major trunk mains

Availability of water

The Bahr Hassan Wasef irrigation channel will be used as raw water source for the new treatment plant. The canal already feeds the El Azab plant.

The canal has sufficient capacity to convey the future requirements of the plant well into the next century. Irrigation will not be impaired.

Water quality

Being at the upstream site of the Fayoum depression, the canal carries irrigation water of good quality; only small quantities of drainage water will have entered on its course to the site.

The water quality is fairly constant through the year, except in January during the irrigation winter closure. In that period the Irrigation Department supplies just sufficient water for the El Azab treatment plant only. Dissolved solids contents and conductivity of the water are higher in that period.

Table 4.2 presents some characteristic water quality parameters. Annex A.2 provides more detailed information on the water quality parameters of the Hassan Wasef canal (monthly values of the last three years).

Table 4.2. Selected Quality Parameters for Bahr Hassan Wasef

Selected Parameter	Hassan Wasef El Azab 1992 (range) *)	
pH	7.9 - 8.5	
Nitrate (N)	0.1 - 1.0	mg/l
Alkalinity	118 - 180	mg/l
Total hardness	124 - 220	mg/l
Chloride	34 - 84	mg/l
T.D.S.	198 - 360	mg/l
Conductivity	330 - 655	
Turbidity (NTU)	25 - 56	units
C.O.D.	10 - 18	mg/l
D.O.	6.2 - 9.2	mg/l
Total Coliform	1600	counts/100 ml
Faecal Coliform	920	counts/100 ml

*) excluding January

4.2 WATER DISTRIBUTION

With an expansion of the water production facilities near El Azab, a major upgrading of the distribution network is required.

- All trunk mains need an expansion of their capacity, either by laying parallel pipes or by replacements with larger diameters.
- New storage reservoirs have to be constructed.
- Branches to individual villages often need replacement. Several small villages and ezbah's still need to be connected.
- Distribution systems inside larger villages and towns require expansion.

4.2.1. Trunk mains

With aid of a computer model, the main distribution network has been calculated for the year 2020 situation. The network has been designed on peak-hourly flows, which amount to 9,300 l/s at the treatment plant. Bulk supply to Fayoum City - in order to meet the city's peak day demand - adds another 1,000 l/s.

The supply is from two adjacent treatment plants: the existing El Azab plant and a new plant some 3 km to the south-east.

To assure sufficient pressure (15 mwc) at the fringes of the supply area, pressures at the treatment plants are 55 and 60 mwc respectively. Hydraulic gradients range from 2 to 4 m/km. Most pipelines can be laid downhill. Four booster stations are required to negotiate steep escarpments at a few locations.

The existing pipes in the network have not been incorporated in the design of the 2020 trunk mains. The network will have a total length of 760 km. Most pipes would have diameters of 1400 mm and less. Only short distances of 1600 and 2000 mm pipelines are required. Figure 4.2 shows the lay-out of the year 2020 network. Table 4.3 summarises the required pipe lengths.

Table 4.3 Investment Requirements Trunk Mains, year 2020 (1992 price level)

Diameter (mm)	Length (km)	Cost million LE
100	30	1.4
150	73	5.4
200	66	6.6
250	54	7.2
300	77	14.2
350	58	13.9
400	53	15.8
450	60	21.2
500	39	17.1
600	44	30.1
700	42	31.2
800	36	31.4
900	13	12.3
1000	70	80.4
1200	23	30.7
1400	11	15.3
1600	3	4.4
2000	3	9.7
4 boosters		1.0
Total	760	350.0

The network thus calculated represents a capital value of LE 350 million.

4.2.2. Reservoirs

In 2020 a total storage capacity of nearly 92,000 m^3 is required for the supply area of El Azab. Fayoum City needs a storage capacity of 41,000 m^3 (see table 4.4).

Table 4.4. Required Storage Capacity, 2020

Location	Presently Available	Total Required 2020
El Azab	11,500 m^3	92,000 m^3
Compact Units	(2,800 m^3 to be abandoned)	
In network	(6,300 m^3 water towers)	
Fayoum City	24,000 m^3 (*)	41,000 m^3
Total	35,500 m^3 (**)	133,000 m^3

(*) after completion of the ongoing works in Fayoum City
(**) excluding the water towers

The additional storage capacity for Fayoum City (17,000 m^3) has to be constructed in the town; in that way only (peak) day demands have to be supplied from El Azab to the city.

The new storage reservoirs for the supply area of El Azab (80,500 m^3) is best located at the new treatment plant, assuring a proportional distribution of the storage capacity over the two treatment plants (considering that the supply to Fayoum City will be made from the old El Azab plant). This is illustrated in figure 4.3.

The costs of the reservoirs amounts to approximately LE 30 million.

4.2.3 Local storage reservoirs

It has been considered to locate a few large storage reservoirs inside the distribution network. It would reduce the required flow capacity of the pipes between the central treatment plant and the reservoirs. But because the water demand is so dispersed (distributed over many villages), there would still be large capacity pipes required from these reservoirs into their supply areas. Financial analysis has shown that savings would therefore not be significant.

A reservoir is effective only if its local supply area is adjacent, and increasingly so with larger sizes of the local supply area and greater distances from the central treatment plant. Savings decrease if the same trunk main also supplies many other areas. For the Governorate of Fayoum this implies that reservoirs are only attractive (financially) for the towns and a few large villages.

This is especially so if ground reservoirs and pump stations were constructed. Water towers are more advantageous in this regard.
For example, for a town like Senoures (100,000 inhabitants in 2020) a saving of LE 4 million could be made when a water tower were constructed there. In case of a ground reservoir, the saving is only marginal.

However, reservoirs may also be considered for operational reasons. Emergency supplies are then assured.

The existing water towers can be used for that purpose. The tanks will not contribute much to a reduction in required flow capacities of the trunk mains - for reasons set-out above. This will be further discussed while formulating the short term investment plan.

4.2.4 Branches

For the expansion of the branches from the trunk mains to isolated villages approximately 150 km of new pipelines are estimated to be required. Most of these pipes will be of 100 mm and 150 mm only - as shown in table 4.5 - and will partly replace existing lines which are in a bad structural condition.

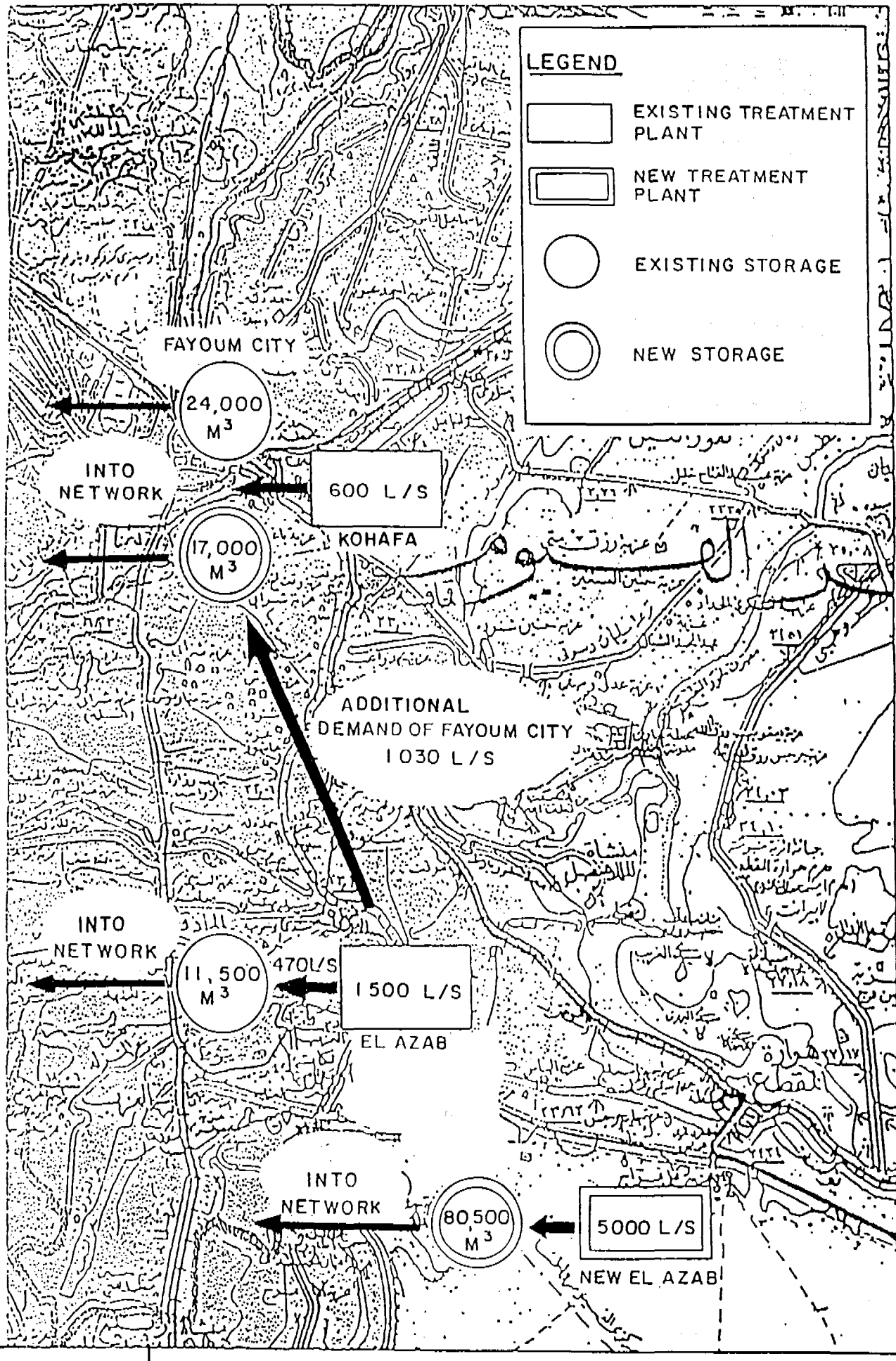


FIGURE 4.3 LOCATION OF STORAGE CAPACITY YEAR 2020

Table 4.5. Requirements of Distribution Branches, 2020 1992 price level

Diameter (mm)	Length (km)	Cost (million LE)
100	70	3.3
150	60	4.4
200	20	2.0
Total	150	9.7

The capital value of these works for 2020 amounts to approximately LE 10 million.

4.2.5 Distribution networks in villages

The assessment of the requirements for distribution systems in towns and larger villages has been based on the expected population in these localities. The number of inhabitants have been correlated with the size of urban areas (with larger population densities in larger towns). Pipe lengths are then related with the size of the urban area; pipe diameters with the population density.

Total requirements for the year 2020 are summarised in table 4.6.

Works on the reticulation systems will mainly pertain to expansion works, while replacement of under-sized or degraded pipes are also included. The works shall include the installation of pressure reduction valves between the village systems and the trunk mains, in order to control the pressure in the local supply areas. This will considerably reduce both water consumption and leakage.

The total capital value of the distribution systems in the towns and larger villages will amount to LE 52 million.

Table 4.6 Requirements of small distribution systems in villages year 2020 (1992 price level)

Diameter (mm)	Length (km)	Cost (million LE)
25	124	1.9
50	578	14.4
100	192	9.0
150	181	13.2
200	3	0.3
250	56	7.5
300	17	3.1
350	2	0.6
550	3	1.7
Totals	1156	51.7

(excluding Fayoum City)

4.3 WATER DELIVERY

4.3.1 House connections

According to our water demand forecasts, some 2.4 million people will obtain their water from private service connections in the year 2020. As a result, approximately 400,000 house connections are then required. Figure 4.4 illustrates the expected growth.

In addition, there will be an unspecified number of non-domestic connections.

Many of the existing 83,000 connections will need replacement or repair. The total capital value of the 400,000 connections is estimated at LE 40 million.

4.3.2 Public taps

Although a sharp increase in the number of house connections is foreseen, still a large proportion of the population will continue to depend on water supply through public taps: an estimated 17% or 500,000 people in 2020.

Public taps will remain in function. The total number will not decrease significantly, considering the disperse distribution of the people using them. The average number of users per public taps may decrease slowly from the present 525 to 350 in the year 2020, as illustrated in figure 4.5.

No new taps will be required in 2020, but investments are required to rehabilitate and upgrade the existing taps. The 1800 taps now existing represent a capital value of approximately LE 2.7 million.

4.4 INVESTMENT REQUIREMENTS YEAR 2020

The capital requirements for water supply infrastructure, required in the year 2020, can be summarised as shown in table 4.7.

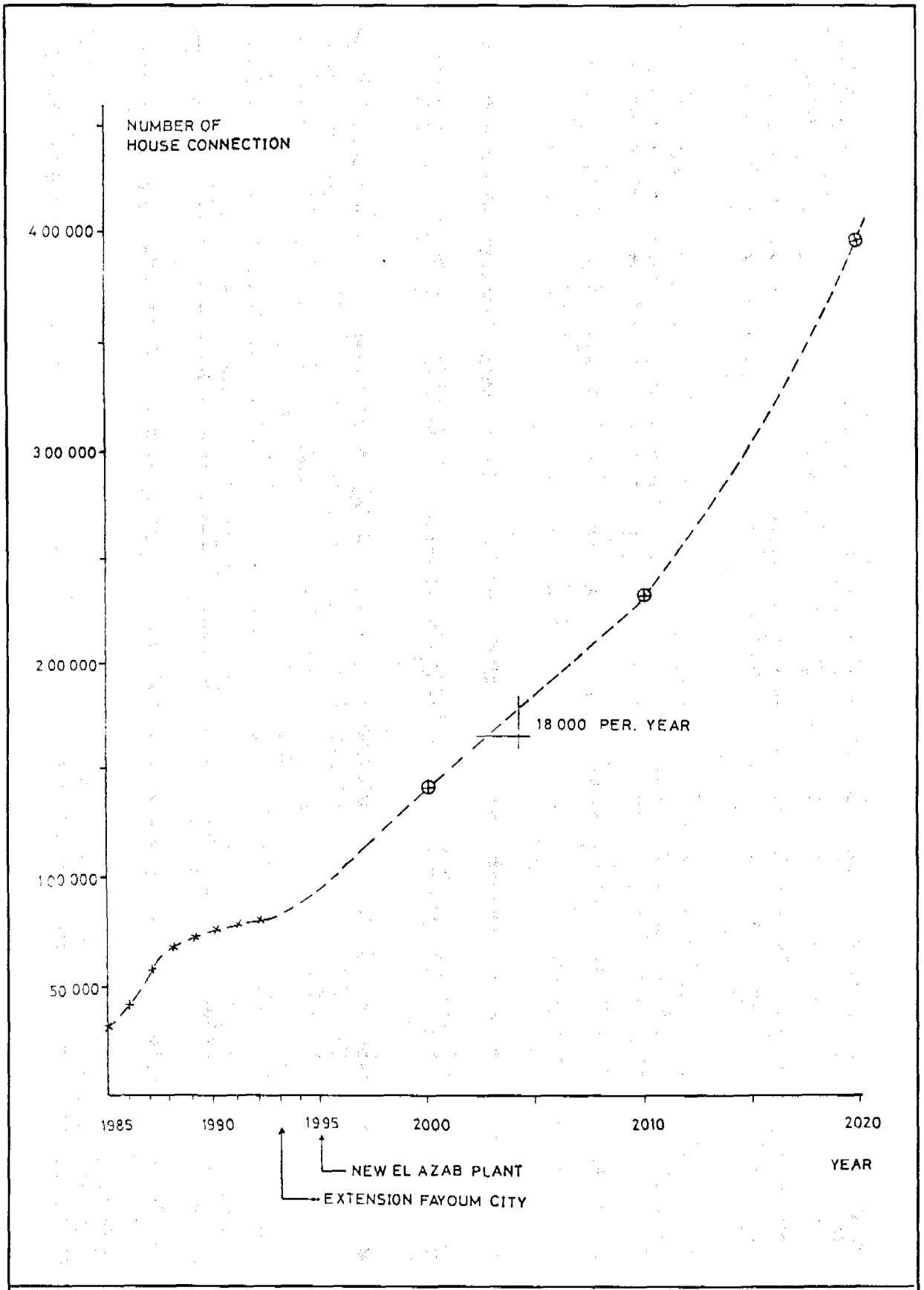


Figure 4.4. Projected increase of house connections

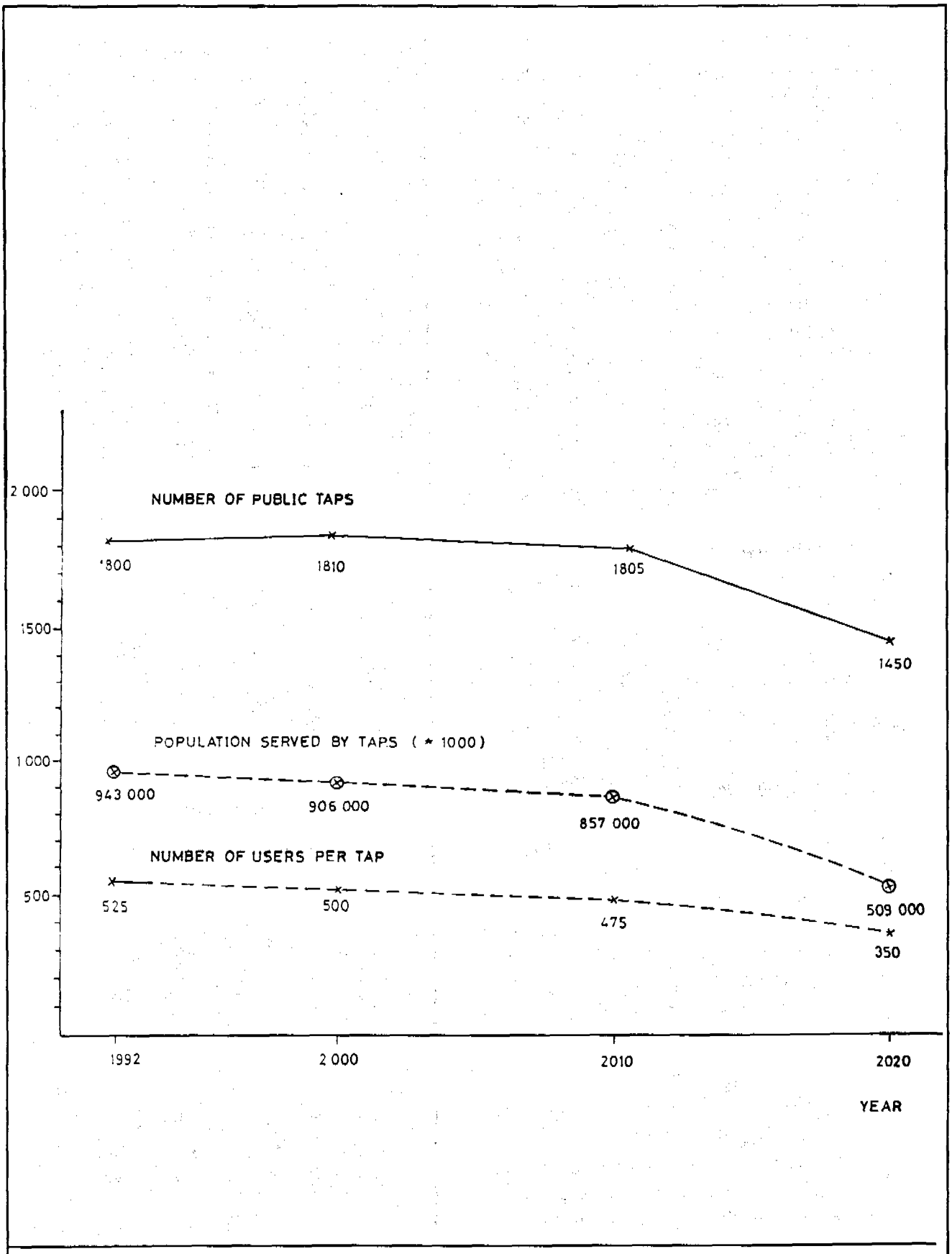


Figure 4.5. Development of public taps

Table 4.7. Summary of Investments upto Year 2020 (1992 price level)

Item	Capacity	Capital Value (million LE)
Water Production		
- consolidation old plant	1500 l/s	38
- new plant	5000 l/s	270
Storage	80500 m^3	30
Water distribution		
- Trunk mains	760 km	350
- Branches	150 km	10
- Village Distribution	1160 km	52
Water Delivery		
- house connections	400,000	40
- public taps	1,800	3
Various rehabilitation works		pm
Offices, warehouses		pm
Total in the order of:		LE 800 million

The estimated investments exclude the requirements for Fayoum City, except for the water production facilities. In 2020, El Azab will supply some 1000 l/s to the city, which represents a capital investment of approximately LE 55 million.

4.5 ENVIRONMENTAL IMPACT OF WATER SUPPLY EXTENSIONS

4.5.1 Introduction

The ultimate objective of investments in El Azab Water Works is to improve the public health conditions in the Governorate through the provision of adequate quantities of drinking water of acceptable quality to the governorate's population. This objective implies a significant positive environmental health impact, but there may be negative side-effects, as illustrated below.

Positive impacts

The major positive environmental health impacts, which will be achieved by implementation of the masterplan for water supply, can be listed as follows:

a) The supply of larger quantities of water to the population, thereby reducing the people's need to use unsafe surface water (from irrigation channels and drains).
b) The increase of the number of private house connections, facilitating improved domestic hygiene and providing convenience.
c) The improvement of the water supply service through public taps (continuous supply, better pressure, improved drainage arrangements).
d) The abandoning of compact treatment units to achieve:

- 24 hours per day pressure in the distribution network, as a result of which less contamination can enter the network,
- continuous - year round - supply, no longer disrupted by the closing period of the irrigation channels from where the compact units abstract their raw water,
- improved water quality control at the centralised treatment facilities.

Negative impacts

The works may, however, also have negative environmental impacts. An early identification of possible negative influences is required in order to incorporate their mitigation in the planning and design stages of the project. In this section an assessment is made of possible negative impacts on the environment as a result of the planned extensions of the El Azab Water Works.

4.5.2. Inventory of adverse environmental impacts

In general, two phases in the life cycle of a project are considered when it is assessed on environmental impacts: the construction phase and the operation phase. Impacts during the construction phase pertain - for water supply works - mainly to public safety, obstruction of free traffic and damage to public roads. Prevention or minimising of these impacts shall be incorporated in the detailed design and construction stages and is not further discussed here.

The operation phase

The possible environmental impacts during operation of the new works are assessed by considering the various components of the water supply system separately; i.e. water production, water distribution and water delivery. A screening of the components on possible impacts will indicate in which stage of the project-preparation cycle (i.e. the planning and the design stages) a full assessment is required in order to formulate mitigating actions. The screening is summarised in table 4.8.

The environmental impact assessments which are to be made during the planning stage are described in the following paragraphs. Possible impacts of the other aspects are only indicated and will be detailed during the design stages of the works.

Table 4.8. Screening on Adverse Environmental Impacts, Operation Phase

Component of water supply system	Aspect	Possible adverse impact	Assessment required during:
Water production (treatment)	Raw water source	Interference with irrigation	Planning stage
	Choice of treatment	Power consumption and use of chemicals	Design stage
	Use of chemicals in treatment process	Aluminium residues and chlorine residues in drinking water	Design stage
	Use of chemicals in treatment process	Safety aspects of chlorination unit	Design stage
	Disposal of sludge from filter	Water quality of receiving channel	Planning and design stage
Water distribution	Pipe material	Effect of PVC and AC on public health	Design stage
Water delivery (water supply)	increased volumes of water in towns/villages and households	aggravation of wastewater disposal problems	Planning stage

4.5.3 Environmental impact of water treatment

Impact on the Availability of Irrigation Water

The new treatment plant of El Azab will subtract its raw water from the Hassan Wasef irrigation channel. The availability of raw water has been an important parameter in the selection of the site of the future treatment facilities (see section 4.1.2 and annex A.6). It will be necessary to increase the flow into the Hassan Wasef inlet, but the channel and its structures are sufficiently large to accommodate this additional flow. The new treatment plant will therefore not interfere with irrigation.

Choice of Treatment Technology

The masterplan recommends rapid sand filtration as treatment technology. The design criteria for the plant shall include environmental aspects, such as minimising power requirements and use of chemicals. Concerning the latter, special emphasis shall be laid on the possible impact on public health of residues of chemicals (such as aluminium sulphate and chlorine) in the treated water.

Residues of Aluminium Sulphate (coagulant) in Backwash Water

The production of drinking water at El Azab includes the removal of fine sediment and colloidal substances by means of coagulation with aluminium sulphate. The resulting sludge is caught in the rapid sand filters and removed with backwashing. At present, the backwashed filter residue is discharged into the irrigation channel, downstream of the treatment plant.

Aluminium is abundant in the natural environment. It is a major component of clay minerals. Nevertheless, under specific conditions, aluminium compounds can exert negative ecological effects. These effects are manifest at pH values in the lower range of normally encountered conditions, e.g. pH <5. Both terrestric and aquatic organisms can be affected.

The mechanism of physiological damage mostly is precipitation of aluminium complexes at membrane tissues, thus impairing gas exchange and metabolism of the exposed organism. The acute toxicity limit for fish is reported to be 7 μmol/l of free Al in surface water.

The human toxicity is not very clear. A relation between the intake of aluminium and Alzheimer's disease has been suggested, but was never epidemiologically confirmed. However, the daily dose from food intake seems to be more important than ingestion with drinking water.

The WHO drinking water standard is 200 μg/l. In many European countries the value is regarded as a Maximal Admissible Concentration. Here, lower limits are imposed or recommended because of specific risks for dialysis patients.

Availability of aluminium in the environment is governed by chemical equilibria. At pH >5 strong complexes exist. Alkalinity and the presence of silica contribute to the formation of insoluble hydroxy-aluminium complexes.

Reported values for silica content and hardness in the intake water at El Azab, which represents the composition of the irrigation water, are 8 mg/l SiO_2 (140 μmol/l), and 184 mg/l $CaCO_3$, respectively. pH is well above neutral (8.0). Under these circumstances is the acute environmental risk minimal. However, the steady discharge of substantial amounts of aluminium into the open environment implies a long term risk factor, as it can be mobilised rapidly with a change of pH. Therefore, in the long run, a more controllable way of disposal has to be adopted.

Application of Chlorine for Disinfection

Chlorine is used for disinfection of the treated water; either as gas or in soluble form. An additional hazard is related to handling of the chemicals during application and the risk of accidents. Precautions shall be included in the design of the treatment works and the prescription of working practices.

4.5.4 Environmental impact of water distribution

Many water pipelines are presently constructed in PVC and AC (asbestos cement). The materials seem the obvious choice for future extensions of the distribution system of El Azab. However, in several western countries the use of these materials is either prohibited or discouraged because of suspected negative impacts on public health. An assessment of possible health impacts is required during the detailed design stage, when a selection of construction materials will be made. The assessment shall weigh the

suspected impact against other health hazards and consider the availability of alternative pipe materials in Egypt.

4.5.5 Environmental impact of water delivery

The provision of more water to the population of Fayoum calls for improvements of sanitary drainage facilities in individual households and in towns and villages. More water inside houses, without adequate facilities to dispose the wastewater will not result in improved health conditions. On the contrary: the current wastewater disposal problems would only be aggravated.

The current problems with wastewater disposal are assessed in the Wastewater Masterplan (Volume III) and the need for improvements - especially where water supply services are to be upgraded - are sufficiently described therein. The interaction between the developments in the water supply and wastewater sectors have been fully integrated into the masterplans of both sub-sectors (see also ref. 9).

CHAPTER 5

FIRST PHASE INVESTMENT PROGRAMME FOR WATER SUPPLY

In this chapter an investment programme for a first phase development plan is drawn up. The plan shall meet the short term needs; i.e. upto the year 2000.

The design capacities of components of the plan may however exceed the year 2000, considering the life time of these components and in line with the masterplan requirements set out in the previous chapter.

5.1 WATER PRODUCTION

5.1.1. Rehabilitation of El Azab

Rehabilitation and upgrading of the existing treatment plant at El Azab will be required to ensure its continuous function in the future and to safeguard the 1500 l/s presently produced. An assessment of required investments for rehabilitation works has been made and is presented in annex A.8.

On the medium term, approximately LE 37.5 million would be needed.

However, major works on the plant - for which close-downs of the plant will be required - can only be executed after the new plant is operational. Therefore, an urgent rehabilitation programme has been formulated (see annex A.8). The total investment required for this amounts to LE 18.4 million.

5.1.2. Compact treatment units

Although the 17 existing compact treatment units will be phased out in the future, this can only be done after commissioning of the new plant and completion of major works on the distribution system. In the intermediate period, the units have to remain in operation. Rehabilitation of several of these units is required as they already approach their life time. Some compact units will need replacement, while in a few areas new units are required. NOPWASD intends to construct a few new units shortly.

Investments required to execute an urgent programme for the compact treatment units is estimated at LE 5 million. With this amount, old units can be rehabilitated and a few new ones installed.

5.1.3. New treatment plant

The site of the extension of the El Azab treatment plant has been selected some 3 km southeast of the old plant. The site area is sufficient to meet land requirements upto 2020.

The new treatment facilities shall be constructed in stages. These stages normally cover a period of 7 to 10 years, after which an expansion is required. The period is not too long in order to prevent a too large over-capacity (and consequent high initial investment), but long enough to accommodate a complete planning-design-construction cycle for the next stage. Several scenarios can be considered. Two options have been examined here, which are summarised in table 5.1.

The "Present Value" analysis of the two options is provided in annex A.9.

Note: The analysis only considers a period upto 2010, because the necessary investments after that year do not influence the results significantly. The objective of the analysis is to determine the financially most attractive scope of the first phase.

Table 5.1. Comparison of staged construction of treatment facilities.

	Option I	Option II
to cover the demand upto 2010		
- number of stages:	2	3
- capacity per stage:	1500 l/s	1000 l/s
- PV all stages (mill. LE):	123	118
- cost of 1st stage (mill. LE)	77.7	55.9
- coverage of 1st stage (year):	2004	2001

note: PV = present value (see annex A.9)

As it is financially most attractive to construct the treatment plant in stages of 1000 l/s, this is recommended. It must be realized however that a second plant shall be constructed around the year 2000, i.e. within six years after completion of the first stage.

Table 5.2 summarises the investment requirements.

Table 5.2 Investment Cost of Treatment Plant - First Phase, 1000 l/s (1992 prices)

Item	Cost
Civil Works	LE 15.3 million
Mechanical & Electrical Equipment	LE 40.6 million
Total	LE 55.9 million

For unit prices, see annex A.5.

In line with the longterm recommendations of this masterplan, it is considered that future requirements of Fayoum City will be supplied from El Azab. Therefore, of the 1000 l/s installed capacity, 300 l/s will be required for Fayoum City, which represents a value of around LE 16.8 million.

5.1.4. Central storage reservoirs

The additional storage requirement is shown in table 5.3 and amounts to 8,000 m^3. This capacity shall be constructed at the new treatment plant. The reservoir capacity is then equally distributed over the two treatment plants of El Azab, as is illustrated in figure 5.1. As demonstrated in section 4.2 it is financially not advantageous to provide storage reservoirs inside the distribution system.

In Fayoum City no additional storage is required on the short term, provided that the 3 new water towers can be brought into operation.

Table 5.3. Required Storage Capacity, 2000

Location	Presently Available 1992	Total Required 2000
El Azab	11,500 m^3	19,500 m^3
Compact Units	(2,800 m^3 to be abandoned)	
In Network	(6,300 m^3 water towers)	
Fayoum City	24,000 m^3	22,700 m^3

The cost of the new reservoir of 8,000 m^3 at El Azab is LE 3.4 million.

5.2 WATER DISTRIBUTION

5.2.1. Trunk mains

The 2020 requirements for the distribution network will be met in two stages. Any new pipe laid now shall have sufficient capacity upto the year 2005. Pipes laid during the second stage - in general parallel to the first one - shall at least be sufficient upto 2020.

Computer simulations have been made to calculate network requirements for 2005. The following pre-conditions have been applied:

- Minimum pressures at the fringes of the main distribution network shall be 15 mwc to ensure sufficient pressure in isolated villages, which are supplied through branches.
- If a network section needs an expansion of its flow capacity, existing pipes will be maintained, unless:
  - there are already two parallel lines in a section,
  - the existing pipe is of cast iron.
  - the existing pipe has an odd diameter (125, 175 mm).

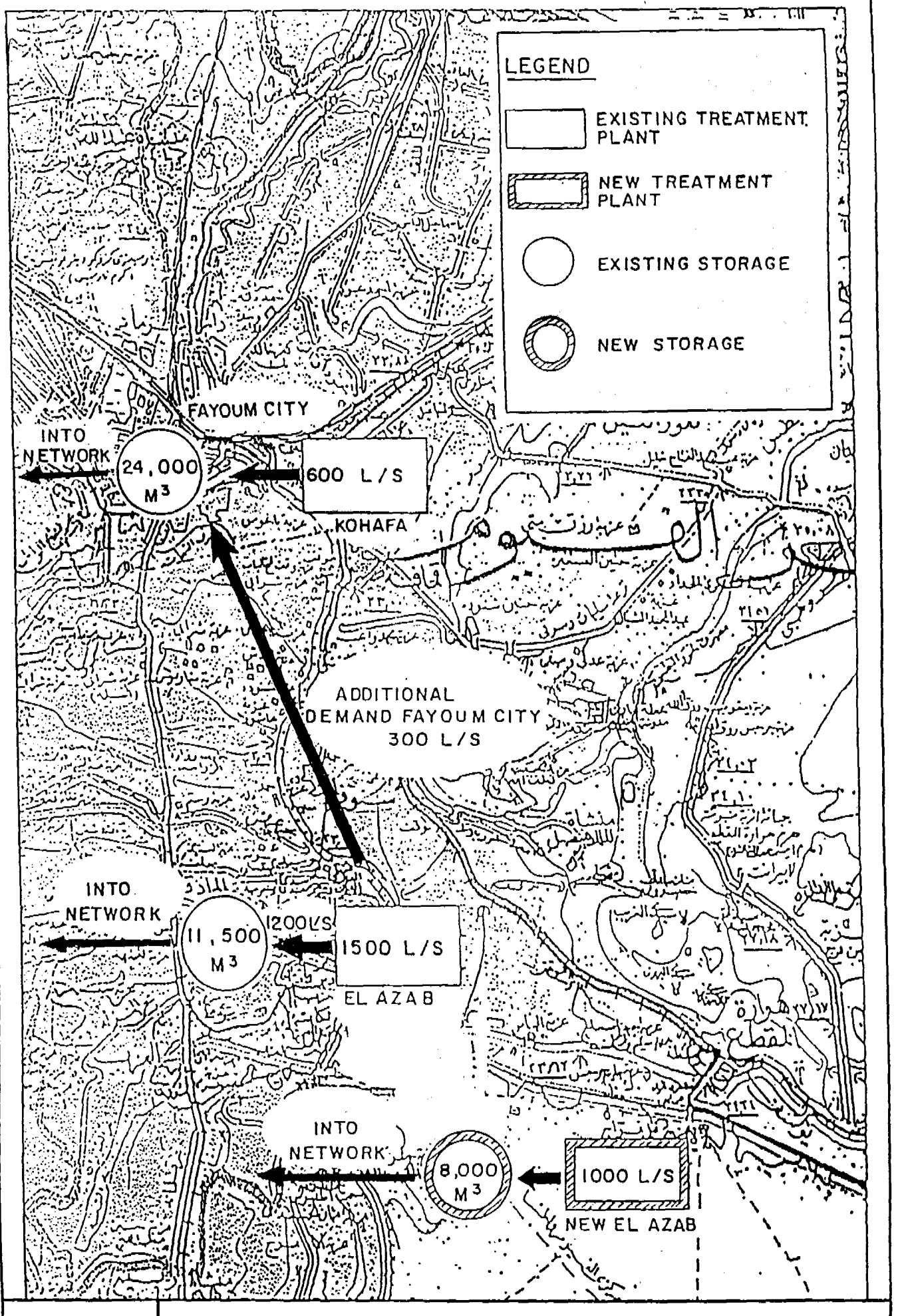


FIGURE 5.1 LOCATION OF PRODUCTION AND STORAGE CAPACITY YEAR 2000

- The network is designed on peak-hour flows, as there will be no storage capacity inside the network.
- Bulk supplies are made to Fayoum City and the industrial area at Qom Osheem (i.e. without a provision for peak-hour flows).
- Pressures in the network under average day conditions shall be sufficient to feed the existing water towers.

Table 5.4 summarises the requirements for new pipelines. Figure 5.2 shows the network.

Implementation of the works implicates that 350 km of the existing network will be replaced. 520 km will be maintained, bringing the total length of the network to 1063 km.

Table 5.4. Investment Requirements Trunk Mains, year 2005 - 1992 price level

Diameter (mm)	Length (km)	Cost million LE
100	41	1.9
150	75	5.5
200	49	4.9
250	67	9.0
300	70	12.9
350	47	11.1
400	20	5.9
450	17	6.1
500	59	25.9
600	54	36.8
700	21	15.6
800	16	13.6
1200	6	7.3
1400	3	3.5
4 boosters		0.4
Total	543	160.5

Urgent implementation programmes for trunk mains

Within the first stage programme for 2005, urgent works are identified which address the most pressing requirements. Distinction is made between high priority and second priority works, which are summarised in tables 5.5 and 5.6 respectively. Location of the pipe sections are shown in figures 5.3 and 5.4.

The high priority works will already result in considerable improvements in the water distribution before the new treatment plant is operational. The sections around the new El Azab plant shall be laid simultaneously with the construction of that plant. The second priority works can be implemented after completion of the new treatment plant. The remaining works shall be realised between 2000 and 2005.

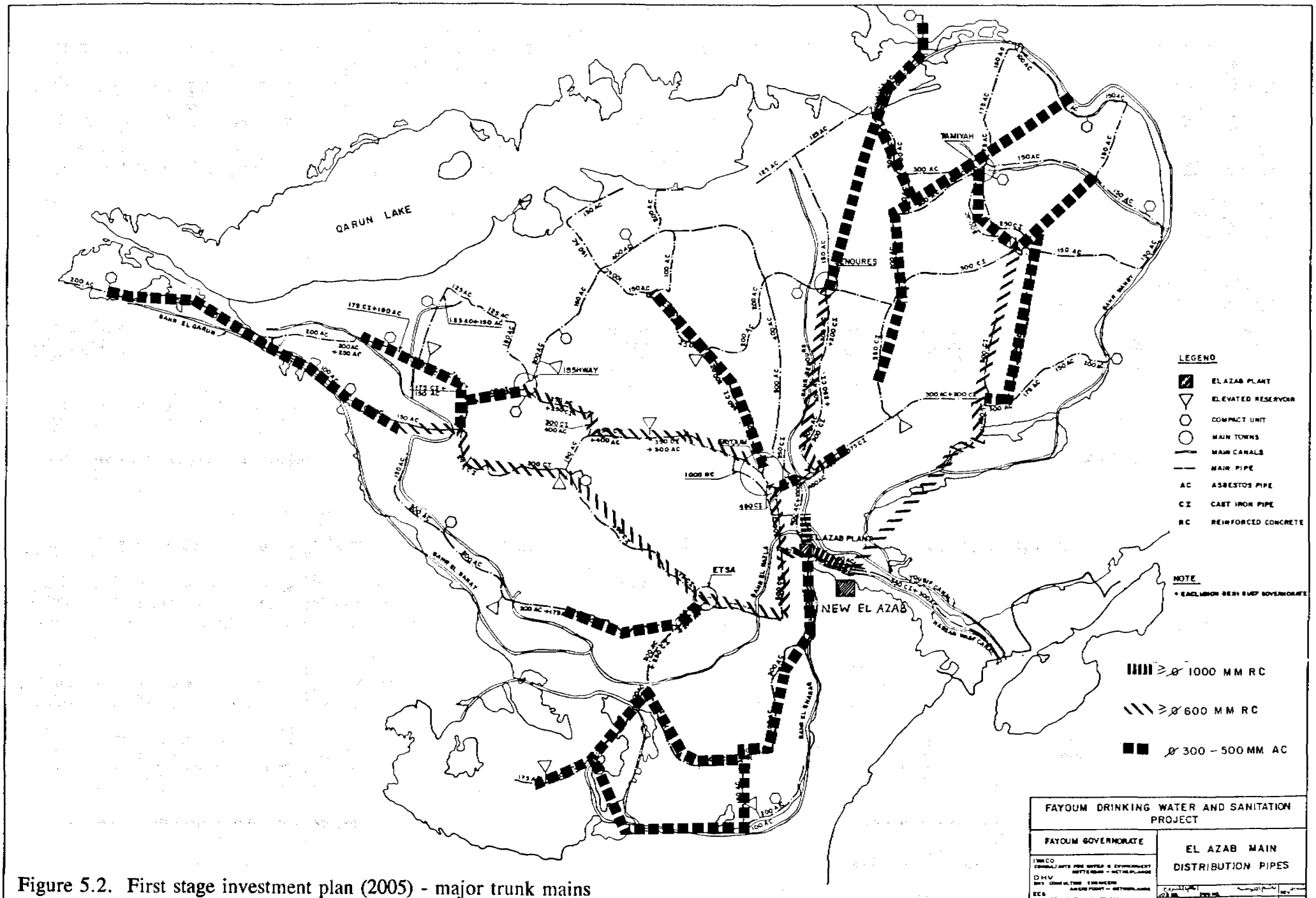


Figure 5.2. First stage investment plan (2005) - major trunk mains

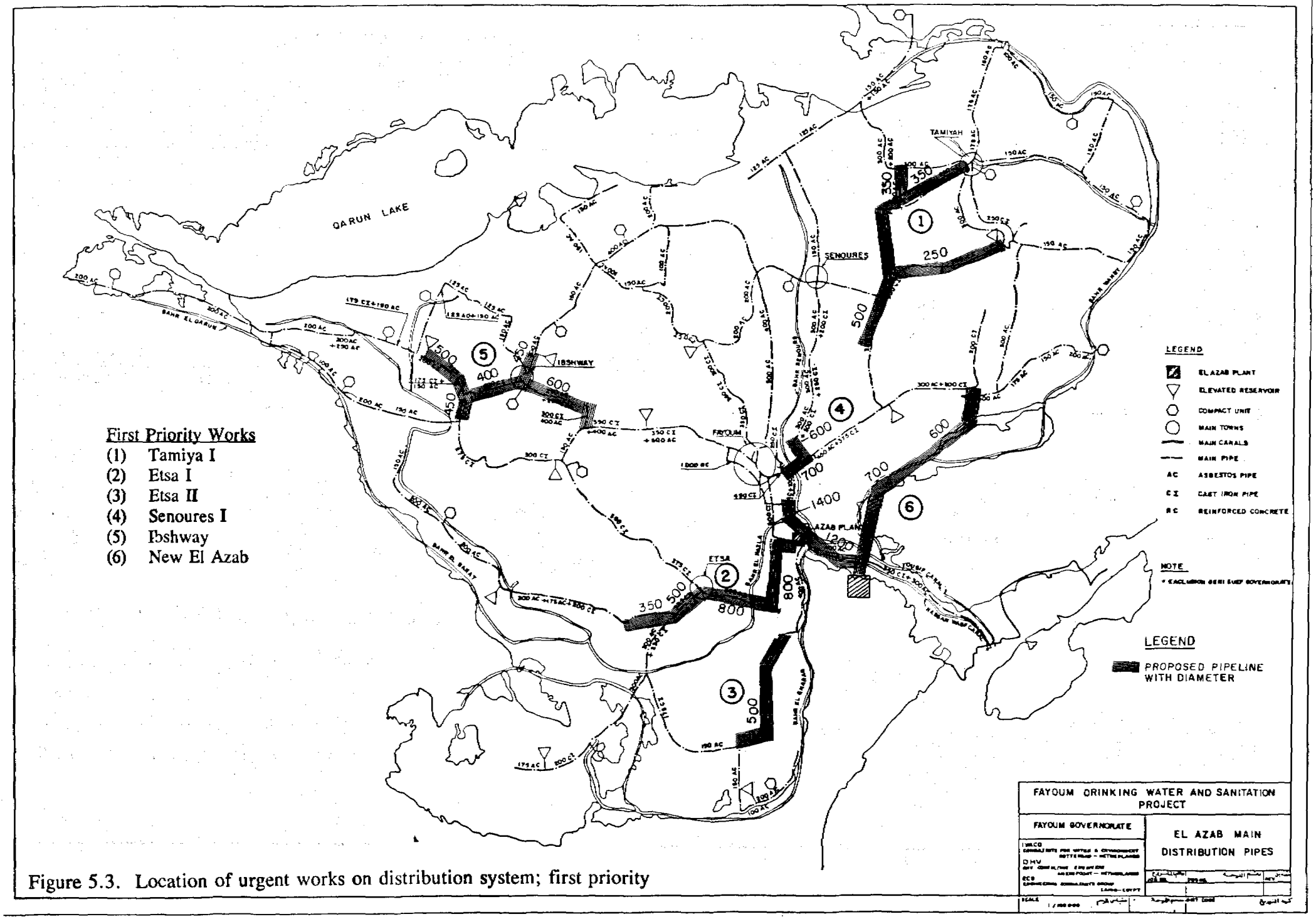


Figure 5.3. Location of urgent works on distribution system; first priority

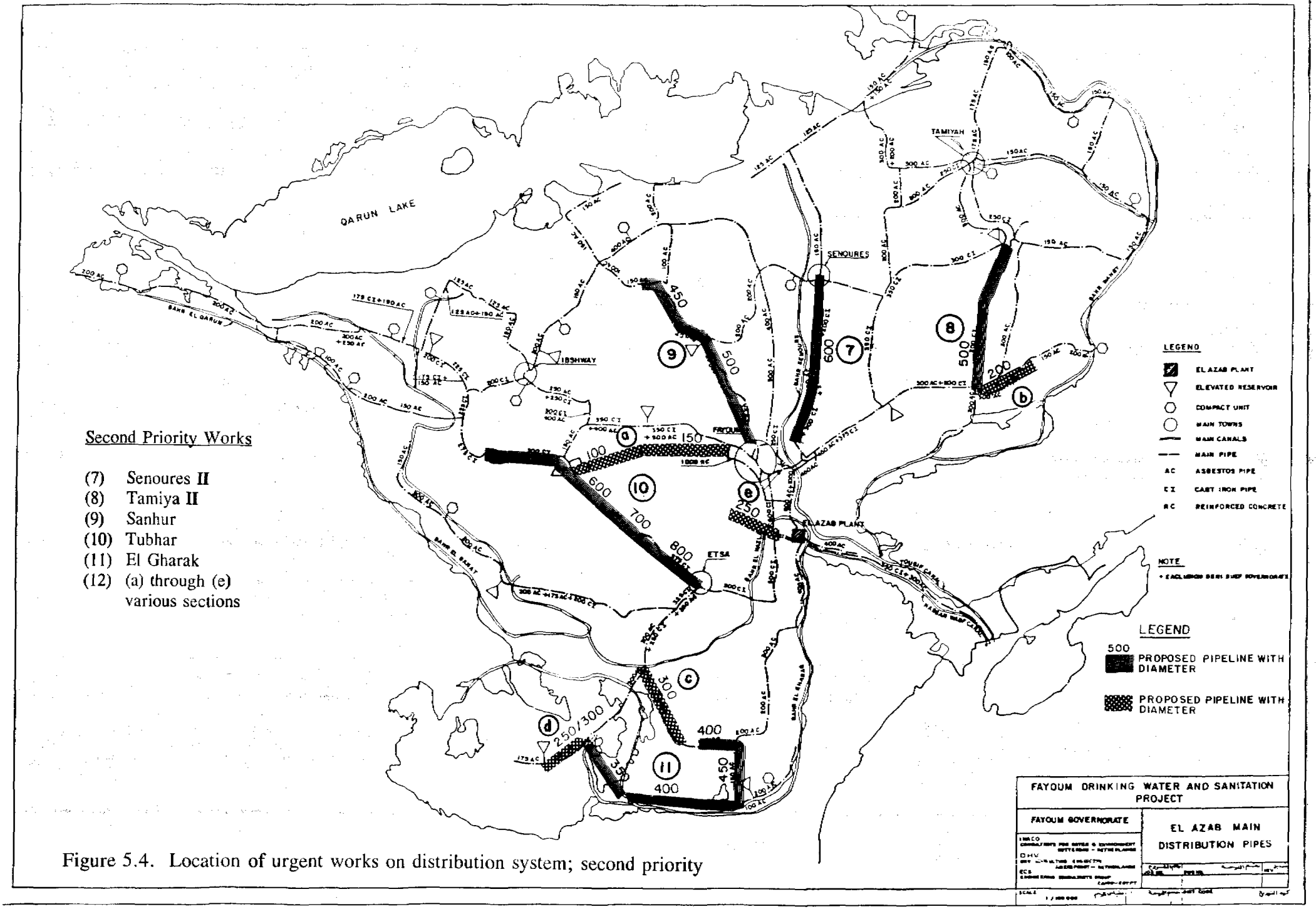


Figure 5.4. Location of urgent works on distribution system; second priority

Table 5.5. First Priority Works on the Distribution System

Location	Works		Costs
	diameter	length	(million LE)
1 Tamiya I	500 mm	11.3 km	7.8
	350 mm	6.5 km	
	250 mm	9.4 km	
2 Etsa I	800 mm	11.4 km	11.5
	500 mm	1.4 km	
	350 mm	3.7 km	
3 Etsa II	500 mm	8.2 km	3.5
4 Senoures I	700 mm	0.7 km	1.6
	600 mm	1.6 km	
5 Ibshway	600 mm	3.3 km	7.5
	500 mm	4.9 km	
	450 mm	3.8 km	
	400 mm	4.5 km	
6 New El Azab	1400 mm	2.5 km	21.3
	1200 mm	3.3 km	
	700 mm	15.0 km	
	600 mm	3.2 km	
TOTAL		95 km	53.2

Table 5.6. Second Priority Works on the Distribution System

Location	Works		Costs
	diameter	length	(million LE)
7 Senoures II	600 mm	11.7 km	8.0
8 Tamiya II	500 mm	10.5 km	4.6
9 Sanhur	500 mm	10.2 km	5.3
	450 mm	2.3 km	
10 Tubhar	800 mm	4.2 km	14.3
	700 mm	3.4 km	
	600 mm	11.9 km	
11 El Gharak	450 mm	4.3 km	4.3
	400 mm	5.7 km	
	350 mm	4.6 km	
12 Various sections		28.4 km	3.1
TOTAL		97 km	39.6

5.2.2. Reservoirs in the network

Although the provision of storage inside the distribution network has no financial advantage, their construction can be considered for operational reasons. Local storage can be used for emergency supply. For that reason it is recommended to take the 12 existing water towers into operation again.

However, the use of these old water towers will not result in a significant reduction of pipe sizes and of the central reservoir at the treatment plant, because most of these towers are not close to large residential areas.

Only reservoirs close to large residential areas result in reduction of pipe sizes and of the capacity of the central storage reservoir. For the year 2005 situation this has been examined. Water towers near the 5 largest towns would cost LE 6.3 million, while savings in the distribution system and central reservoir will amount to LE 10 million. (Ground reservoirs + pump stations in the 5 towns cost LE 8.4 million).

The premise to the incorporation of the existing water towers in the distribution system is a good control on the pressures in the system. Pre-conditions to be met are:

- a reduction of water losses in the distribution system through leaks and malfunctioning public taps;
- a minimisation of unnecessary pressure losses due to blockages inside pipes;
- a control of the water consumption in high pressure zones, close to the central treatment plant;
- the implementation of the urgent implementation works for trunk mains.

The following policy is recommended with regard to local storage:

- The construction of local reservoirs is not included in the short term investment plan.
- Local reservoirs shall be considered in a second stage (around 2005). Their construction at that time will make it possible to postpone a necessary expansion of trunk mains.
- By that time it should also be clear whether water towers can indeed be operated; i.e. whether sufficient pressure in the mains can be maintained to fill the towers.
- The construction of ground reservoirs with pump stations is not recommended, especially because of the high operation costs.

5.2.3 Branches

A reservation for the expansion of branches from the trunk mains to isolated villages - as far as not yet included in tables 5.5 and 5.6 -of LE 3 million has been made for the first phase.

5.2.4 Distribution networks in villages

Upgrading of the distribution systems inside towns and larger villages shall be started. A reservation of LE 5 million has been made for the first phase. Priority areas remain to be determined, and they will be related with the implementation of sewer systems.

In the first phase, priority shall also be given to the disconnection of house connections from trunk mains in high pressure zones in order to obtain control over water consumption in these areas. For that purpose, parallel service lines and pressure-reduction valves between trunk mains and local distribution networks will occasionally be required.

5.2.5 Pipeline rehabilitation works

Rehabilitation of the existing distribution network has a high priority. Many blockages and leaks in pipe lines have to be repaired while appurtenances have to be repaired or installed.

The general objectives of the rehabilitation works are:

- the reduction of water losses through leaks;
- the reduction of pressure losses through blockages in pipes (sand, air, others):
- the incorporation of sufficient appurtenances to allow for effective operation of the system.

El Azab is currently undertaking a system-wide rehabilitation programme. The approach and methodology is outlined in detail in Annex A-10. It is estimated that, to continue this programme, approximately LE 5 million is required during the first phase.

5.3 WATER DELIVERY

5.3.1 House connections

With the new treatment plant in operation, El Azab will be able to provide water to some 146,000 house connections. As soon as the new plant in Fayoum City is brought into operation, (which is expected this year) the installation of new house connections should be accelerated to a rate of 18,000 new connections per year; similar to the rate in 1985-1987.

Procedures for application and installation should be simplified (see chapter 7).

Upto the year 2000, a budget of LE 12.6 million is required for that purpose.

5.3.2 Public taps

The 1800 public taps in the supply area shall remain in function. In order to improve the service through these taps and to control wastage of water, an estimated 500 may need complete reconstruction, while some 1000 require repair works. The budget requirement is set at LE 2.0 million. Recommendations for an integrated policy for public taps are given in annex A.11.

5.4 FIRST PHASE INVESTMENT PLAN, YEAR 2000

Table 5.7 gives a summary of investment requirements for the first phase implementation plan. At 1992 price level, a total of about LE 200 million will be required. In the next chapter a financial analysis is presented in order to investigate the feasibility of this scheme. The requirements for cost recovery will be stated.

The investment requirements of table 5.7 do not include the costs related to technical assistance (TA) programme for the organisational development and strengthening of El Azab. The scope of this programme is identified in chapter 7.

Table 5.7. Investment Plan Water Supply, First Phase 2000 (1992 price level)

Item	Capacity or Quantity	Capital Value (million LE)
Water Production		
- rehabilitation old plant El Azab		18.4
- compact units upgrading		5.0
- new plant El Azab	1000 l/s	55.9
Central Storage	8000 m^3	3.4
Water Distribution		
- Trunk Mains		
- first priority	95 km	53.2
- second priority	97 km	39.6
- Branches	50 km	3.0
- Village distribution	100 km	5.0
- Rehabilitation		5.0
Water Delivery		
- house connections	126,000	12.6
- public taps	1,500	2.0
Offices, Warehouses		pm
Total Investment		LE 203 million

CHAPTER 6

COST RECOVERY

6.1 INTRODUCTION

Improving cost recovery is not simply a matter of raising tariffs but should focus on technical as well as financial and administrative requirements. The objective is to achieve maximum cost recovery at affordable tariffs for the consumers.

An important aspect of cost recovery is the optimisation of the volume of water sold as percentage of the total production. This amounts presently only to a meagre 38% but could be increased to some 75% of production by the year 2000.

Section 6.2 summarises El Azab annual expenses upto the year 2000, and specifies the required investments for capital works, based on the demand analysis, and the external technical assistance requirements.

Sections 6.3 and 6.4 analyse the possibilities for cost recovery, by increasing the volume of water sold, and secondly by tariff increases.

6.2 PROJECTED ANNUAL COSTS OF EL AZAB 1992-2000

The costs of El Azab can be broken down into the following categories:

- operating expenses;
- depreciation;
- capital costs.

Each category is evaluated in the sections below. Data are taken from annex A.12 which provides a complete financial analysis. The costs are based on future production requirements as determined in chapters 4 and 5.

6.2.1 Operating expenses

Operating expenses are shown in table 6.1. Production capacity increases by 35%, but operating expenses increase by 180% because of a projected relative increase of wages, electricity prices and costs of chemicals. More intensive maintenance requires a bigger effort and hence an increased cost level.

Table 6.1 Projected annual operating expenses 1992-2000 (million LE/1992 prices)

Category	1992	1994	1996	1998	2000
Salaries and wages	1.9	2.2	2.6	3.1	4.0
Electricity	3.1	6.1	7.6	8.7	9.6
Chemicals	1.2	2.3	2.8	3.1	3.3
Materials	0.3	0.3	0.4	0.5	0.6
Other expenses	0.1	0.1	0.2	1.0	1.0
Operating expenses	6.6	11.0	13.6	16.4	18.5

source: annex A.12

6.2.2 Depreciation

Table 6.2 shows projected annual depreciation in the period 1992-2000. This projection is based on an assumed value of assets of LE 80 million in 1990. It should be noted however that this value is an estimate and not based on a thorough asset evaluation. New production capacity is planned to be available by 1996, so a substantial increase in fixed assets is apparent.

Annual depreciation by the year 2000 amounts to LE 9.4 million, over 50% of operating expenses.

Table 6.2 Assets and depreciation, 1992-2000 (in million LE/ 1992 price level)

	1992	1994	1996	1998	2000
Fixed assets in operation	83.5	84.6	213.2	229.2	242.2
Accumulated depreciation	49.0	58.3	68.8	88.7	107.5
Annual depreciation	4.4	4.7	5.3	10.0	9.4

source: annex A.12

6.2.3 Investments and capital costs

Total investments in capital works were analyzed in chapter 5. They amount to a total of LE 203.1 million in the period 1994-2000. In addition a Technical Assistance budget is required of approximately 10% of the investments. Of the TA budget of LE 20.5 million it is estimated that LE 12.0 million will be required for detailed design and supervision works, LE 2.5 million for start-up O&M services of new installations and LE 6.0 million for organisational support and strengthening (see also chapter 7).

In table 6.3 the projected annual investments and TA requirements are provided. The investments should be externally financed by a mix of loans, grants and customer payments. The loans are only for financing infrastructure. Two types of grants are considered: investment grants, for the smaller works, and TA grants. It is recommended to finance the entire TA requirement from grant financing.

No cash contribution from El Azab is taken into account.

The investments in house connections are made upfront by El Azab but paid back by the customers within a year. It is recommended that the house connection, including the meter will be property of El Azab, in order to standardize materials and procedures.

The proposed financing scheme is composed of 54.4% loans, 40.4% grants and 5.2% customer payments.

Table 6.3 Annual investments, TA requirements and financing plan (1994-2000), in million LE

INVESTMENTS	1994	1995	1996	1997	1998	1999	2000	TOTAL
Treatment plant		10.0	30.0	30.0	10.0	2.7		82.7
Distrib. mains		20.0	20.0	30.0	20.0	2.8		92.8
Sec. distribution	1.0	1.0	2.0	2.0	1.0	0.5	0.5	8.0
Public tap rehab.	0.5	0.4	0.3	0.3	0.2	0.2	0.1	2.0
House connections	1.0	1.0	2.0	3.0	3.0	1.6	1.0	12.6
Rehabilitation	1.0	1.0	1.0	0.5	0.5	0.5	0.5	5.0
TOTAL INVESTMENTS	3.5	33.4	55.3	65.8	34.5	8.3	2.1	203.1
TECHNICAL ASSISTANCE								
Detailed design and supervision	6.0	2.0	2.0	1.0	1.0			12.0
Start-up O&M					1.0	1.0	0.5	2.5
Organisational support	1.5	1.5	1.5	1.0	0.5			6.0
TOTAL TECHNICAL ASSISTANCE	7.5	3.5	3.5	2.0	2.5	1.0	0.5	20.5
TOTAL FINANCING REQUIRED	11.0	36.9	58.8	67.8	37.0	9.3	2.6	223.6
PROPOSED FINANCING								
Investment Loan		30.0	50.0	41.7				121.7
Investment Grant	3.5	2.4	4.3	22.1	31.5	5.3	0.5	69.8
TA Grant	7.5	3.5	3.5	2.0	2.5	1.0	0.5	20.5
Customers contrib.		1.0	1.0	2.0	3.0	3.0	1.6	11.6

From table 6.3 it appears that three loans are required, the first one in 1995. It is recommended to consider a grace period of 4 years for amortisation and interest payments. This means that debt servicing should start as from 1999. Capital costs are as indicated in table 6.4.

Table 6.4 Capital costs (million LE/1992 price level)

	1999	2000
Amortisation	5.6	5.6
Operational interest	2.1	2.0
Total	7.7	7.6

Having determined the total annual costs for El Azab upto the year 2000, in the following sections it is analysed as to how these costs can be recovered. Firstly, by increasing the percentage of water sold (section 6.3) and secondly, by applying cost covering tariffs (section 6.4).

6.3 INCREASING THE VOLUME OF WATER SOLD

6.3.1 Priorities and targets

There are four priorities which should be addressed. Table 6.5 quantifies the targets for the increase of volume sold.

The priorities are:

1) decreasing technical losses by upgrading the physical system and the operational management;
2) increasing the number of household connections and reducing the percentage of free public tap water; this requires an extension of the production capacity as analyzed in chapter 3;
3) improving the revenue collection efficiency through a better billing and collection system;
4) cost recovery from public taps.

The targets imply that with a 35% increase of production, the volume of water sold could increase by 163%.

Table 6.5 Targets for increasing the volume of water sold (up to year 2000) in the supply area of El Azab

Volumes in Million m^3 (Mm^3)	1992	1994	1996	1998	2000
Mm^3 total production	41.1	50.6	50.1	49.6	55.6
Percent losses in network	28%	26%	24%	22%	20%
Losses in Mm^3	7.8	9.9	9.0	8.1	10.3
Mm^3 available to consumers in service area	33.3	40.7	41.1	41.5	45.3
Mm^3 Public taps (consumption + losses)	7.4	7.7	7.3	7.3	7.3
Mm^3 Free water + losses	7.4	5.4	3.4	2.6	2.3
Mm^3 Potential sales	25.9	35.3	37.7	38.9	43.0
Revenue collection efficiency(%)	60%	70%	80%	90%	95%
Mm^3 Actual sales	15.5	24.7	30.2	35.0	40.8
Sales as percentage of production	37.7%	48.8%	60.2%	70.6%	73.5%

6.3.2 Decreasing technical losses

Technical losses in the El Azab network presently amount to an estimated 28%. Between 1994 and 1998 no substantial increase of production capacity can be realised, because

during this period construction of new capacity is still ongoing. Demand will continue to increase so it is of substantial importance that during the coming five years great effort is invested in reduction of system losses.

The target is to reduce losses from the present 28% to 20% in the year 2000 and further down to 15% by 2010 and to 10% by 2020.

6.3.3 Increasing the number of house connections

In 1998 additional production capacity of 1000 l/s should come operational. A substantial increase in the number of house connections is made possible by this extension.

The target is to achieve 146,000 HC's by the year 2000, which means more paying consumers and hence increase of revenues.

6.3.4 Improving the revenue collection efficiency

Collection efficiency is defined as the percentage of the potential revenue that is actually being collected, and is an important indicator for the efficiency of the revenue management system. The estimated percentage for El Azab arrived at 60% for the year 1992, and is planned to increase to 95% by the year 2000. The required reorganisation of the revenue management system is further dealt with in chapter 7.

6.3.5 Cost recovery from public taps

The masterplan shows that the number of people using public taps will not decrease until the year 2000, because of the population growth. Total demand from public taps may even increase. At present an annual estimated 7.4 Mm^3 treated water is piped and pumped to destinations at considerable cost, but much of it is wasted because of poor maintenance and the lack of an attached price label.

It is therefore of utmost importance that:

- the majority of the public taps are rehabilitated according to an improved accepted design which minimizes the wastage;
- a system be developed for regular inspection, supervision and maintenance;
- a system be developed to recover the costs of the water consumed.

The approach for rehabilitation and maintenance of public taps and cost recovery options are outlined in annex A.10. Here a short summary is provided on cost recovery.

Charging consumers of public taps is required but is a rather difficult problem to deal with. The following options have been studied:

a) a caretaker for each tap, who cashes a certain amount for each container taken;
b) house-to-house collection of fees;
c) charging the Local Unit for the water consumed through public taps;

d) no charge for the public tap users but cross-subsidising the costs from more affluent consumer groups.

The first option requires appointment of some 1800 standpost caretakers. The amounts collected should allow for paying the water consumption bill to El Azab plus a reasonable salary for the caretaker. This option is not recommended because of the high extra costs of the caretakers.

The second option (collection of fees from the houses) is not feasible because of the large number of houses to visit. The costs of collection would be more than the revenues.

The third option seems a feasible solution although there are disadvantages also. The basic idea is that the Local Unit is charged for the water consumption from all public and governmental facilities, including public taps. This option requires that the Government provides an adequate budget to each Local Unit for its public water supply costs. At the same time paying of bills should be enforced. Government subsidies for public services are thus shifted from the providers to the users of the service.

The advantage of this system is that:

- El Azab will reduce "unaccounted for water" considerably;
- Local Units will face the real costs of public water supply (through the specified bills they get);
- the Local Units may become motivated to save water in order to reduce their bill, and stimulate people to take a house connection, or otherwise, limit water consumption from public taps and avoid wastage;
- Local Units can collect community contributions for public water supply for example by adding a "water component" to an existing tax.

Cross-subsidisation, which is mentioned as option 4, implies that certain consumers pay more in order to support others. In this case for example, house connections or non-domestic users support public taps. This would imply that tariffs in those groups would have to be increased by some 10 to 20% additionally. At the same time there is still no price tag to the water of the public tap, with all the related negative consequences. This option is therefore not recommended.

The third option, which implies payment through Local Units is the recommended option.

6.4 FUTURE WATER TARIFFS

6.4.1 Introduction

In this section two main scenarios for cost recovery are elaborated. The first one is full cost recovery by the year 2000. The alternative approach is based on affordability of the water bill for the customers.

The first approach implies that El Azab should become an autonomous and financially independent water supply utility by the year 2000. The underlying financial analysis is presented in annex A.12.

The second approach argues that the increase should be limited in order to avoid that the low income classes would be deprived from piped water because of the high costs.

6.4.2 Tariffs for full cost recovery in the year 2000

The financial analysis which is fully presented in Annex A.12, starts from the assumption that El Azab will become an autonomous and financially independent water supply utility for the Fayoum Governorate (excluding Fayoum City). The main objective of the analysis is the determination of water tariffs to ascertain cost recovery by the year 2000. Five options to reach financial independence and full cost recovery by the year 2000, with a 5% rate of return (RoR) on net assets have been studied. The water production and distribution assets are to be revalued and transferred to El Azab as capital contribution of the Government.

The five options to determine new water tariffs are described as follows:

a. gradual increase of the water tariffs up to the year 2000. In that year it should just reach full cost recovery as well as the 5% RoR on assets;

b. recovery of operational cost, starting in 1995 and continuing until it is equal to the tariff sub (a);

c. operational costs and debt service plus part of the investments;

d. operational costs plus depreciation or debt service of loans, which-ever is highest;

e. operational costs plus depreciation and the realisation of a rate of return on net revalued assets. The RoR is assumed to increase from 0% (which means cost recovery or break-even) in 1995, to 1% in 1996, 2% in 1997 and reach 5% by 2000.

Option (a) is the minimum option; the break-even point for O&M costs is reached in 1998 and full cost recovery by 2000.

Option (e) which is a theoretical one, aims at full cost recovery from 1995 and this is the ideal case for El Azab, reflecting the objective of every autonomous and financially independent company. This option (e) is analysed in detail, to serve as a frame of reference, not as the most realistic option.

Methodology of the analysis

For the purpose of the analysis, the water tariffs system is simplified to three user categories. Basic domestic tariffs are used for house connections, the tariff for public

taps is assumed to be equal to this basic domestic tariff. For other users a tariff equal to the industrial tariff is applied; these "other uses" represent not more than 10% of total drinking water for domestic use. These tariffs are determined in the analysis for every year covered by the analysis. The weighed averages of these three tariffs are also determined year by year in detailed tables in annex A.12, showing three historical years 1990, 1991, 1992, estimates for 1993, and new tariffs from the beginning of 1994.

Annex A.12 contains data and calculations on the necessary inputs to justify the financial statements. There are population forecasts for markaz capitals, semi-urban areas and the rural population; these forecasts are linked to the water demand in litres per capita per day and the increase of the number of house connections, while maintaining the number of public taps and the assumption that the users of public taps will pay for their consumption from 1994 onwards.

The income statement will break-even in 1995. This implies that tariff revenues will cover the costs as defined in the various cost recovery options. For full cost recovery according to option (e) this means O&M-costs as well as depreciation of assets. Break-even means that all costs are recovered without any remuneration of the existing assets; the rate of return (RoR), on (revalued) assets is zero % in 1995.

In the following years a RoR covenant would come into operation to ensure further tariff adjustments and realise increasing RoR on fixed assets. The rate of return might be limited (by the government), but a covenant is usually to be agreed upon with the World Bank to obtain IDA or WB financing for public projects providing basic social services like drinking water.

A reasonable RoR (on net revalued assets) for a public utility company serving a social purpose is 5%. This rate of return (RoR) can be reached gradually, particularly since the Company starts without any debt service on old loans. After 1995, the RoR is assumed to increase by 1% each year until it reaches 5% in 2000. In this way the company becomes financially independent and is expected to pay for the debt service (interest and amortisation of the principal) of (new) loans that are necessary to finance the planned extension of water treatment capacity and distribution systems. With these assumptions, the company should be able to self-finance 10%-20% of the planned investments. Furthermore, grants and other equity contributions might be expected from the Governorate or Central Government, while a tax exemption is assumed to establish a feasible financing plan. Notice also that a tax holiday is assumed to facilitate the start of the company. These and other items are proposed and the assumptions made are discussed in more detail in the annex.

A final remark should be made on the presentation of the results. A financial analysis is - usually - conducted at current prices. For the purposes of presentation, the results of this analysis are shown here at constant prices. In this way the costs, tariffs and revenues are indicated at the 1992 price level, also in the year 2000. Therefore, only the real increases of the tariffs are indicated. Compared to the present low water tariffs, the increases required at constant prices are already considerable.

Results of financial analysis

The analysis focuses on the supply of drinking water and the related water supply investment programme, while aiming at full cost recovery by raising water tariffs and keeping costs as low as possible. This analysis is carried for the traditional activities of El Azab only. Option (e) is analysed to show how such a company could financially function without being dependent on the central government, in perspective to the outcome of the other options. Full cost recovery according to option (e) represents the ideal case for El Azab. The recommendation to differ from this option is given on grounds of the social feasibility to introduce the new tariff gradually and applies only to the period until the year 2000.

The other options have been analysed also and some of the outcomes are compared to option (e).

By the year 2000 the average tariff should have reached LE 0.89 per m^3 (at constant 1992 price) in order to realise full cost recovery. Therefore, tariffs are set according to reach this goal.

The resulting tariffs are indicated in Table 6.6 and graphically represented in figure 6.1. With equal targets for the other five options (a) to (e), i.e. full cost recovery in the year 2000, the following can be concluded:

1) options (c), (d) and (e) which aim at some degree of recovery of capital costs and depreciation, require a quadrupling of the average tariff in 1995. Option (e) is the ideal scenario, yielding a cumulative net profit of LE 24 million in the period 1994-2000; full autonomy and financial independence is achieved from 1995 onwards.
2) options (a) and (b) reach O&M cost recovery in 1998 and 1995 respectively and thereafter head for full cost recovery by the year 2000, through a gradual annual tariff increase.

Table 6.6 Average cost covering water tariff scenarios for El Azab in LE (at constant prices of 1992). 1992-94 are existing tariffs.

Year	Cost recovery option				
	O&M in 1998, full cost recovery in 2000	O&M in 1995, full cost recovery in 2000	O&M from 1995 Debt service + part of investments from 1999	Full cost recovery excl. RoR target	Full cost recovery from 1995 incl. RoR target
	(a)	(b)	(c)	(d)	(e)
1992	0.10	0.10	0.10	0.10	0.10
1993	0.15	0.15	0.15	0.15	0.15
1994	0.18	0.18	0.18	0.18	0.18
1995	0.28	0.45	0.63	0.64	0.64
1996	0.38	0.45	0.64	0.66	0.71
1997	0.47	0.47	0.64	0.76	0.89
1998	0.50	0.50	0.65	0.76	0.89
1999	0.67	0.67	0.70	0.76	0.89
2000	0.89	0.89	0.89	0.89	0.89

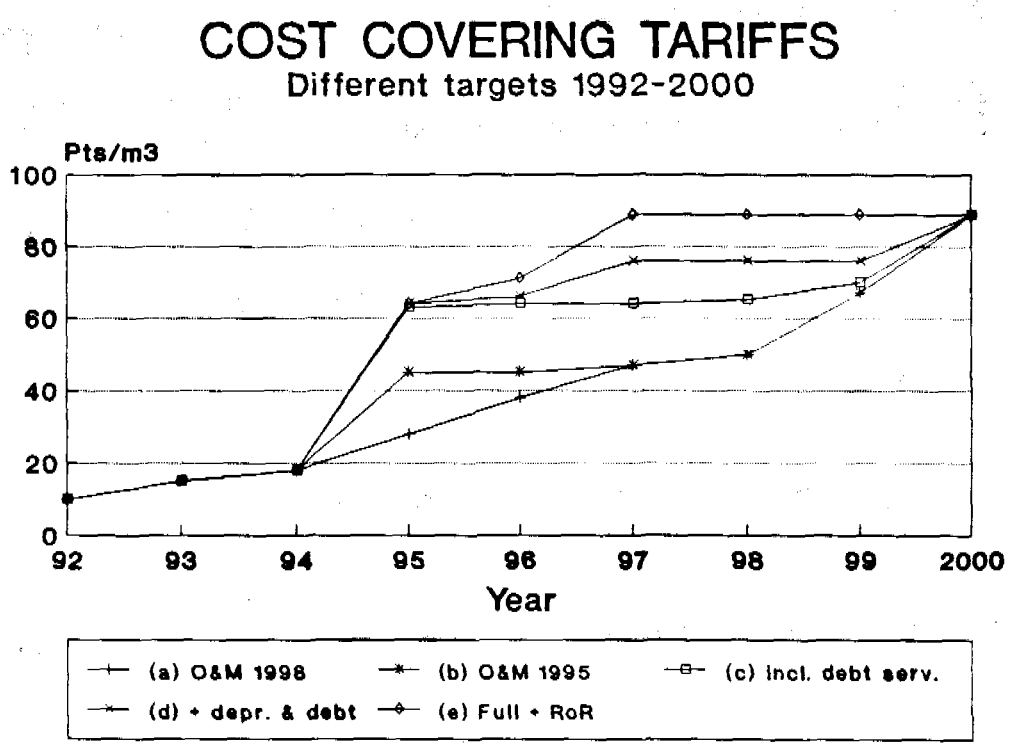


Figure 6.1

6.4.3 Tariffs based on affordability for consumers

An average tariff of LE 0.89/m^3 in the year 2000 implies that if 40.8 million m^3 are sold in that year, the total revenue will be LE 36.3 million. In chapter 3 (table 3.5) assumptions were made about average incomes and percentages thereof which could be spent on drinking water. The resulting average tariffs for the various consumer classes ranged between 19 and 42 piastres per m^3. This is less than half of the required tariff needed for full cost recovery.

Based on table 3.5 the maximum revenue which may be collected from consumers can be determined by multiplying the number of households per consumer class and the maximum assumed amount a household is able to spend on water. The number of households in each consumer class in the year 2000 follows from tables 3.2 and 3.4.

In table 6.7 the monthly potential income for El Azab in the year 2000 is calculated. The collection efficiency is assumed to be 100%. For non-domestic consumption which is estimated at some 650,000 m^3/mth (see tables 3.4 and 3.6) a revenue of LE 1.0/m^3 is assumed. Monthly potential revenues thus calculated arrive at LE 1.7 million or some LE 20.2 million annually.

Table 6.7 Calculation of El Azab potential revenues (year 2000)

Consumer Class	Year 2000 proportion of population (in %)	Number of HH per class	Max. amount spent on water per HH (see table 3.5) (LE/mth)	Potential income for El Azab per month*) (1000 LE)	As % of total income for El Azab
A	0	0	15.0	0.0	
B	10.3	34300	10.0	343.0	B+C:
C	9.2	30600	8.0	244.8	34.9
D	18.2	45625	4.5	205.3	D+E:
E	17.1	42875	3.0	128.6	19.8
P	45.2	113125	1.0	113.1	6.7
Non-domestic	21% of domestic	648.8 m^3 total non-dom.demand	LE 1.0/m^3	648.6	38.5
		TOTAL	LE/MTH	1,683.2	100%

*) at 100% collection efficiency

It follows from table 6.1 that consumer classes A,B, and C contribute 35% to the revenues, classes D and E 20%, non-domestic users 38% and public tap users only 7%.

It can be concluded that with the abovementioned revenues the annual O&M costs in the year 2000 (LE 18.5 million, ref. table 6.1) can be recovered, plus a small part of depreciation or operational interest (LE 2.0 million, ref table 6.4). Full recovery of depreciation and debt servicing is not yet feasible.

In table 3.5 limitations to year 2000 tariffs were indicated:

- public tap water could have a price of LE 0.19/m^3. Whether the amounts of average LE 1/mth/HH are actually going to be collected from the households is left to be seen, because of the collection costs and the administrative complications.

- the "social tariff" for small consumers (< 15 m^3/mth) without a sewer connection. This tariff would be LE 0.31/m^3 (year 2000).

- For the consumption groups between 15 and 30, and over 30 m^3/mth, more progressive average tariffs can be applied of over LE 0.40/m^3.

Based on these limitations it is proposed to consider the following tariff groups in the year 2000:

I. Basic house connection tariff, for monthly consumption less than 15 m^3. All house connections will pay this tariff for the first 15 m^3 of consumption. Consumer classes D and E will not consume more than these 15 m^3.

II. For a monthly consumption between 15 and 30 m^3, a tariff of LE 0.50 per m^3 can be applied for the consumption over 15 m^3 (consumer classes B and C). The average tariff at a consumption of 30 m^3/mth should be LE 0.40.

III. For monthly consumption over 30 m^3 (consumer class A), a tariff is applied of LE 0.60 per m^3. The maximum average tariff at 40 m3 monthly consumption should be LE 0.45.

IV. Public tap tariff (consumer class P).

V. Non-domestic tariff.

VI. Sanitation surcharge for consumers with a sewer connection (percentage of the waterbill).

Figure 6.2 shows the average domestic tariffs in the year 2000, as a function of monthly consumption.

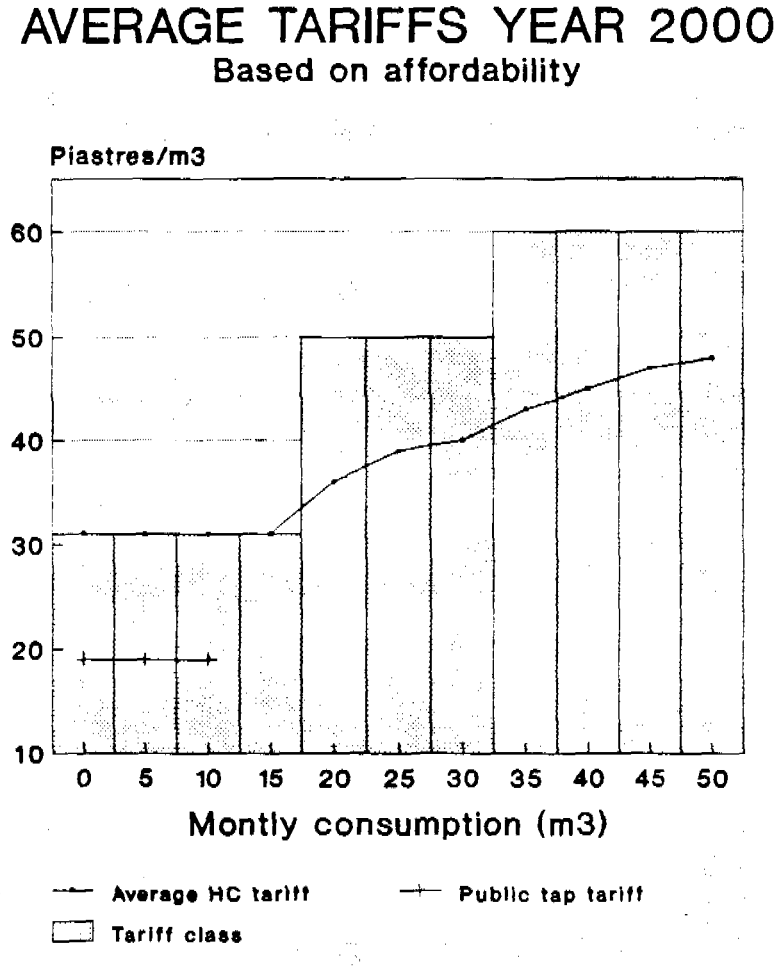


Figure 6.2

Table 6.8 and figure 6.3 show the recommended tariff developments in the period 1992-2000 for the five tariff groups. It should be noted that the tariffs for 1992-1995 are already fixed, based on a Decree from the Ministry of Housing, dated 10/5/93. The new tariff structure may be implemented as from 1996.

Table 6.8 Proposed tariff development 1992-2000 (LE/m³), based on affordability 1992 price level

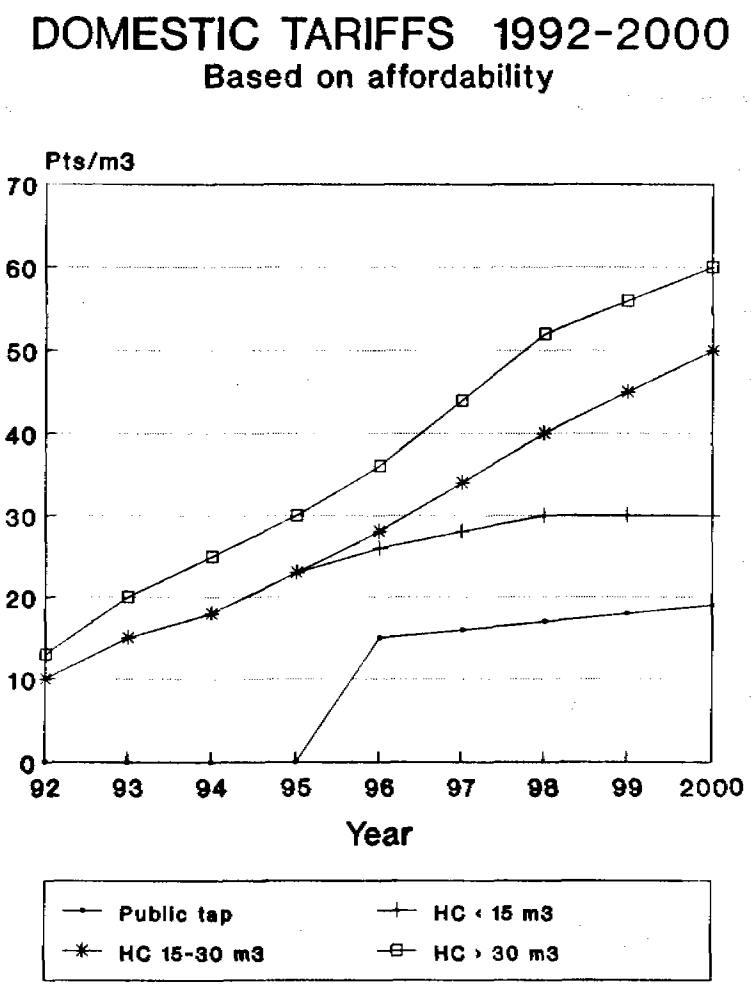
Year	Public tap	House connections (m³/month)			Non-domestic
		< 15 m³	15-30 m³	> 30 m³	
1992	0	0.10	0.10	0.13	0.23
1993	0	0.15	0.15	0.20	0.30
1994	0	0.18	0.18	0.25	0.38
1995	0	0.23	0.23	0.30	0.50
1996	0.15	0.26	0.28	0.36	0.60
1997	0.16	0.28	0.34	0.44	0.70
1998	0.17	0.30	0.40	0.52	0.80
1999	0.18	0.30	0.45	0.56	0.90
2000	0.19	0.30	0.50	0.60	1.00

6.4.4 Conclusion: recommended tariff structure

The financial analysis shows that full cost recovery will come within reach of El Azab beyond the year 2000. The basis for this will be laid in the remainder of this decade, when El Azab has the time to develop into an efficient organisation. Whether full cost recovery will be reached in 2002, 2005 or even 2010 will depend mainly on the socio-economic development of the region.

It is recommended that affordability of the population to obtain a water connection should be the main factor on the short term, coupled with full recovery of O&M costs. In the next decade financial autonomy can be pursued if socio-economic conditions allow so.

The proposed tariff structure for the period upto the year 2000 is shown in table 6.9. Upto 1995 the tariffs comply with the Decree of the Ministry of Housing. As from 1995/96 a new tariff structure should be introduced, with more differentiation in the domestic category, and less differentiation in other categories. The distinction within the non-domestic class between Governmental and private for instance should be eliminated.


DOMESTIC TARIFFS 1992-2000
Based on affordability
Pts/m3
70
60
50
40
30
20
10
0
92
93
94
95
96
97
98
99
2000
Year
Public tap
HC < 15 m3
HC 15-30 m3
HC > 30 m3

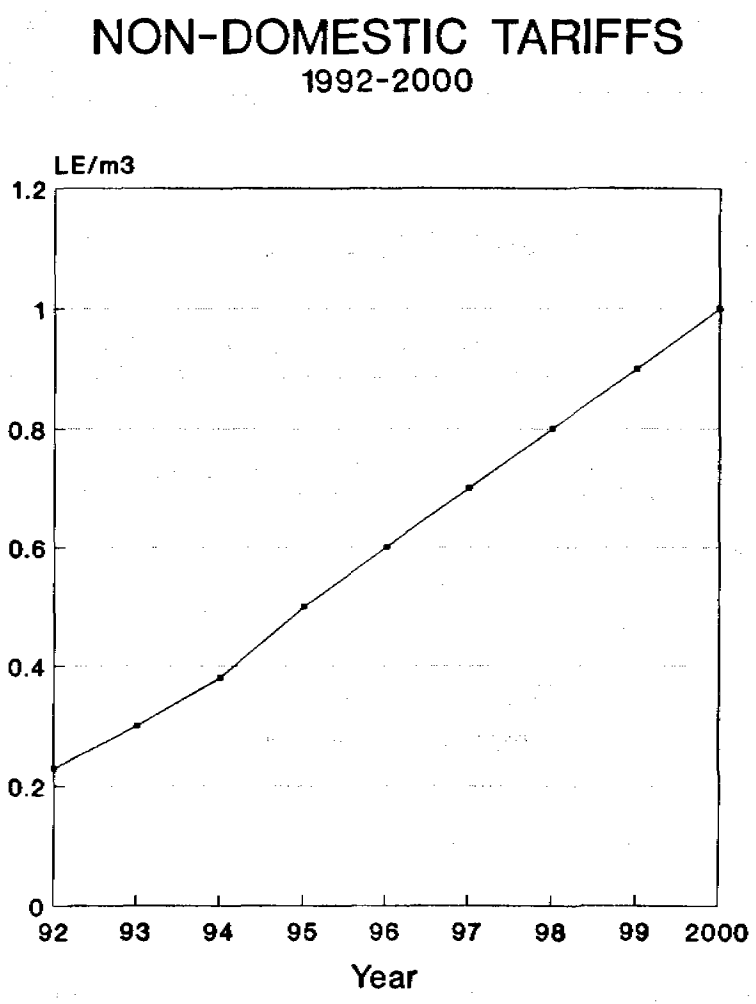

NON-DOMESTIC TARIFFS
1992-2000
LE/m3
1.2
1
0.8
0.6
0.4
0.2
0
92
93
94
95
96
97
98
99
2000
Year

Figure 6.3

Table 6.9 Proposed tariff structure 1992-2000

Type of consumption	Consumption per month in m^3	Tariff class	92	93	94	95	96	98	2000
			Tariffs as per instructions from the Min. of Housing (10/5/93), valid upto 30/6/95				Recommended new tariff structure		
Domestic	< 15 m^3	I	n.a	n.a	n.a	n.a	0.26	0.30	0.31
House connections	< 30 m^3		0.10	0.15	0.18	0.23	n.a	n.a	n.a.
	15-30 m^3	I : < 15 m^3 II : 15-30 m^3	n.a	n.a	n.a	n.a	0.26 0.28	0.30 0.40	0.31 0.50
	> 30 m^3	I : < 15 m^3 II : 15-30 m^3 III: > 30 m^3	n.a 0.13	n.a 0.20	n.a 0.25	n.a 0.30	0.26 0.28 0.36	0.30 0.40 0.52	0.31 0.50 0.60
Public tap	< 10 m^3	IV	n.a	n.a	n.a	n.a	0.15	0.17	0.19
Non-Domestic	Governmental		0.20	0.25	0.32	0.40	n.a	n.a	n.a
	Private		0.23	0.30	0.38	0.50	0.60	0.80	1.0
Sanitation surcharge in % of water bill	Domestic		20	20	30	35	40	50	60
	Non-domestic		20	20	40	60	70	80	90

CHAPTER 7

ORGANISATIONAL DEVELOPMENT

7.1 INTRODUCTION

The water supply needs assessment presented in this masterplan implies a substantial increase of the size, complexity and financial committment of water supply operations in Fayoum. This development imposes new requirements on the organisation and management of the drinking water sector in Fayoum. Given the fact that the present organisational structure and capacity are already inadequate and outdated with respect to the present day requirements, the necessary short and medium term changes in the organisational structure and managerial system are quite considerable.

Although decentralised in 1984, El Azab has limited autonomy. The Governorate's management and control systems, to which El Azab is subjected are not conducive to an efficient production orientation, as was explained in section 2.4.

The establishment of a semi-autonomous Water Utility in Fayoum is one of the means by which an improved and more sustainable drinking water service can be achieved. Without this new organisational structure, improvements will be hard to realise.

The basic institutional requirement therefore is to arrive at a more effective and more performance oriented water utility in Fayoum which is capable of:

a) sustaining the future required investments and expansion of the production and distribution facilities, physically and financially, and
b) enhancing the service level to the consumers, at affordable costs.

A key issue with respect to the above is the achievement of a consensus between the Governorate, NOPWASD and the interested Donor Agencies about the steps to reach a sustainable water supply utility in Fayoum. Obtaining funds for the rather ambitious investment programme, will to a large extent depend upon the availability of, and adherence, to an agreed development path.

The requirements for cost recovery and the related tariff issue were dealt with in the previous chapter. This chapter provides an organisational needs assessment, and based upon that, an outline organisational development plan.

7.2 ORGANISATIONAL NEEDS ASSESSMENT

7.2.1 Future responsibilities and legal status of El Azab

Organisational needs are determined by the tasks and responsibilities of the organisation and its legal status.

The following future responsibilities are formulated:

with respect to the essential tasks:

- to guarantee an uninterrupted supply of drinking water in adequate quantities and of acceptable quality to the population of the Governorate;
- preventing wastage and leakage of drinking water and keep it at an acceptable percentage of water production;
- charging all customers a fee which is affordable and at the same time covers O&M costs. Recovery of depreciation, capital costs and some internal cash generation are subsequent targets;
- provide customers with basic information about their rights and duties with respect to the obtained water supply services;
- preparing independently for extension and investment plans.

with respect to operational autonomy:

- executing a Government independent personnel management system with respect to recruitment, salary structure, incentives etc.;
- executing a Government independent accounting and financial administration system.

With respect to the future legal status of El Azab there are three possibilities:

a) a branch of the local government (present situation);
b) a fully private company;
c) a semi-autonomous public utility.

It is clear that the present status cannot be maintained, for reasons explained in chapter 2. On the other hand, full privatisation is not desirable either, because some public sector influence over basic policies and standards is required. Therefore the semi-autonomous public status is proposed. Some government regulation, control and support will still be available, but operational autonomy and performance oriented management are made possible.

7.2.2 Organisational restructuring

In this masterplan not all legal implications of a change of organisational status are dealt with. The discussions about a general restructuring of the drinking water and wastewater sector in Egypt are still in a preliminary stage, and the actual pace and direction of developments is yet uncertain. The description provided here is based on an analysis of functions. Three basic issues are addressed:

a) basic organisation and management structure;
b) merger of Fayoum City Water Authority with El Azab;
c) integration of wastewater services in El Azab.

Organisation and management structure

The El Azab of the future would be largely free from external interference, but a National or Regional Sector Authority (NOPWASD, or another institution to be developed) would provide support, guidelines and set targets for technical and financial performance.

The new structure for El Azab is designed in such a way, that all technical, operational, planning and administrative functions can be carried out independently. The basic organisation structure consists of three elements:

1. Headquarters, principally concerned with:

   - policy making, planning and design, general management;
   - personnel and administration;
   - coordinating water treatment, supply and distribution;
   - provision of operational support services (procurement and stores, workshops, drawing office, billing & revenue dept., specialist maintenance services).

2. Distribution Districts (present maintenance centres), with the following main functions:

   - water distribution, leak detection and prevention, and O&M of pumps and boosters;
   - pipeline repairs;
   - laying of service pipes and installation of customer connections;
   - maintenance of public taps;
   - meter reading and revenue collection;
   - customer services.

3. Main treatment plants:
   - drinking water production and pumping;
   - water quality control.

A more detailed description of this basic structure, with organisation charts, function allocations and responsibilities is provided in annex A.13.

Merging El Azab with Fayoum City water supply

It is required to investigate the feasibility of a future general water utility for all Fayoum Governorate. The three main reasons for this are the following:

- The networks of Fayoum City and El Azab are interconnected. El Azab supplies considerable volumes (300 l/sec. average) to the city, for which it is marginally paid. This leads to the situation where El Azab is subsidising the city's water supply.

It is expected that the interconnection will continue also after the start up of the new Fayoum City water treatment plant. The demand analysis shows that Fayoum City will continue to depend on supplies from El Azab.

- A merged company will consider future water supply requirements from a global Governorate point of view. This will have the advantage that future plants can be of larger scale and thus benefit from the economies of scale. Savings on investment costs are essential since the water industry is highly capital intensive.

- A strong and efficient revenue collection system in the city will strengthen the financial performance of the whole company. By nature, revenue collection in rural areas is more difficult and less effective because of the dispersed population and the widespread water use from public taps (free water). By combining the more efficient cost recovery of the city with the rural areas the more affluent city subsidises water supply in the poorer rural areas.

Integration of wastewater services

The wastewater masterplan recommends the separate development of a Wastewater Department in the Governorate as a first step. The main reasons for NOT integrating the wastewater department in El Azab on the short term are the following:

- the organisational complexity would increase considerably;
- El Azab should concentrate first on achieving cost recovery for its water supply operations. Adding the responsibility for wastewater would absorb too much energy and efforts and moreover would increase the costs for O&M considerably. The wastewater sector still needs longterm Government subsidisation, for the water sector on the other hand financial self reliance can be achieved on the short term.

Good cooperation and coordination between El Azab and the Wastewater Department would have to be established. At a later stage when the Wastewater Department has matured it may become integrated in the Water Utility.

7.2.3 Operation and maintenance

O&M of water production, distribution and delivery facilities is one of the basic functions of the organisation which needs substantial strengthening. The functions and responsibilities with respect to O&M are included in annex A.13. Here a summary is provided.

O&M of production

A substantial maintenance backlog is apparent with respect to all production facilities (see annexes A.2 and A.8). Preventive maintenance is not carried out. Measuring and control

facilities are not available or out of order. Substantial overhaul is required and a trained and well equipped plant maintenance crew has to be established.

The laboratory is functioning well, but here also renovation and intensification of water quality monitoring is required in the future also at water delivery points. After all, El Azab will be responsible for safe water provision to over 2 million people by the year 2000.

O&M of distribution

Maintenance centres have to be provided with more skilled workers and better facilities. Work planning, supervision and control have to be improved. This is especially important with respect to the planned increase in the number of house connections, which implies a substantial increase in workload and corresponding planning requirements.

House connections and public taps

El Azab requires a new and much bigger workshop for the repair and calibration of water meters.

Public taps should, after their rehabilitation, be maintained well. Here is a task for the users as well as for the maintenance centres. The main objectives are, reduction of losses and improved service to the users.

7.2.4 Meter reading, billing and collection system

This can be subdivided into five parts:

1) water meter management,
2) customers data base,
3) billing system,
4) meter reading system,
5) revenue collection system.

Water meter management

A considerable number of water meters located at customers' residences appear to be out of order. Estimates range from 25-30%. A proper repair and maintenance system for water meters does not exist.

The FaDWS made a survey to collect data about numbers and status of meters. An overhaul programme should be executed to repair broken meters. Therefore the repair and maintenance workshop needs extension. The procedures of dismantling and reinstalling meters are proposed to change. A meter management plan should be designed including all technical and financial aspects.

Customers data base and billing system

The data base of customers appears to be incomplete and definitely not up-to-date. Automation of the manual system is required to improve accessibility of data.

The billing system is completely manual at present. It is proposed to introduce a computerized billing system in order to work faster and more accurate and to improve monitoring and control.

The billing frequency is proposed to change from four to six times annually in order to reduce bill amounts which mitigates tariff increases.

Meter reading and revenue collection system

The meter reading system is not working effectively at El Azab. Of course many meters are out of order, but also readers are suspected to fill in readings without paying visits. It is recommended to change the reading frequency from four to three times per year in order to save costs.
At present meter reading and revenue collection is the responsibility of the local unit. This has the advantage that in every local unit there are 2 or 3 readers and collectors, which is an enormous improvement as compared to the former situation when all El Azab had only some 12 readers and 15 collectors. However, keeping the responsibility for the income of the water utility in the hands of the local unit is an impossible option for the future. Readers and collectors should be employed by the water utility.

Improving the revenue collection efficiency

Collection efficiency is defined as the percentage of the potential revenue that is actually being collected, and is an important indicator for the efficiency of the revenue management system. The estimated collection efficiency for El Azab is between 50 and 70%. The inefficiency in collection is caused by a number of reasons which are summed up below.

Bad debts
This loss is partly due to reasons that are beyond the control of El Azab. Unforseen debt failure of customers is one reason. Another one is that El Azab supplies water to governmental organisations that have no budget allocations for paying water. As a result part of these bills cannot be cashed. The cities of Fayoum and Senoures, both supplied with bulk water, constitute a major part of these bad debts.

Coverage of customers
Not all the customers are covered by the revenue system and not all customers are registered in the data base mainly because of illegal connections. Then the billing list produced by the accounting department is incomplete, because the data supplied by the meter readers are not perfect. Finally not all the customers are visited by the collectors.

Arrears

Customers tend to pay only a part of their bill. It appears that 50% of the customers have outstanding bills of more than a year. Accumulated arrears of private customers run as high as LE 2.26 million and for the governmental users LE 1.0 million as at the end of June 1992. Rescheduling of these debts is very important.

7.2.5 Customer services and information

This aspect is presently only marginally covered. Customers may file complaints or address the El Azab management directly.

Table 7.1 User information requirements

Information issue	Message	Medium	Target group	Information channel	Responsibility
Functioning of the drinking water system	Considerable efforts are required in order to supply the population with potable water	-Information -booklet -Video -Slideshow	-LU staff -teachers -students	-El Azab -Schools	El Azab
Water saving (avoiding wastage)	Water should not be wasted but conserved	Direct approach of users	all users	El Azab	El Azab
Water storage (in the house)	Stored water should not become contaminated	Direct approach of users	especially women	Health Centre	Health Department
Waste water disposal	How to safely dispose the waste water	Direct approach of users	all users	Local Unit; Health Centre	Health Department
Health aspects	Importance of clean water for health and hygiene	direct approach	especially women	Health Centre	Health Department
Relevant El Azab procedures	How to obtain a HC How to pay the bill What to do in case of failures etc.	Information leaflets; oral explanations	existing and potential customers	El Azab	El Azab
Information about the bill	How is the amount due calculated	Information leaflet; oral explanation	HC's	El Azab	El Azab
Maintenance of facilities	How to maintain c.q. protect the connection	Information leaflet; oral explanation	All users	El azab	El Azab

Printed information to customers about procedures, water use, water saving, billing principles etc. is not provided. A complicating factor is the widespread illiteracy.

A system needs to be developed, addressing the various types of customers (target groups, such as individual households, government institutions, schools, industries, public taps users). The structure of such a system is outlined in table 7.1.

7.2.6 General management

The present El Azab management consists of 4 chief executives: the General Manager and his three subordinates being the heads of Distribution, Production and Administration.
This group of managers does not function as a Management Team however. There are no regular meetings, but decisions are made ad hoc throughout the day in a somewhat chaotic, but pleasant and open atmosphere. Policy making and strategic planning is not El Azab's responsibility, so most matters dealt with concern routine administration.

In the future El Azab will have more responsibilities to cope with, so modifications are required in the general management structure (see annex A.13).

The chief executive is the Chairman, who heads the Board of Directors. He is responsible for controlling all planning, operating and reporting functions and is in charge of the organisation's external representation. A Management Team has to be established, which consists of the following members:

- Chairman
- Head of Distribution Department
- Head of Production Department
- Head of Personnel Department
- Head of Finance and Administration Department
- Head of Planning and Projects Department

It is essential that the abovementioned chief executives delegate the majority of routine administrative matters to their subordinates. Restructuring of these departments is therefore necessary (see annex A.13). The introduction of new systems for personnel management, accounting and administration requires stimulating and powerful management capabilities.

7.2.7 Staff requirements year 2000

For El Azab the responsibilities of each Department and the staffing and job descriptions of personnel have been prepared, based on the needs up to the year 2000 (see annex A.13). A summary of required personnel in 5 major job groups for the year 2000, as compared to the present staffing is shown in table 7.2.

The projected increase in the staffing of the company is 35%, but the number of managerial and specialised staff should increase by a factor 7! Also administrative staff should triple, of which a large part is the result of more meter readers and revenue collectors. The above can be compared with an increase of water production capacity by 60% (from 1500 to 2400 l/sec) and an increase in the number of house connections by 90% (from 80,000 to 150,000).

The number of employees per 1000 connections is projected to decrease from the present 9 down to about 7, which means increased efficiency and performance. This increase in efficiency is necessary on the one hand to be able to pay higher wages to the personnel, and on the other hand to limit the increase in production costs.

Table 7.2 **Projected staff requirements for El Azab in the year 2000** (compared with present situation).

JOB CATEGORY	Number of staff 1990	Number of staff 2000
Managers	4	30
Specialists	6	46
Administrative staff	120	338
Technical staff	185	204
Labour	435	418
TOTAL	750	1036

Detailed breakdown: annex A.13.

7.3 FIRST PHASE ORGANISATIONAL DEVELOPMENT PROGRAMME

7.3.1 Phasing of targets

The gap between present conditions and the future requirements is considerable. It is estimated that El Azab will need at least 5 years for its organisational restructuring process. The green light to start this process should be given by the Governorate, even without a change in legal status of El Azab. Within the framework of the existing responsibilities, the Governorate can already start at short notice, to charge El Azab with the basic preparations for the restructuring process.

The following phases towards sustainability are considered:

PHASE I: 1994-1996 ORGANISATIONAL RESTRUCTURING

Preparation of an organisational restructuring programme.
Changing the Legal Status of El Azab in order to provide more autonomy and flexibility for the restructuring process. Execution of first phase organisational reforms.

PHASE II: 1996-2000 O&M COST RECOVERY

Reaching cost recovery for Operation and Maintenance at improved technical performance and service levels.

PHASE III: 2000-2010 FULL COST RECOVERY

Full cost recovery, including depreciation and debt servicing. Independent investment decisions can be taken.

The following targets until the year 2000 are formulated:

Before 1994 basic agreement of the Governorate should be available on:

1. the scope of responsibilities and performance standards of El Azab, and the time schedule to reach the formulated targets;
2. a jointly formulated draft Decree for the semi-independent water company;
3. the Terms of Reference for an externally sponsored Technical Assistance Programme for El Azab.

In Phase I (1994-1996) the following targets are to be achieved:

1. the actual transformation of El Azab into a semi-autonomous water utility;
2. adopting the cost covering tariff increase scenario 1995-2000;
3. completion of the first phase organisational restructuring programme;
4. improved level of skills and staff performance;
5. approval of grants and loans for the major investment schemes and start of major implementation works.

The targets for Phase II (1996-2000) are:

1. reaching cost recovery for O&M;
2. decision on a merger of El Azab and Fayoum city Water Authority;
3. decision on integrating El Azab with the Fayoum Sanitation Department;
4. masterplan updating and establishing the targets for 2005 and 2010.

Before the start of Phase III, an updating of the masterplan is required.

In the following section the activities for the two phases are listed.

7.3.2 Organisational development activities

The actions with respect to organisational development can be divided into three closely interrelated groups:

1. Governmental actions;
2. actions by El Azab;
3. external support actions.

Furthermore these actions should be addressing three categories of issues:

a. institutional issues;
b. operational issues;
c. issues related to new investments.

Table 7.3 Required actions for organisation development

	ISSUE	GOVERNMENTAL ACTIONS	EL AZAB ACTIONS	EXTERNAL SUPPORT ACTIONS
INSTITUTIONAL	El Azab legal status	Issue Decree to transfer El Azab into a Public Sector Company by 1994	Contribute to draft Company Decree	Preparation of Draft Decree; Execute asset evaluation
	El Azab organisation structure	Approve new structure and responsibilities	Contribute to preparation of new structure	Prepare new organisation structure; function & job descriptions
	Company Management	Appoint Board of Directors	Establish new departments and Management Team; delegate routine responsibilities to Dept. Heads	Design management systems and advise on and support implementation
	El Azab staffing	Provide training facilities	Recruitment of professional staff	Prepare Human Resources Development plan; identify staffing needs and training requirements
	Merger with Fayoum city	Support the study and issue Decree after approval	Prepare for integration	Carry out study and advise on merger
	Integration of FSD in El Azab	Support the study and issue Decree after approval	Prepare for integration	Carry out study and advise on integration
	New Tariff System	Issue Decree for cost covering tariffs 1995-2000	Apply new tariffs	Update financial analysis and advise on tariffs

Table 7.3. Required actions for organisation development (continued)

	ISSUE	GOVERNMENT RESPONSIBILITY	EL AZAB RESPONSIBILITY	EXTERNAL SUPPORT PROGRAMME
OPERATIONAL	O&M of production	Decrease subsidies gradually; allow revenues to be retained in El Azab	Improve O&M; Execute rehabilitation	Prepare O&M and rehabilitation plan; advise on plant management
	O&M of distribution		Designate more responsibilities to Distribution Districts	Provide equipment, facilities, training and advise on DD management
	Leakage reduction		Carry out rehabilitation programmes	Advise on leakage reduction programmes
	Water meter management	Instruct for transferring ownership of water meters to El Azab; assign responsibility for meter reading to El Azab	Establish WM workshop; repair/replace meters; read & inspect all meters once yearly	Provide equipment and facilities and advise on procedures
	Public tap management	Instruct for payment of PT water through LU's	Rehabilitate PT's; implement maintenance system; collect revenues	Provide rehabilitation funds; advise on maintenance procedures
	Revenue improvement	Enforce payment of water bill by Govt. agencies, mosques; transfer resp. for revenue collection to El Azab	Keep customer dbase up-to-date; issue and collect 2-monthly bills	Provide equipment; advise on procedures and revenue management
	Customer services		Establish customer services in Distrib. Districts	Advise on customer services and information system
INVESTMENTS	Planning and Design	Review & approval of plans and designs (NOPWASD)	Prepare investment projects based on masterplan	Assist with feasibility studies and detailed designs; updating of masterplan after 5 years
	Funding	Provide part of investment budget; arrange co-financing from donors	Submit funding proposals	Assist with the preparation of funding proposals; co-financing through loans and grants
	Supervision of implementation	Provide support (NOPWASD)	Establish proper supervision system	Assist with supervision
	Start-up O&M	Provide part of budget	Provide appropriate staffing	Provide O&M start-up services and arrange for co-financing

The resulting matrix of activities is presented in table 7.3. It is especially the institutional issues which require positive action on the short term. The decision about the establishment of El Azab (public) water company, is at the basis of the whole programme.

The external support actions to be carried out in Phase I (1994-95) are to a large extent included in the programme of the Netherlands sponsored Fayoum Drinking Water and Sanitation Project, but are excluding the services required for feasibility studies and detailed designs of major investment works.

The costs for the technical support programme are estimated as in table 7.4.

Table 7.4 Costs of the technical support programme (million LE)

ACTIVITY	1994	1995	1996	1997	1998	1999	2000
Detailed design and supervision	6.0	2.0	2.0	1.0	1.0		
Organisational support	1.5	1.5	1.5	1.0	0.5		
O&M start-up services (new plant)					1.0	1.0	0.5
Total	7.5	3.5	3.5	2.0	2.5	1.0	0.5

It is proposed that the required technical assistance funds are provided from external donor grants.

CHAPTER 8

MAIN CONCLUSIONS, RECOMMENDATIONS AND PROPOSED IMPLEMENTATION SCHEDULE

8.1 INTRODUCTION

In this chapter the main conclusions and recommendations from the previous chapters are summarised. An implementation schedule is provided for the period 1994-2000. In 1999 an update of the masterplan should be prepared on the basis of which a more detailed development programme for the period 2000-2010 can be formulated.

The activities start in 1994 after the formal approval and adoption of the masterplan,which is expected to take place by the end of 1993. In the subsequent three years 1994 through 1996 an external support programme is required, which shall concentrate on:

1. preparing for organisational and operational independence of El Azab and executing the related development activities;
2. preparation of detailed designs for major investment works;
3. arranging the required investment funds;
4. improving cost recovery.

8.2 MAIN CONCLUSIONS AND RECOMMENDATIONS

8.2.1 Production and distribution

Production

Present available water supply production capacity, excluding compact units, but including Fayoum City, amounts to 2100 l/s. From the population projections and the development of per capita consumption of water it was concluded that by the year 2020, totally 7100 l/s will be required. This means that in 30 years time a total new production capacity of 5000 l/s has to be constructed, serving both rural Fayoum as well as Fayoum city. Compact units will be abandoned.

The new capacity of 5000 l/s will be built in stages. The first stage of 1000 l/s should, according to the demand analysis be completed in 1995, but will actually not be operational until 1998. The second phase of 1000 l/s must be constructed after the year 2000. The masterplan update of 1999 will determine the actual plan.

Water production in Fayoum shall remain centralised and use the conventional rapid sand filtration technology. The existing plant of El Azab shall remain in function but needs to be rehabilitated.

Distribution
Until the year 2000, all trunk mains need to be expanded, new storage reservoirs have to be constructed, the majority of branches to individual villages need replacement and service pipelines inside towns and villages need extension.

Expansion of trunk mains until the year 2005 has been divided into first and second priority works (see tables 5.5 and 5.6 and related figures 5.3 and 5.4).

Rehabilitation of the network has a high priority. Many blockages and leaks still have to be repaired, while appurtenances (valves) have to be repaired or installed. Operation of the network can be improved significantly.

Water delivery
By the year 2020 some 400,000 house connections are required, as compared to the present 80,000. Upto the year 2000 an additional 70,000 HC's will be installed. It is recommended that the connection inclusive of the meter will be owned by El Azab.

Parallel improvement is required of wastewater disposal facilities, like sewerage or on-site sanitation, in order to make the considerable increase of HC's possible and environmentally acceptable. This aspect is dealt with in the wastewater masterplan.

Public taps will remain in function until the year 2020, but their average number of users will decline. Most public taps require rehabilitation and need to be provided by a water meter. Water spillage from public taps needs to be reduced drastically, while the water must become priced as from 1995. A proper maintenance system for public taps has to be established.

It is recommended that Local Units pay the bill for public tap water consumption as from 1995.

8.2.2 Operation and maintenance

O&M of production and the network have to be upgraded to a higher level of performance. This is to be achieved as follows:

- by reducing and simplifying routine administrative work and intensifying professional dedication;
- by developing new procedures and methods for operation and maintenance;
- by developing maintenance centres into more independent distribution districts;
- by recruiting new executive professional staff;
- through training and on-the-job guidance of personnel;
- through increased budgets for O&M.

8.2.3 Cost recovery and tariffs

Improved cost recovery will be achieved in two ways:

1. by increasing the volume of water sold, as percentage of total production;
2. by increasing the tariffs.

Volume of water sold is targetted to increase from the present 38% to 75% of production in the year 2000. This can be achieved by a reduction of technical losses (from 28 to 20%), by a reduction of free public tap water (from 18 to 4% of production), and by an increase of the revenue collection efficiency from 60 to 95%.

Tariffs should increase, but they should remain affordable to the majority of the population. As from 1995 not only a public tap tariff should be introduced, but also a low basic tariff for house connections, for the consumption of the first 15 m^3 per month. Tariffs become progressive over 15 m^3 monthly consumption. The new tariff structure is shown in tables 6.8 and 6.9.

With the above measures cost recovery for O&M costs can be achieved by the year 2000. Depreciation and debt servicing may be recovered by 2005 or 2010.

8.2.4 Customer and user information

This is presently non-existing but it will be a basic requirement for the future company. Table 7.1 provides an outline of the requirements. Health and hygiene education which is closely related to the supply of drinking water is not considered a responsibility of El Azab, but it is recommended that El Azab liaises with the Health Department for this purpose.

8.2.5 Organisational status

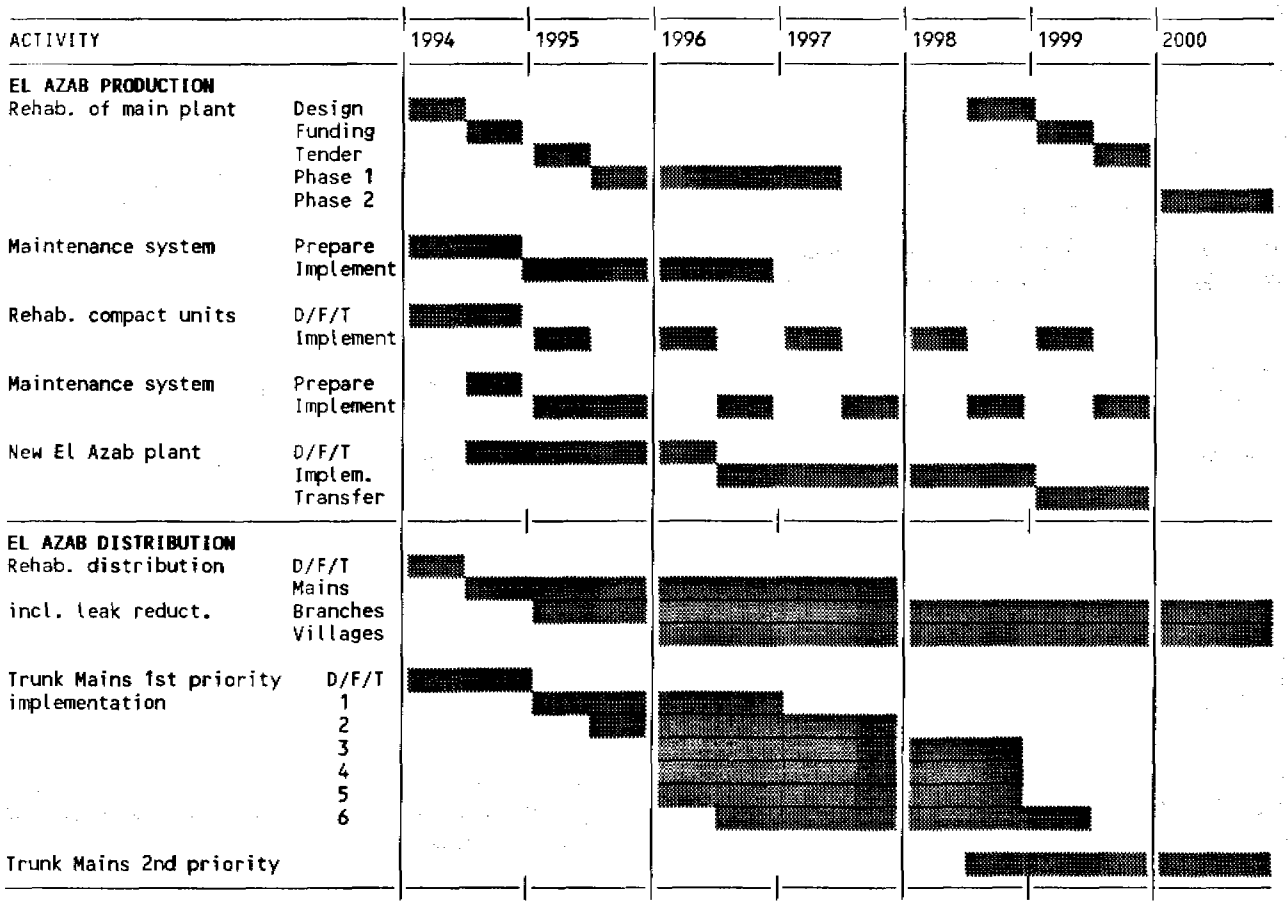
The change of the present status of El Azab is a number one priority which is at the basis of the total development process. If this requirement is not met on the short term, say by end of 1994, the development programme will meet a giant bottleneck and stumbling stone. If the required actions for organisational development, which are outlined in table 7.3, cannot be taken because of administrative constraints, not only will the development process stagnage, but also donors will be reluctant to invest money in the required new projects.

8.3 IMPLEMENTATION SCHEDULE

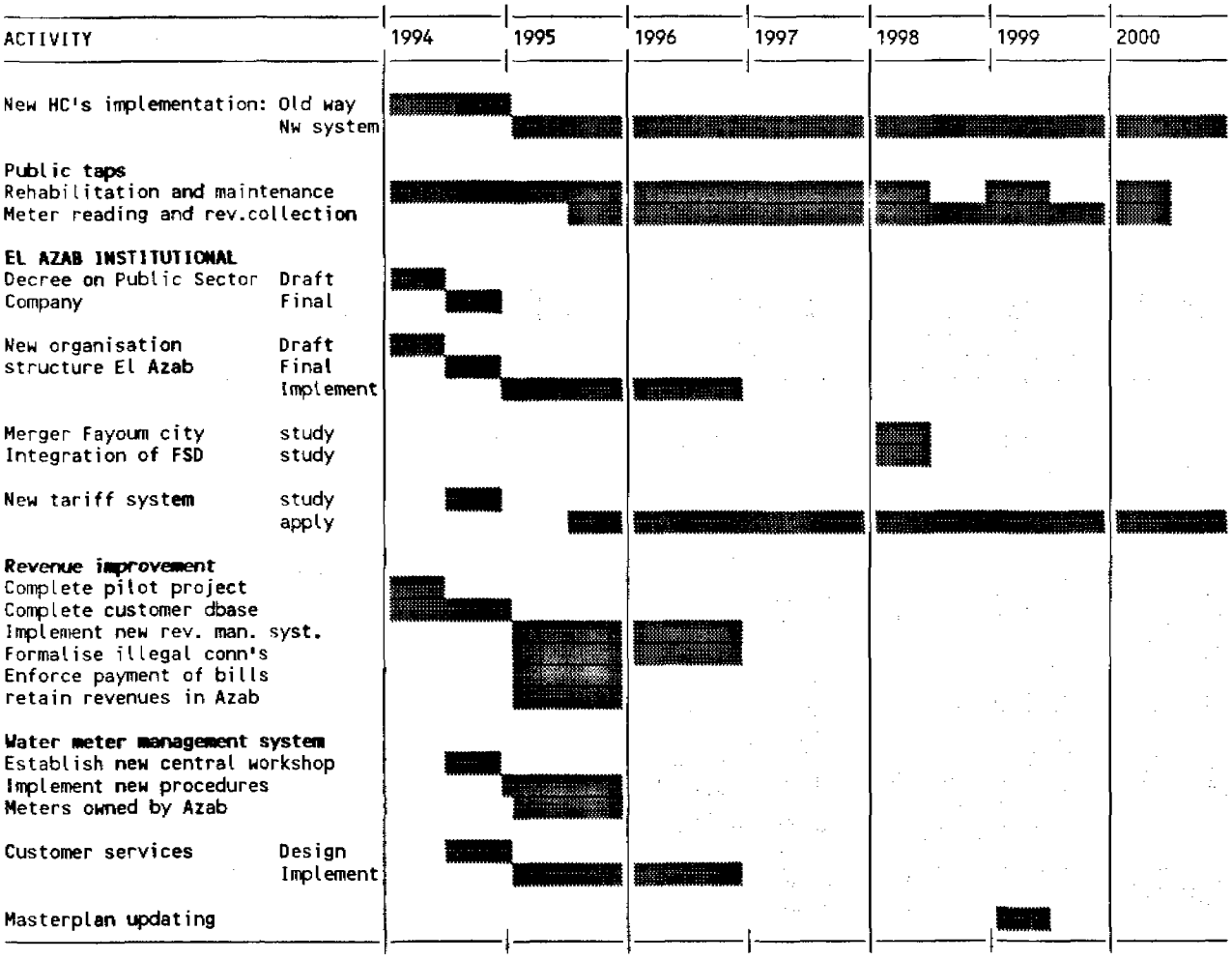
8.3.1 Activities

The activities for the period upto the year 2000 are shown in the time schedule of figure 8.1. The activities are grouped into production, distribution and institutional categories. Critical activities are:

FIGURE 8.1 TIME SCHEDULE WATER SUPPLY ACTIVITIES 1994 - 2000



Time schedule continued



- issuing the Public Sector Company Decree (end 1994);
- obtaining the investment funds for the various implementation projects.

External consultants services have to be acquired for the preparation of feasibility studies, preliminary and detailed designs. Based on this output, funding proposals can be prepared, which can be assessed by Egyptian financing agencies and donors alike.

It is recommended that based on the masterplan, a few donors commit themselves to the financing of (parts of) the masterplan. This will limit the time required for fund raising. The exact amounts to be provided as loan, grant or local contribution, will be established after the completion of detailed designs.

8.3.2 Estimated manpower inputs, costs and financing

Total investment costs and TA requirements upto the year 2000 were summarised in table 6.3. Manpower requirements on behalf of El Azab are summarised in table 7.2 and elaborated in annex A.13.

External consultants services are especially intensive in the period 1994-96. For the organisational support programme a minimum of three fulltime Egyptian- and two expatriate consultants are required. This is excluding consultancy services for the preparation of detailed designs.

It is recommended that the consultants services for the organisational support programme be covered from the ongoing Netherlands supported FaDWS project. Specific engineering consultants services for preparation of detailed designs and tender documents for the major investment programmes may be contracted separately.

The detailed workplans for these services are not included here but shall be prepared separately in compliance with the masterplan.

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