2.2.4 Groundwater

As shown on Fig-2.2.4, the wells for water supply are concentrated in the western and southern part of Sharqiya Governorate. The groundwater station at Didamoon in Faqus Markaz is the northernmost one in the Governorate.

The number of systems supplying water is 8 for cities, 14 for the Abbasa Regional System and 82 for villages. The villages' 82 systems are placed under control of the governorate's Housing Department. Each station consists of a pump station and a few wells which are used in turn. For almost all pumps, a pumpset unit is in 20 - 25 1/s capacity range. Each system's features are explained in Table-1.3 of Working Paper No. 1.

Wells in the above mentioned stations are mostly of 200 - 250 mm diameter and the depth is about 50 - 60 m, more or less similar for all wells in the study area. As shown on Fig-2.2.6, a strainer covers a length of about 20 m at the bottom. The strainer, either slit type or perforated type, is wrapped by wire mesh of copper and steel combination. The void between the casing pipe and drilled hole is filled with gravel. It is doubtful if the structure can prevent seepage from above the strainer part. No sandpit is provided at the bottom.

Available literature reports that k values (permeability coefficient) are 60 - 100 m/day, but they will differ substantially depending on the area's geology.

The groundwater will be divided roughly into 3 levels of quality concerning the conductivity, namely above 3,000 µS/cm, between 3,000 and 2,000 µS/cm, and below 2,000 µS/cm.

The above 3,000 µS/cm water is distributed in the area to the north of a line, connecting northern Diarb Nigm and Faqus City. The 3,000 to 2,000 µS/cm water is distributed in the area bordered by the said line to the north and another line, connecting Diarb Nigm and

Hihya City, to the south. The area corresponds approximately to that containing above 300 mg/l chloride concentration. The below 2,000 µS/cm water can be divided further into two, between 2,000 and 1,500 µS/cm and below 1,500 µS/cm. Electric Conductivity Distribution and Chloride Ion Concentration Distribution are shown in Fig-2.2.7 and 2.2.8, respectively.

As for the chloride (ion) concentration, the division line is 200 mg/l and the whole area is divided into the 300 - 200 mg/l part and below 200 mg/l part, the former approximately coinciding with below 2,000 µS/cm conductivity area. It occupies the central part of Sharqiya Governorate and a part of Mashtul el Soak in the south. The below 200 mg/l part can be found in Diarb Nigm, the eastern half of Minyet el Qamh Markaz, Bilbeis and Abu Hammad Marakaz in the eastern zone of the Governorate. Also values below 200 mg/l are detected at the western part, close to the branch of El Raiya El Taufiqi from the Nile, and at the eastern part where the Ismailiya Canal runs. It will be deduced that the groundwater in those area is affected greatly by seepage of the Nile and the Canals' water.

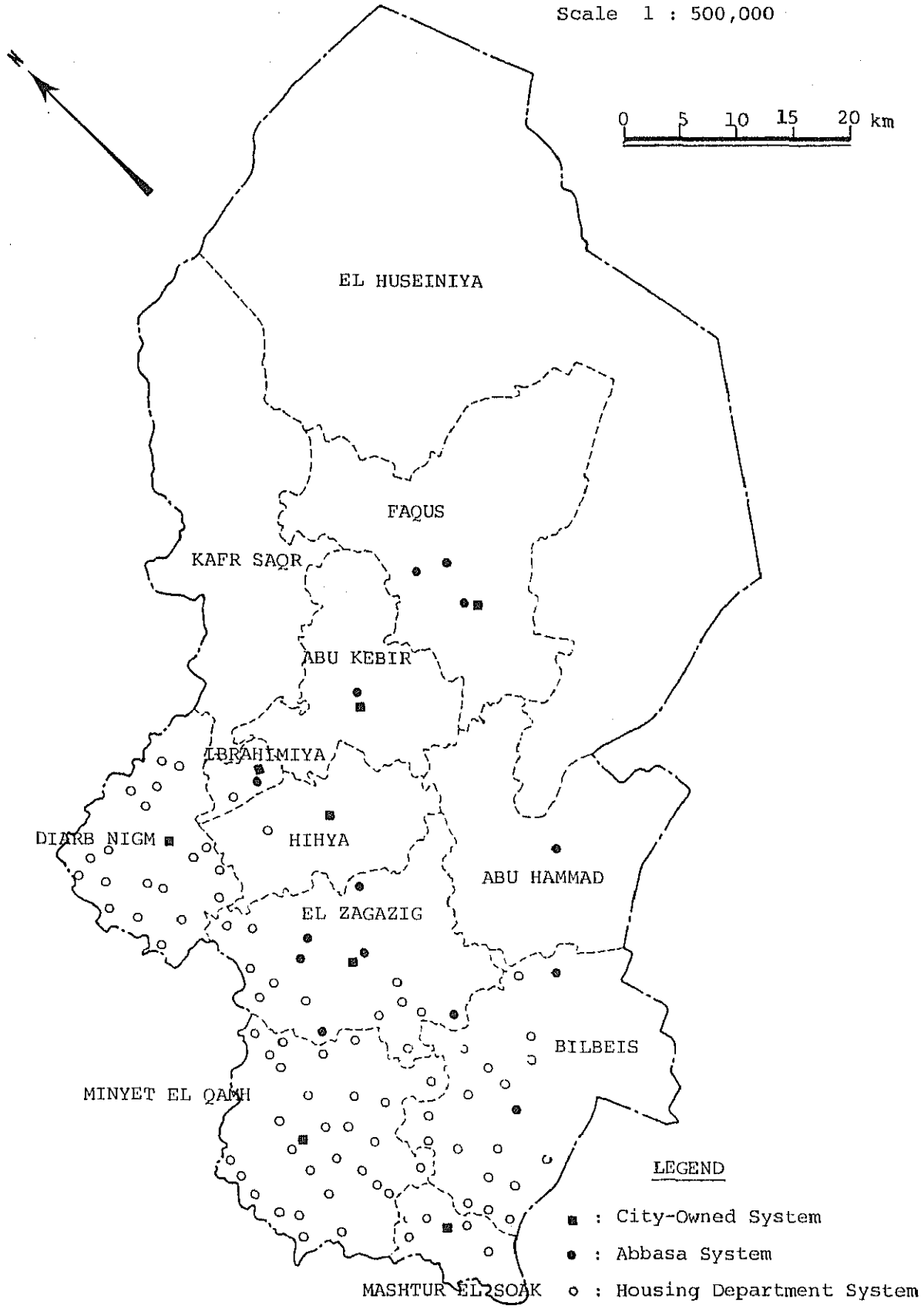


Fig-2.2.4 GROUNDWATER PUMPING STATION

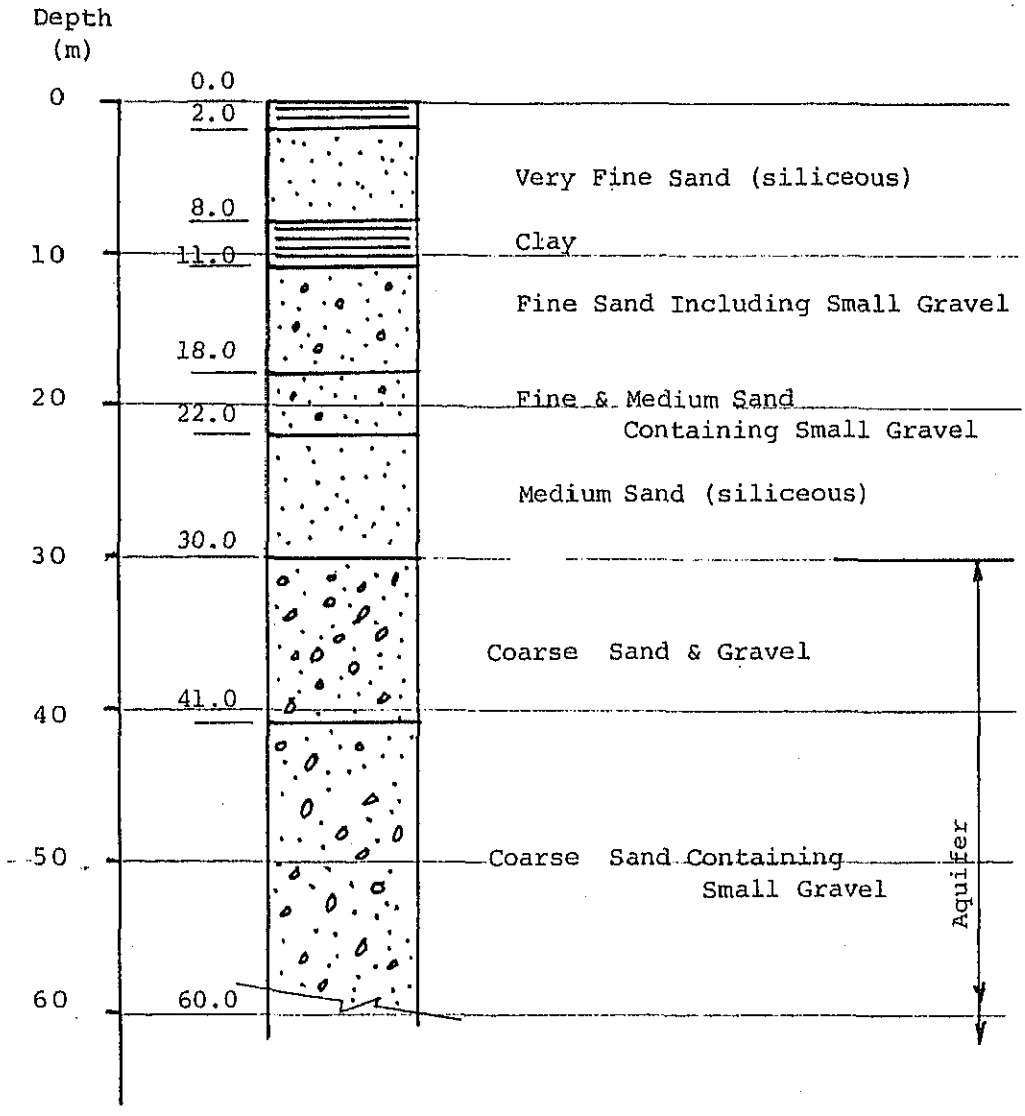


Fig-2.2.5 GEOLOGICAL COLUMNAR SECTION
IN SHARQIYA

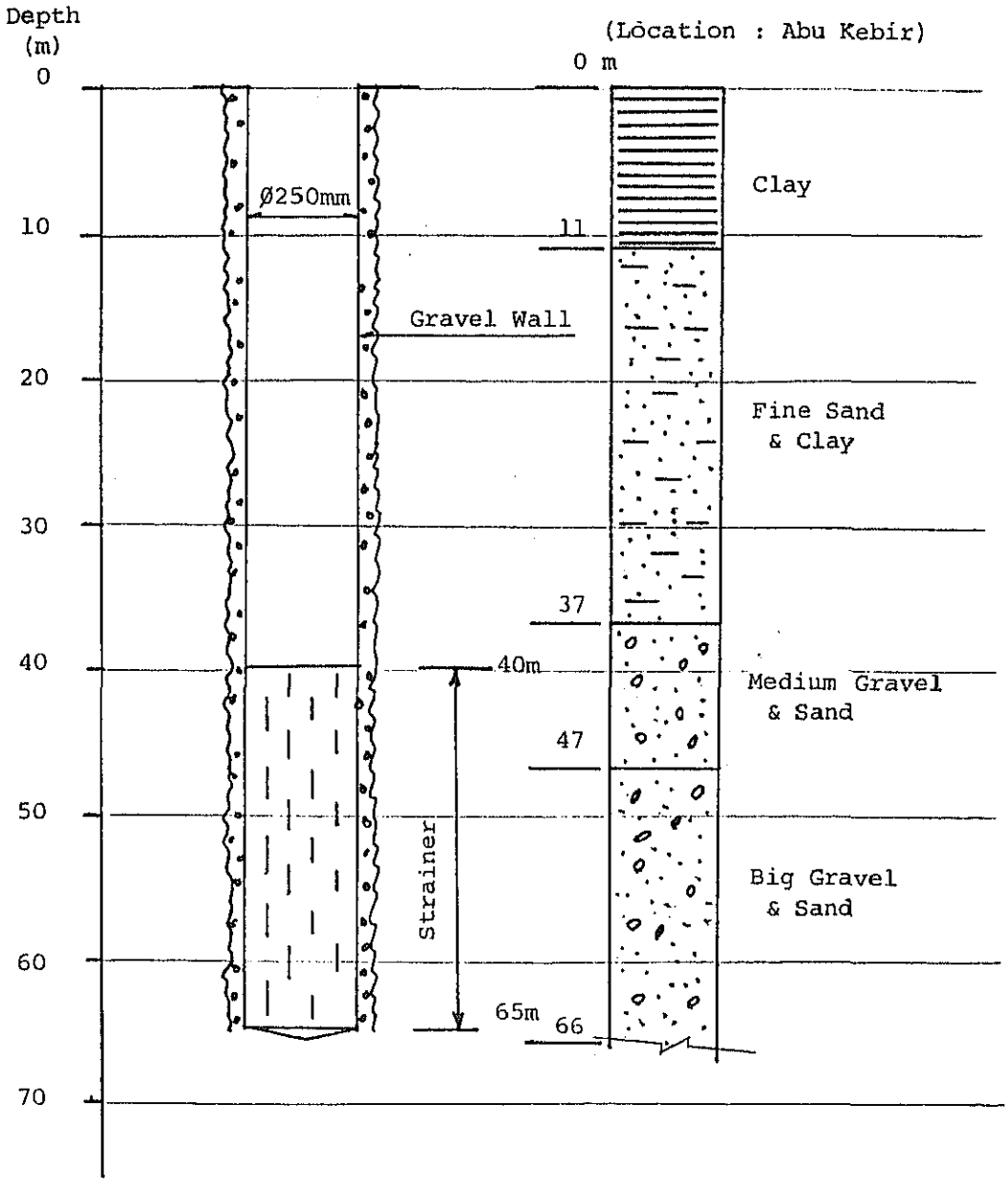


Fig-2.2.6 WELL STRUCTURE

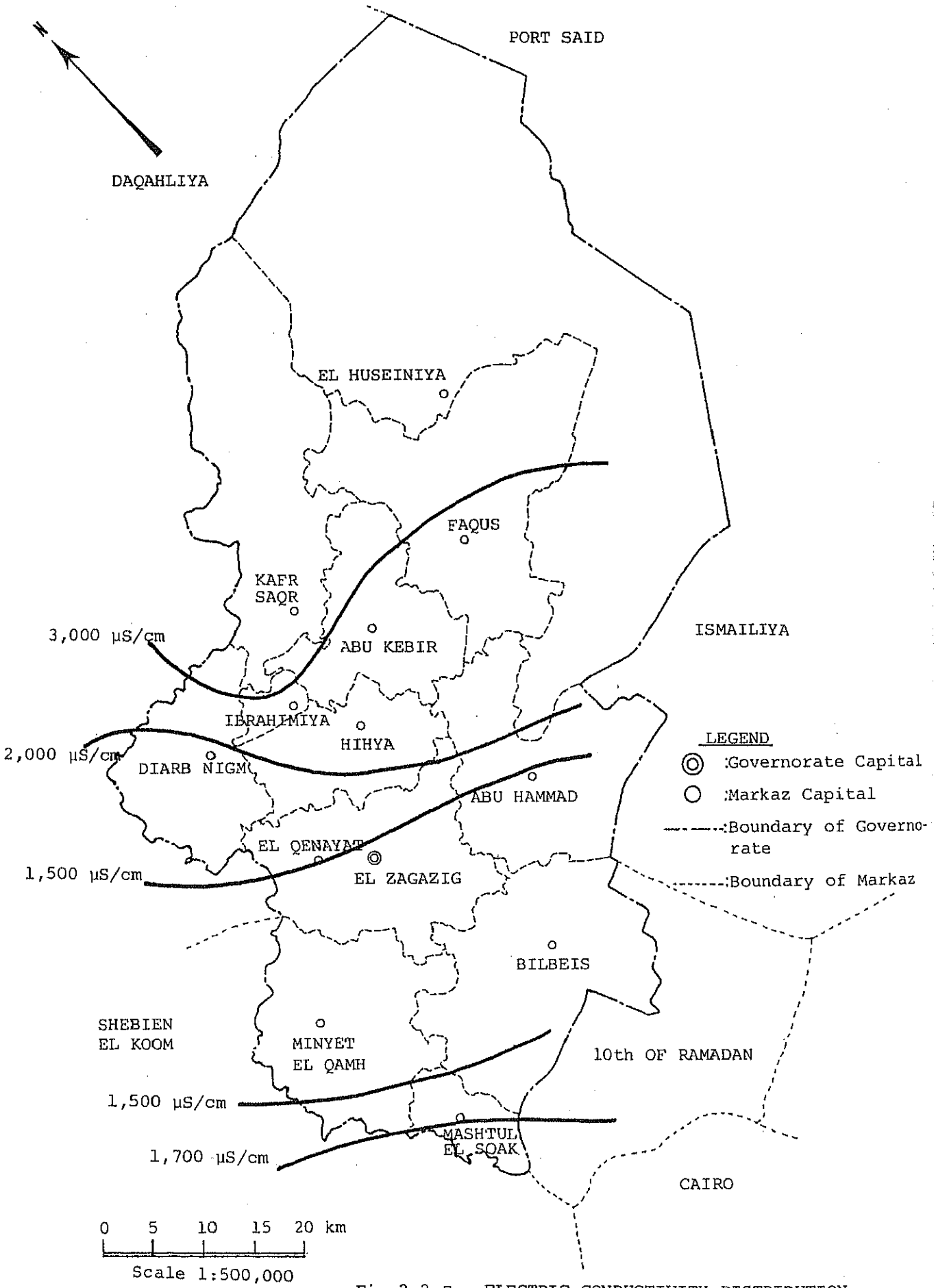


Fig-2.2.7 ELECTRIC CONDUCTIVITY DISTRIBUTION

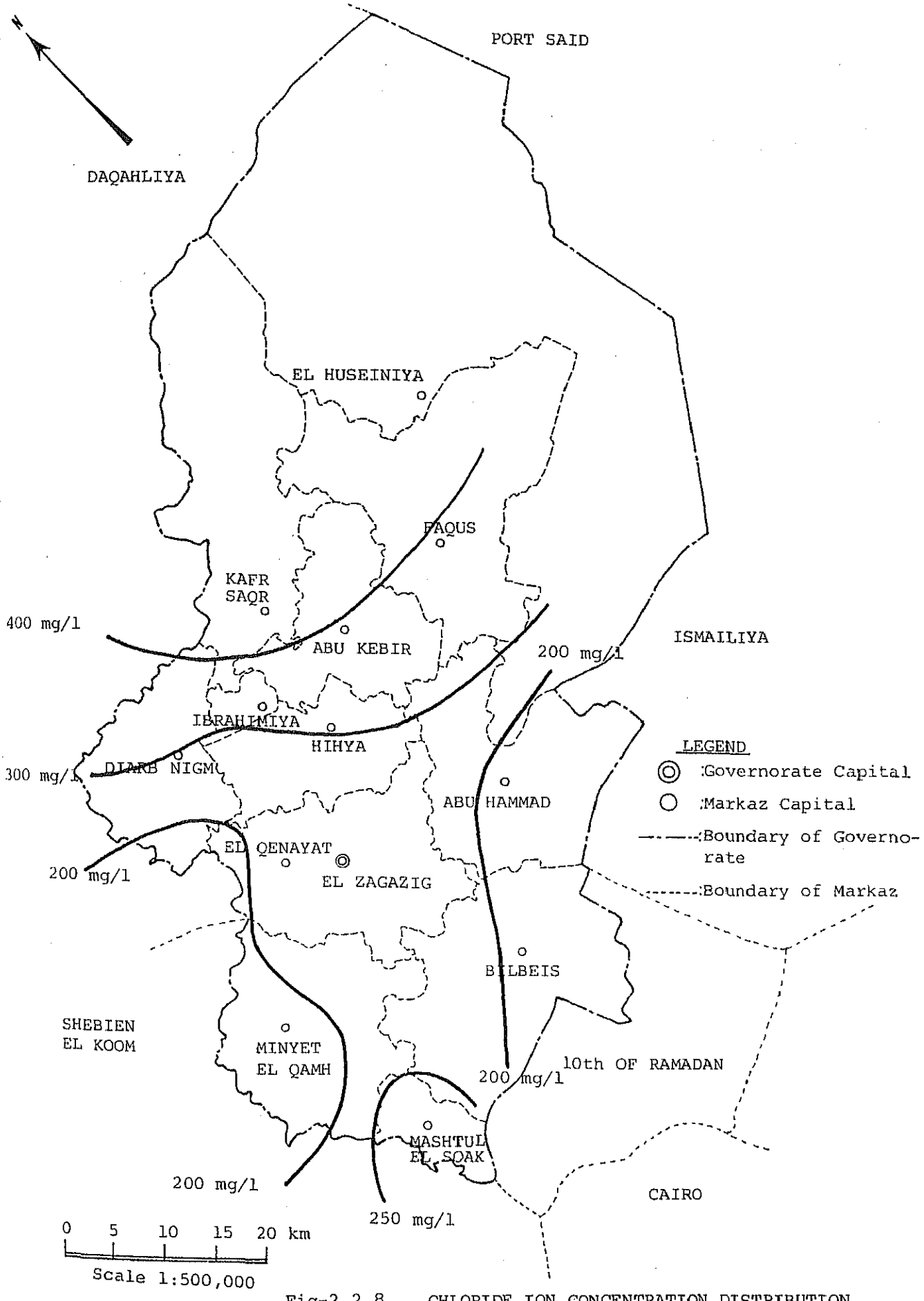


Fig-2.2.8 CHLORIDE ION CONCENTRATION DISTRIBUTION

2.2.5 Quality of Water

2.2.5.1 Groundwater Quality

The groundwater quality is described based on the analytical results of samples obtained from 32 wells and the water quality records studied by the Governorate. Details are stated in Working Paper No.2.

The groundwater wells in the study area are distributed mostly in the southern and central parts of the Governorate as shown in Fig-2.2.4. Most of wells' water are satisfactory in quality for public water supply, even though the concentration of some components exceeds the standards of the General Organization for Greater Cairo Water Supply (GOGCWS), possibly owing to geological condition, which standards are shown in Table-2.4.3.

The quality of twenty wells out of thirty two examined conforms to the GOGCWO standards. Ten samples exceeded the standard value of 0.5 ppm of manganese together with more than 400 ppm of chloride in two wells, and more than ten degree of turbidity in two wells.

At almost all of wells managed by the Housing Department of the Governorate, iron and manganese are detected. Iron ranged from 0.1 to 0.3 ppm with the maximum of 0.6 ppm except cases in Ibrahimiya where 500 to 840 ppm was detected. As nitrogen was barely detected, however, the water deemed to be free from organic pollution.

Concentration of such components as chloride, manganese and turbidity is generally not harmful to consumers but they make poor taste and unpleasant appearance. Well water containing iron and manganese will cause a red/black color of the water when chlorinated, even though the concentrations are within the standards stated above.

The water quality of wells which depthes are mostly of 50 - 60 m proves satisfactory to the standards, and the wells will be used in future as well.

2.2.5.2 Surface Water Quality

All of the surface water of the Governorate originate in the Nile. The quantity is, needless to say, abundant and the quality is, the dissolved contents concentration is far lower than in the groundwater, good chemically. In the study area, in addition to the Ismailiya Canal which takes water from the Nile at the northern Cairo, the Muweis and Faqus Canals are used as sources of the public water supply systems.

Qualitative characteristics of the Nile water are, it was found, that since the startup of storage of water in the Aswan High Dam, overgrowth of algae has been noticeable and turbidity has been kept rather low through the year. Those changed quality is preserved in the canals in the study area. The canals being used as the public water supply sources were originally constructed for agricultural uses and therefore, the water quality is affected substantially by the conditions like the seasonal fluctuation of irrigational water demand and periodical (usually winter) dredging in the canals.

The water quality of Zagazig Treatment Plant on the Muweis Canal and of Abbasa Treatment Plant on the Ismailiya Canal has been found good, containing low dissolved solids and low nutrient salts, even though the relatively fast flow (60 - 80 cm/sec in the center of flow) is suspending fine and easily settleable turbid matters.

The quality tests for chemical and biological examination show fairy good condition in general as water sources. Details are described in Working Paper No.2.

The biological examination of four samples from Ismailiya canal and one from Faqus canal taken in September 1983 showed the results of 580 - 980 colonies/ml and 440 colonies/ml. Such number of algae is considered extraordinary for the running river water, or rather seems like a pond, reservoir or a lake.

The superior species of Ismailiya canal water is Synedra (needle-like diatom) followed by other diatoms such as Melosira and Nitschia. Superior species is not appearing in the Faqus canal water and its majority is diatoms (Bacillariophyceae).

As for the bacteriological tests, it was found that the number of fecal coliform was less than 7/ml, and general bacteria were less than 200/ml in spot samples taken during the field survey.

According to the past records of surface water quality at Abbasa Plant (Ismailiya Canal), turbidity is from 25 to 30 degree, alkalinity from 140 to 150 ppm and algal number from 3,000 to 9,000 per milliliter.

Low turbidity, high alkalinity and a large number of algae characterize the quality of the surface water. Other features such as a low concentration of nitrogen and natrient salts like phosphorous compounds and a relatively low number of bacteria indicate that the water is less polluted by human wastes. These conditions are to be taken into account in electing the treatment processes and in operating the plant.

It is considered in general that a conventional type of water treatment, that is, rapid sand filtration method, is fit for such surface water quality.

2.3 Water Supply Systems

2.3.1 General

The oldest water supply system in Sharqiya Governorate is Zagazig city-owned system which was constructed in 1909 with Muweis Canal water treated by sedimentation and with filtration with German engineering at that time. The treated water was supplied to the central area of the city through cast iron pipelines, which are still utilized as distribution mains at present.

Successively the second oldest systems were installed in 1928 in Bilbeis city with Ismailiya canal water without treatment and in Minyet el Qamh city with groundwater. Currently, 9 cities have their own public water supply systems, and 3 cities and one town are supplied from Abbasa Regional Water Supply System which was started in operation from 1959 upon its completion.

In order to supply local villages in line with the national policy a number of the Housing Department's water supply systems were constructed in the years from 1950 to 1956. The water source was the groundwater available locally. The area served by the Housing Department's systems was limited to the southern part of the Governorate, since in the northern part the groundwater was not potable due to salinity. Nowadays such systems operated by the Housing Department have come to serve 189 villages in 7 Marakaz.

For the purpose of supplying potable water to the area which had been left from city-owned and Housing Department systems, without access of public water supply, Abbasa Regional Water Supply System was completed in 1959. To this end, one large treatment plant named Abbasa Water Treatment Plant was constructed at Abbasa of Abu Hammad Markaz at a site along Ismailiya Canal.

The plant has been treating the surface water of the canal by rapid sand filtration process with chlorination afterwards. The treated water is

supplied to the northern area of the Governorate as well as the southern area, through long-distance transmission, helped by the distribution pumps in the plant and booster pumps on the way of transmission. In later years, to supplement the production capacity, groundwater stations and so-called compact units treating canal water were added to the system.

As stated above, the public water supply systems in the Governorate can be classified into the undermentioned three types: a) City-owned systems, b) Housing Department's systems, and c) Abbasa system.
Their outline is tabulated below :

Table-2.3.1 OUTLINE OF THE SYSTEMS

System	Source	Served Area	Production (m^3/day)	Total Population in Served Area (x1,000)
City-owned	Canal Water & Ground water or Groundwater only	9 Cities	84,976	607
Housing Dep.	Groundwater	189 Villages	27,211	802
Abbasa	Canal Water & Groundwater	3 Cities 1 Town 240 Villages	114,739	1,549
Total		12 Cities 1 Town 429 Villages	226,926	2,958

2.3.2 Abbasa Water Supply System

2.3.2.1 Outline of the System

Abbasa water supply system, consisting of Abbasa treatment plant, 5 booster stations, 18 elevated tanks and distribution mains, started its service to Sharqiya Governorate in 1959, as one of GOPW's major regional water supply systems in Egypt. The system aimed to supply municipalities which had no public water supply system or no own water sources, or which fell in severe water shortage, especially in the northern part of the governorate where groundwater was not potable due to salinity.

Water demand in the area had been increasing gradually year by year, exceeding the original supply capacity of the system, and Abbasa system ceased to supply water to remote areas eventually. Almost all of the elevated tanks in the system were not filled due to lack of enough water and low pressure and the booster stations were put out of operation, as the water from Abbasa could not reach there.

To solve the situation, many groundwater pumping stations drawing well water and several so-called "compact units" treating nearby canal water were hastily constructed, along the distribution pipelines routes, as supplementary supply sources.

Table-2.3.2 PRODUCTION OF ABBASA SYSTEM

Facility	No. of Facility	Production
1. Abbasa Plant	1	750 l/sec*
2. Ground Water Station	14**	642 l/sec
3. Compact Unit	5	56 l/sec
Total		1,448 l/sec (≒ 125,100 m3/day)

(Note) * : (Surface Water) + (Groundwater) = 650 + 100 = 750 l/sec

**: Except station in Abbasa Plant

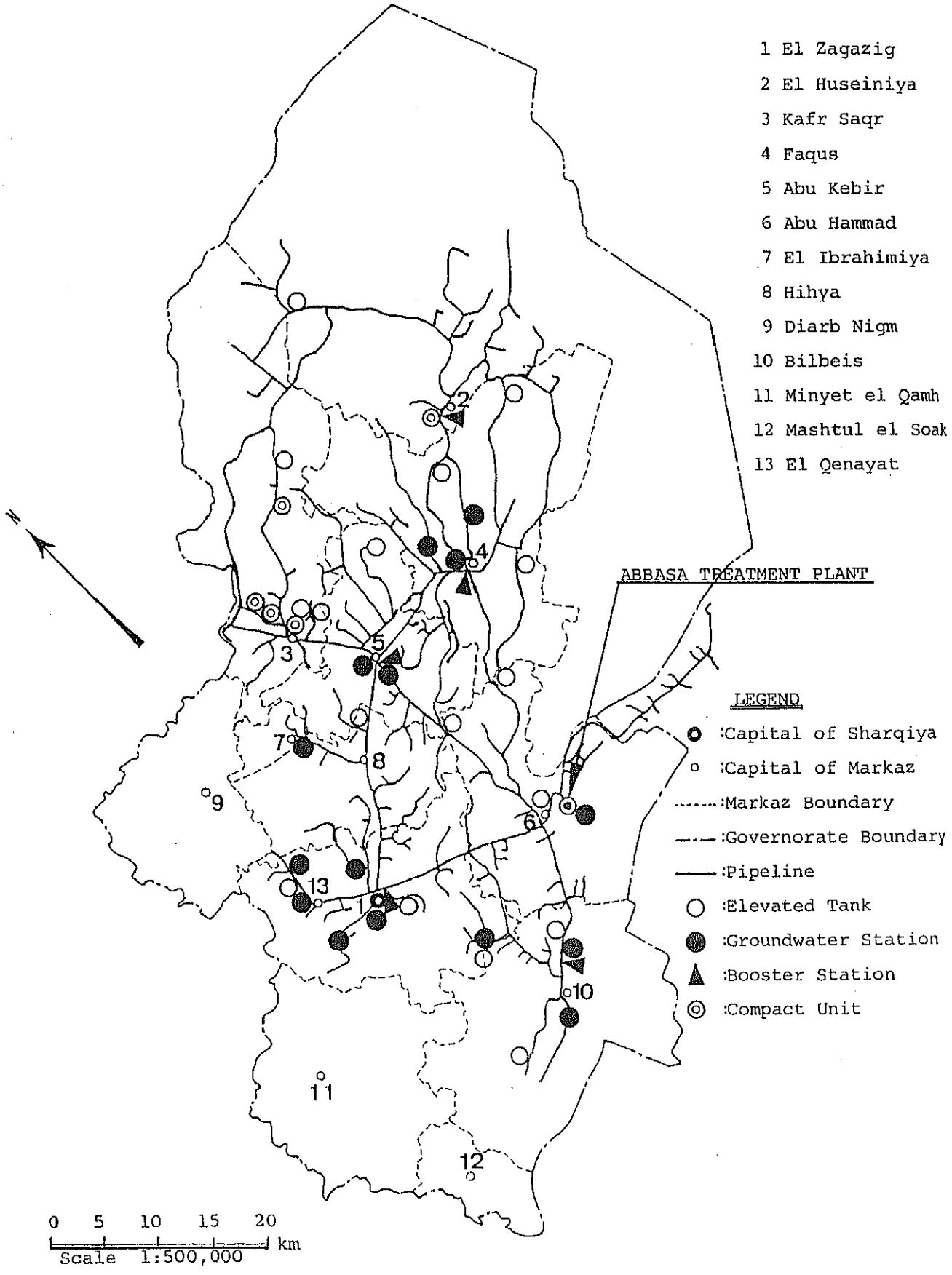


Fig-2.3.1 GENERAL PLAN OF ABBASA SYSTEM

2.3.2.2 Abbasa Treatment Plant

Abbasa Plant has two kinds of water source: surface water of Ismailiya Canal and groundwater. The groundwater, pumped from deep wells sunk in the Abbasa Plant compound, flows into a suction well of the distribution pump station without treatment and there it is mixed with the treated and chlorinated surface water.

The process complies with the rapid sand filtration, composed of coagulation, sedimentation, filtration and chlorination. The flow diagram of Abbasa Treatment Plant is schematically shown in Fig-2.3.2 attached below.

Raw water is taken from Ismailiya Canal, passes through intake screen/intake gates, and flows into a receiving well in the plant compound by gravity, by way of intake pipelines (1000 mm dia. x 2 lines of reiforced conctrete made). It then is pumped to 3 units of clarifiers (coagulation/sedimentation basins, upflow type, $3\frac{1}{2}$ hours detention time) through a raw water main (800 mm dia. cast iron made). Aluminum sulfate (20 - 30 ppm) and pre-chlorine (3.0 - 4.5 ppm) are injected into the raw water main. After sedimentation, the settled water is transferred to sand filters (48 m2 x 16 units) for rapid filtration.

The filtrated water goes to the underground reservoirs (2 units; 4 hours detention time) for storage via a filtrated water main (800 mm dia, cast iron made), on the way of which aluminum ammonia (50 % of post-chlorine dosage) and post-chlorine (1.5 - 2.5 ppm) are injected. The finished water is conveyed to a suction well of the distribution pump station and there it is mixed with the groundwater, as described before. The distribution pumps (4 units x 60 m head) feed it to the distribution mains for public supply.

The measurement of water flow is made by Venturi-meters for raw water (800 mm of cast iron made pipeline), filtrated water (800 mm of cast iron made pipeline) and distributed water (800 mm CIP main and not 600 mm main). In addition, each of intake pumps, filtrated water pipes and distribution pumps is equipped with a Veturi-meter, though some of them are not working presently.

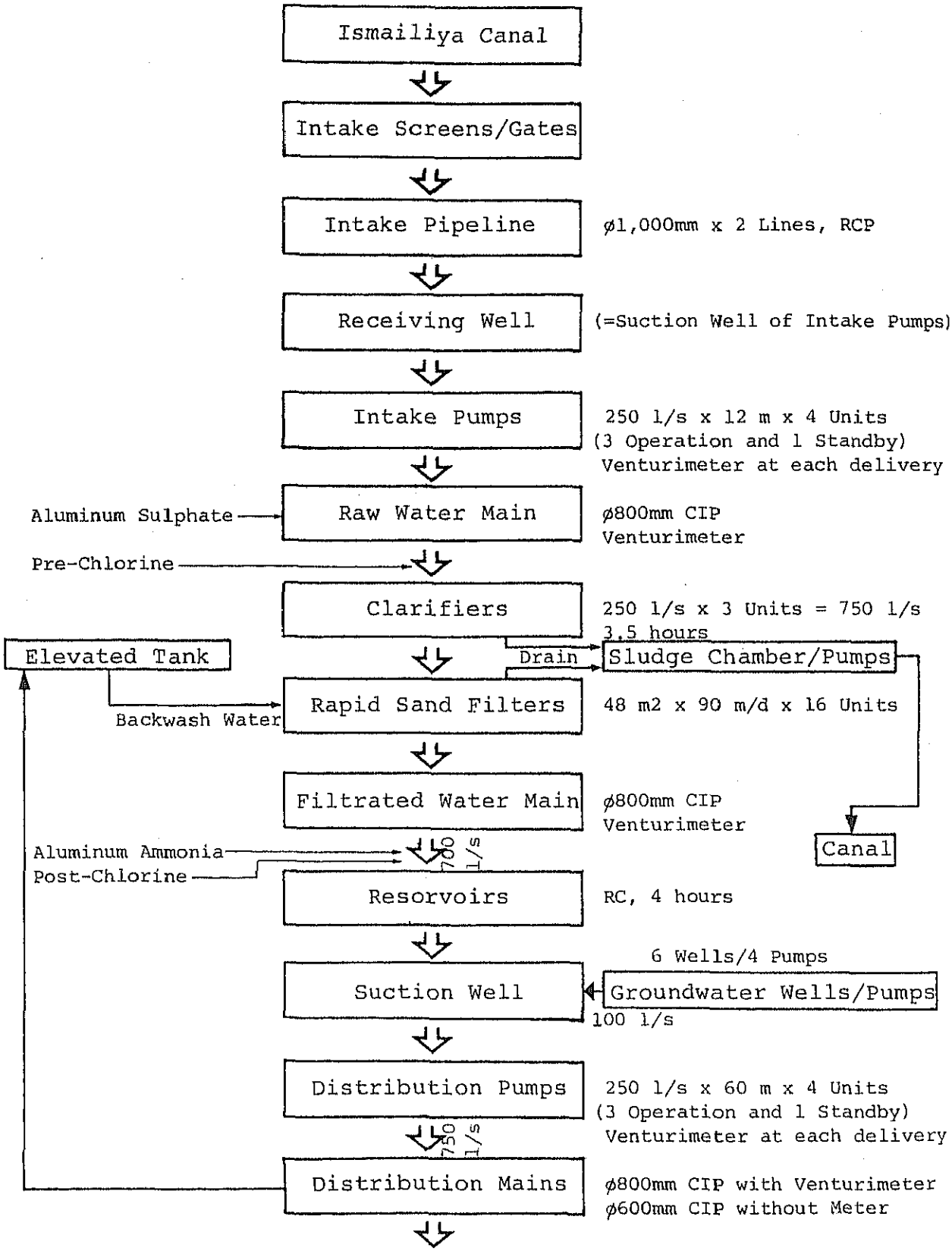


Fig-2.3.2 FLOW DIAGRAM OF ABBASA TREATMENT PLANT

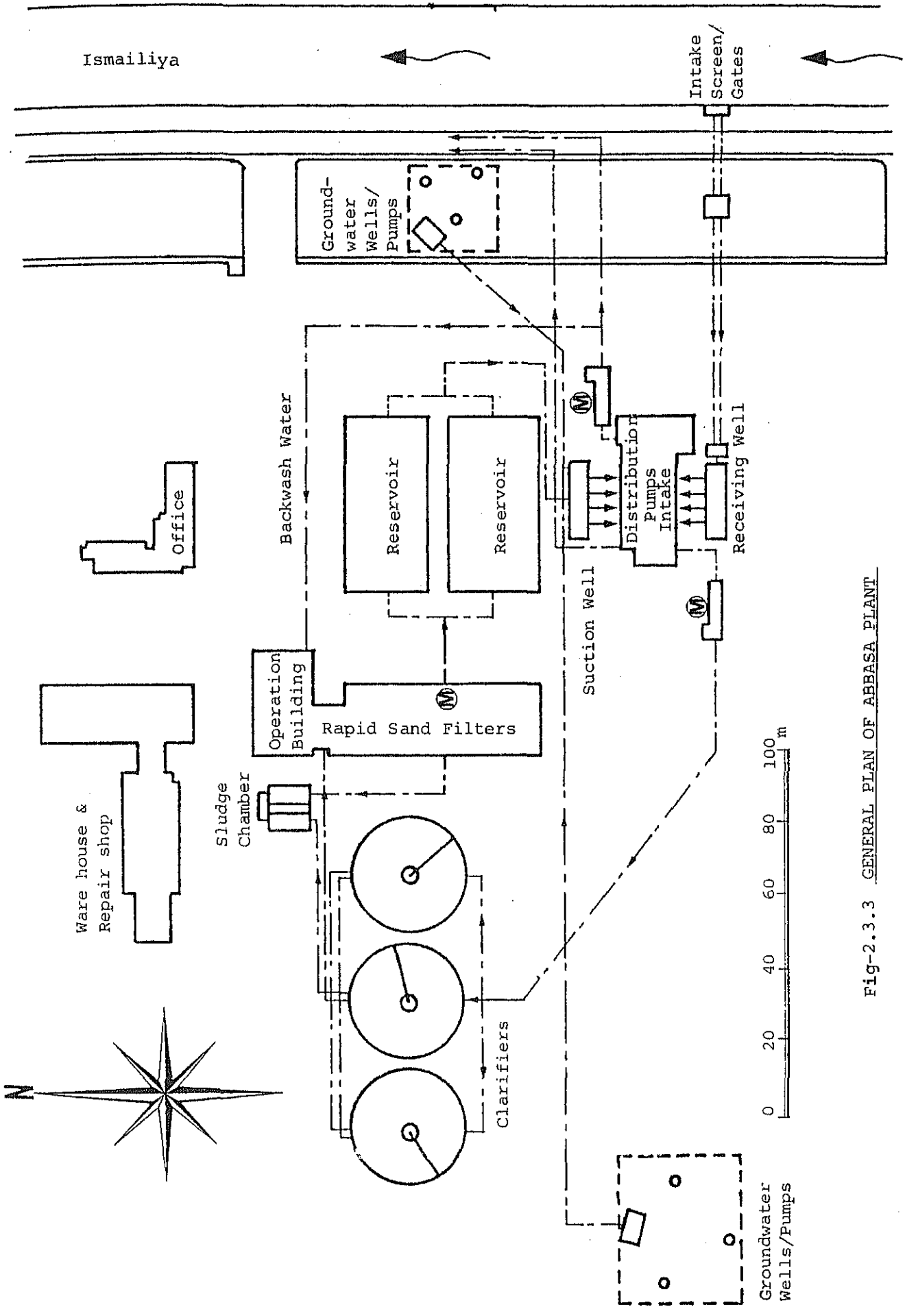


Fig-2.3.3 GENERAL PLAN OF ABBASA PLANT

2.3.2.3 Pipelines of Abbasa System

Transmission pipelines of Abbasa System are composed of ACP Ø600 - Ø400 x 28.5 km in total covering Abu Hammad, Huseiniya, Abu Kebir and areas shown in the attached drawing. The total length of the distribution pipelines is about 2,101 km consisting of cast iron, steel and mainly asbestos cement pipe.

Asbestos cement pipe is employed in almost all of pipelines, as it is produced locally and its price is reasonable. As jointing materials, a collar type joint made of asbestos cement with rubber gasket and a cast iron joint consisting of gland packing and bolt & nuts are popular. Jointing materials and fittings of pipe installation are supplied locally, although the supply capacity is still limited at present.

For canal/river crossing and rail road crossing works, steel pipes are utilized from their mechanical strength and easiness of adjustment at sites. The usual sizes of steel pipes and fittings are also available locally as far as the quantity is not so much.

Accessories such as drain valves, line valves and air relief valves are installed at appropriate sites along the pipelines. To show the location of the strategic valves clearly, stand marks like traffic sign are set at both upstream and downstream sides of the valves.

House connections made of steel pipe (Ø50 - Ø13mm) or PVC pipe (Ø50 - Ø13 mm) number about 53,000 currently. The house connections are branched from distribution mains or secondary mains which are separated from distribution mains.

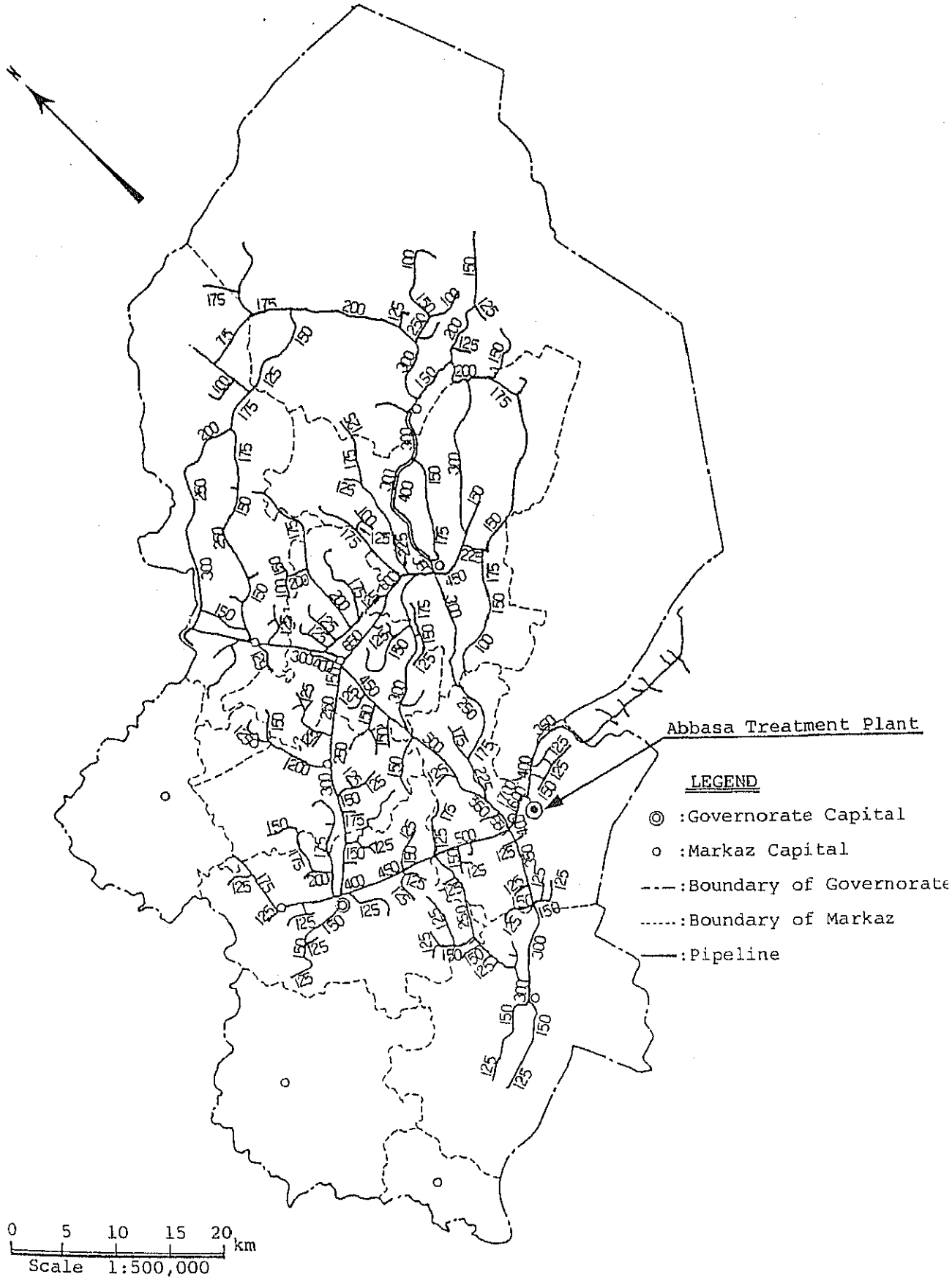


Fig-2.3.4 PIPELINE NETWORK

2.3.2.4 Booster Pumping Stations and Elevated Tanks

Five booster pumping stations were constructed in 1959 on the way of distribution pipelines of Abbasa system to add pressure to water coming from the Abbasa Plant for distributing to nearby areas and sending to distant areas.

They are not in use currently, because the Abbasa water has ceased to reach the stations due to shortage of water. To correct the situation, deep wells have been constructed in and around the stations' premises and groundwater has been supplied to the distribution pipelines, in place of the originally planned Abbasa water, as the construction of groundwater station is more economical than strengthening Abbasa Plant due to availability of groundwater.

Table-2.3.3 BOOSTER PUMPING STATION

No.	Station	Pumps	Remaks
1.	Huseiniya	75 kVA x 380 V x 1 Units 50 " x 380 " x 2 "	
2.	Faqus	75 " x 380 " x 2 " 50 " x 380 " x 2 "	7 deep wells added
3.	Abu Kebir	100 " x 380 " x 2 " 50 " x 380 " x 2 "	7 deep wells added
4.	Zagazig	75 " x 380 " x 2 " 50 " x 380 " x 2 "	3 deep wells added
5.	Saadat	50 " x 380 " x 2 " 35 " x 380 " x 2 "	1 deep well added

Abbasa warter supply system includes 18 elevated tanks for supply storage which are made of reinforced concrete. They were constructed in 1959, together with Abbasa Plant and located along the distribution mains in the service area. All types and shapes of the elevated tanks are similar due to employing standarized tanks at the time of their design.

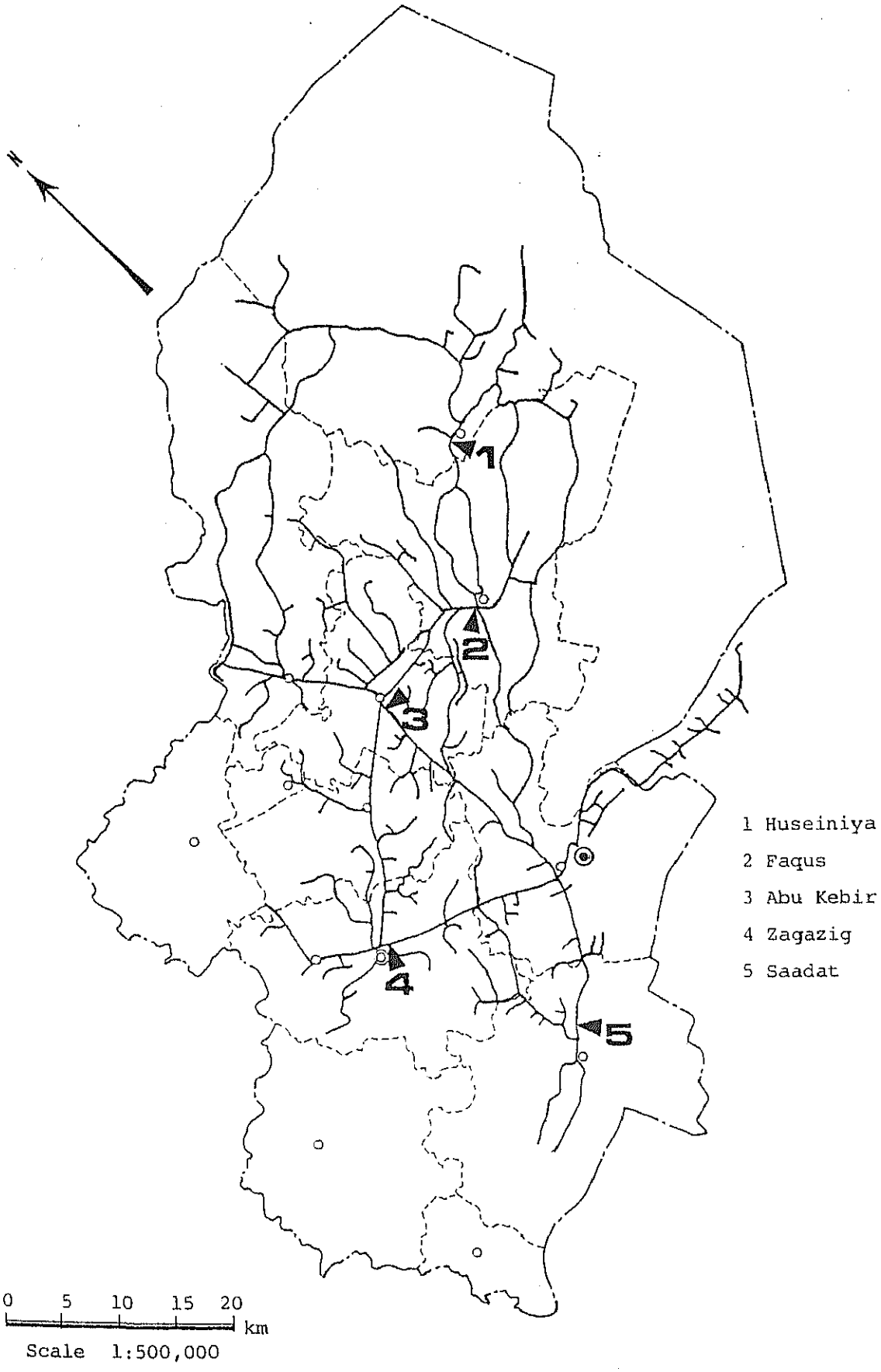
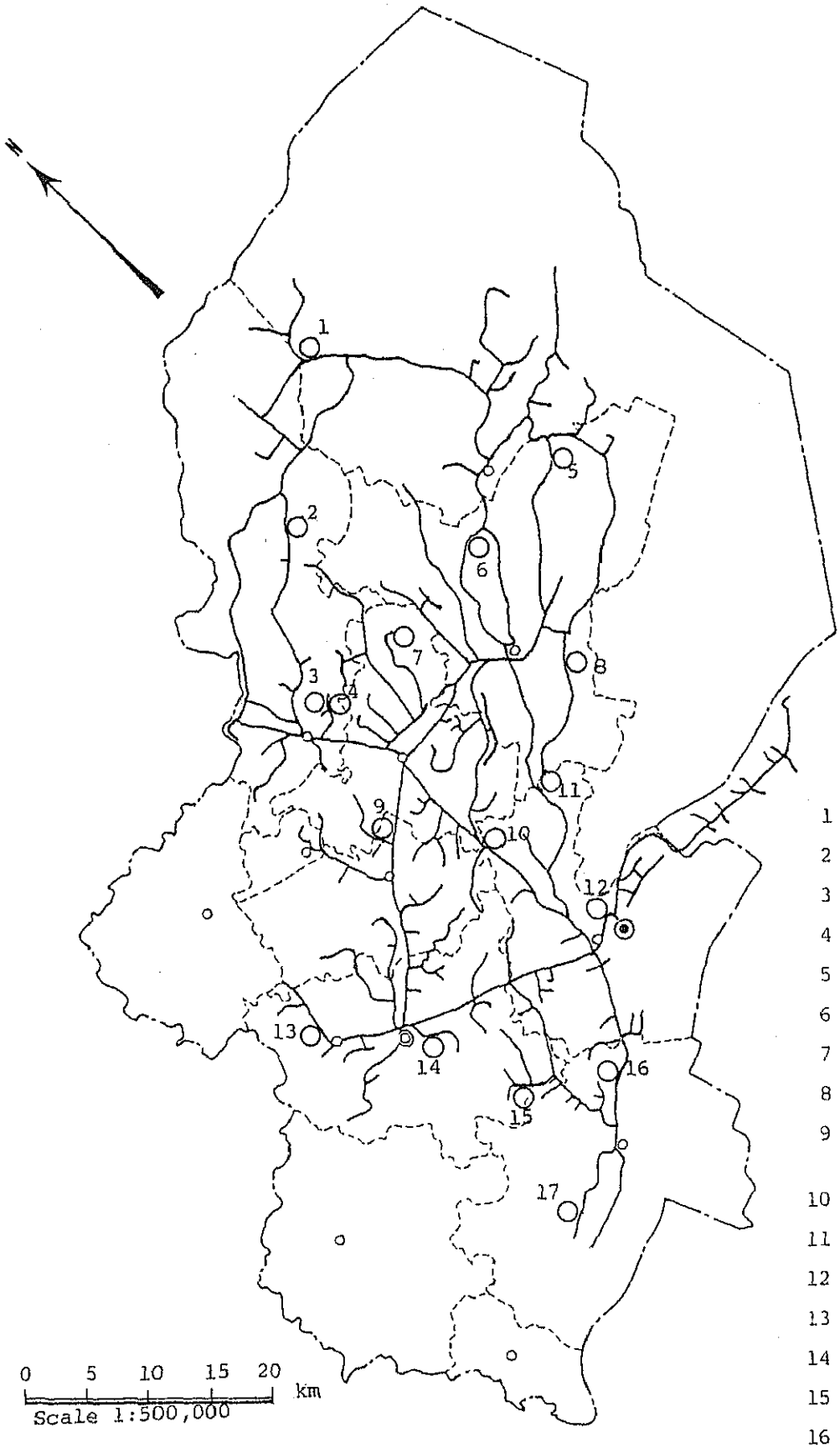


Fig-2.3.5 BOOSTER PUMPING STATIONS



1 San El Hagar
2 Tell Rak
3 Kafr Saqr
4 Natora
5 Kahboona
6 Kanteer
7 El Fadadna
8 El Roda
9 El Sakakra (Soobieh)
10 Tel Moftah
11 Korean
12 Abu Hammad
13 Farsis
14 Shobek Basta
15 Kafr Abaza
16 Saadat
17 Tel Rosen

Fig-2.3.6 ELEVATED TANKS

The average volume of the tanks is about 450 m3 and the height of them is 20m - 30m above the ground. Every location is as shown in Fig-2.3.6. Nowadays insufficient service capacity and pressure hinder normal function of the storage, and no tanks are used except the tank in Abu Hammad.

2.3.2.5 Groundwater Stations

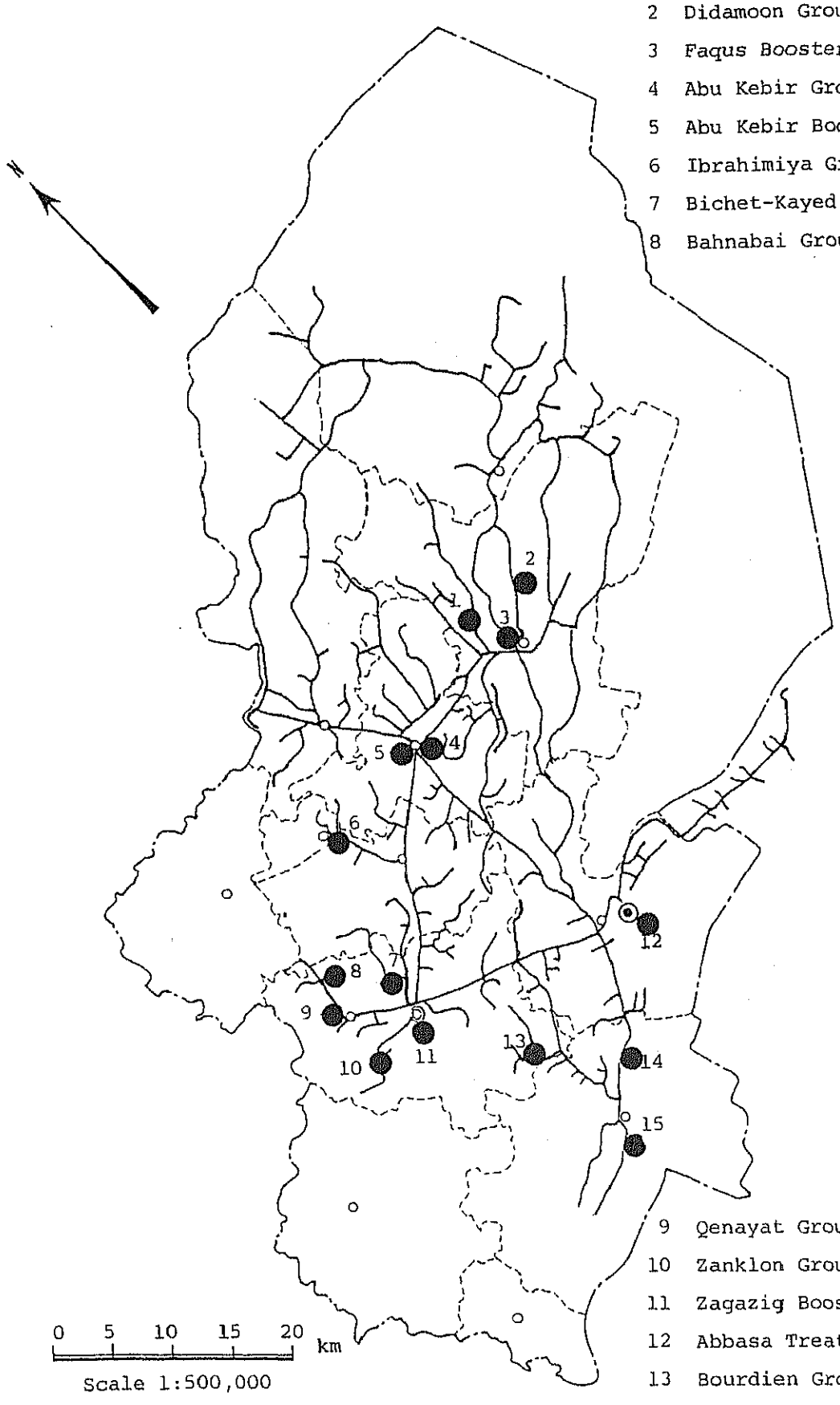
The Abbasa system which was originally planned as a surface water supply now is supplemented by 48 deep wells located in the local services areas. These wells have been constructed successively, corresponding to the increase of population and water demand of the areas. They are located at 15 sites: 1-Abbasa Plant, 4-booster pumping stations, and 10-groundwater stations isolated. Each well in average is sized of 250 mm in diameter and 60 m in depth (40 m galvanized steel pipe casing at upper part and 20 m perforated pipe screen wrapped with fine net made of copper and steel wire).

Static groundwater level is ranged 3 - 6 m below ground level; and pumping water level is 10 - 15 m. Average discharge of each well is estimated at 25 l/sec. The well water is pumped by about 50 m by either horizontal volute pump (35 - 45 HP) or submersible pump (25 KW) and injected into distribution pipelines without chlorination. Each well operates 16 hours in average a day. The total capacity obtaining from groundwater stations amounts to 742 l/sec (64,100 m3/day).

2.3.2.6 Compact Units

The Abbasa system has been supplemented with "Compact Units" in both Markazes of Huseiniya and Kafr Saqr where water shortage has been serious and potable groundwater is not available.

The compact unit is equipment to treat surface water by rather simple process: a kind of rapid sand filtration with high rate sedimentation. The equipment is of above-ground type steel structure and it is assembled at construction site.



1 Mollemien Groundwater St.
2 Didamoon Groundwater St.
3 Faqus Booster St.
4 Abu Kebir Groundwater St.
5 Abu Kebir Booster St.
6 Ibrahimiya Groundwater St.
7 Bichet-Kayed Groundwater St.
8 Bahnabai Groundwater St.
9 Qenayat Groundwater St.
10 Zanklon Groundwater St.
11 Zagazig Booster St.
12 Abbasa Treatment Plant
13 Bourdien Groundwater St.
14 Saadat Booster St.
15 Ghita Groundwater St.

Fig-2.3.7 GROUNDWATER STATION

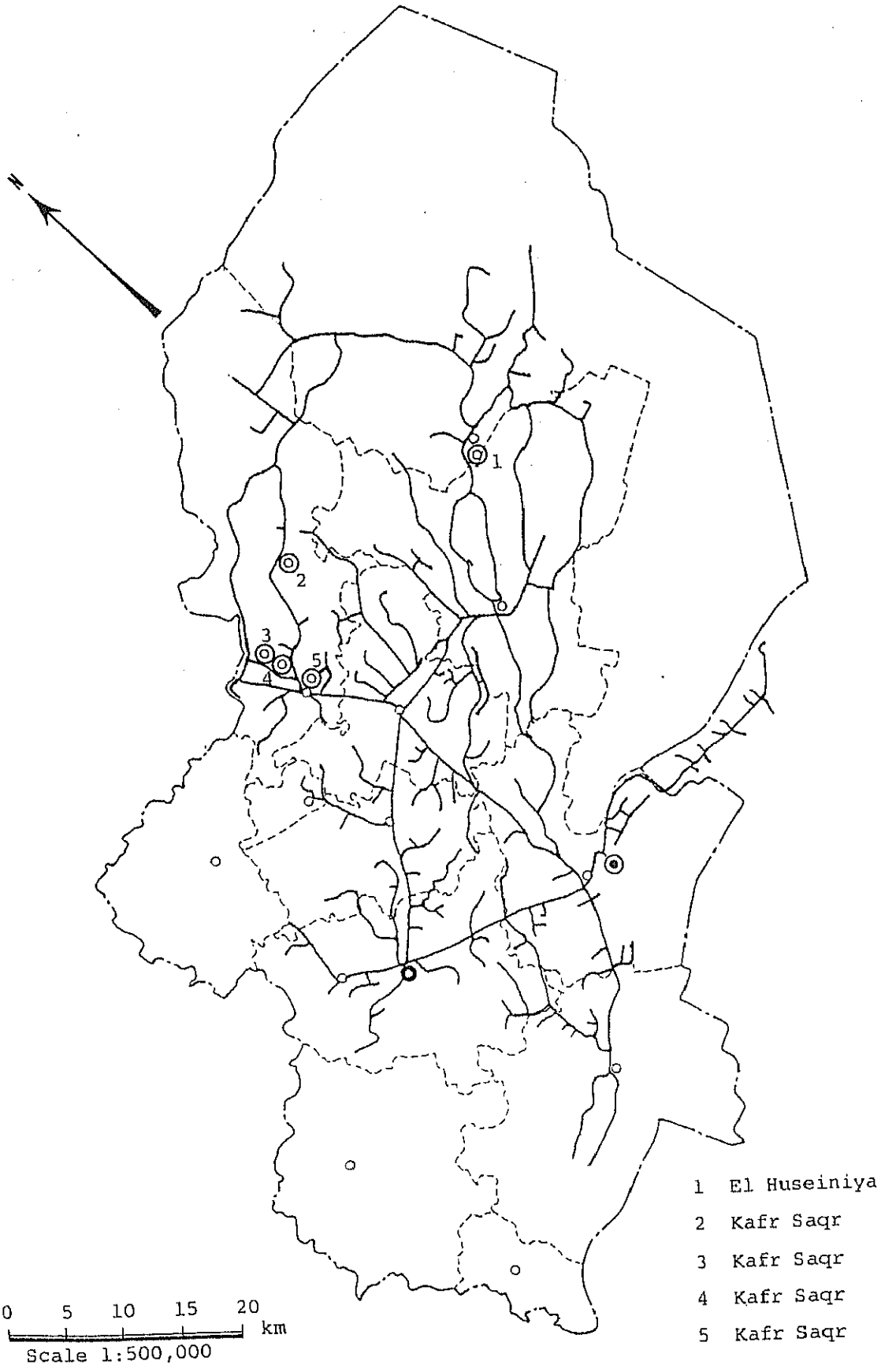


Fig-2.3.8 COMPACT UNITS

Capacity of each unit is standarized to be of 100 m3/hour (28 l/sec) which can supply to 10,000 people. Currently every compact unit has been operated only in daytime owing to a shortage of electric power. The total supply capacity of the compact units will be estimated as follows:

Total Capacity = 4 units x @28 l/sec x 1/2 (daytime) = 56 l/sec
(≒ 4,800 m3/day)

2.3.2.7 Operation and Maintenance

Abbasa system is managed under the Housing Department of Sharqiya Governorate. As the organization of Sharqiya Governorate will be discussed in detail in the following section "2.5 Institution and Management", the operation and maintenance of Abbasa system is to be stated in this section.

The maintenance of Abbasa system is divided into two parts; for the maintenance of Abbasa Treatment Plant and pipelines by Technical Division and for booster stations and groundwater pumping stations by Maintenance Division.

The operation and maintenance groups of Abbasa Plant are stationed at the Plant for convenience of 24-hour operation which is carried out with 4 shifts. The maintenance groups of the pipelines are stationed at 8 branches taking into consideration immediate actions necessary due to the wide supply area.

Organization of Abbasa System

Abbasa Regional Water Supply System
- Administration & Accounting Division
- Maintenance Division (Procurement of Material, Maintenance of Booster and Groundwater Stations)
- Technical Divison (Planning and Design, Construction, Maintenance of Plant and Distribution System, Delivery of Material)

One maintenance group of pipelines consists of a technician, a skilled pipe worker, two assistant pipe workers and two - six workers for digging, backfill and other works.

2.3.3 *Housing Department Water Supply Systems*

2.3.3.1 Outline of the Systems

Prior to Housing Department Water Supply systems' introduction rural villages in the area used to depend generally on small and nearby groundwater wells which were insufficient in quantity and unsafe in quality as the wells were not always well-protected from the surroundings. In almost all cases, supply was made for common use at the well site and there was no distribution pipeline.

To improve such condition the rural water supply system under the authority of Housing Department was planned and constructed in the beginning and middle of 1950s, financed by the national budget, before the construction of Abbasa Regional Water Supply System, which supplies water to areas left from city-owned and Housing Department systems'.

The Housing Department presently owns and operates 82 groundwater stations in seven Marakaz in the southern part of the Governorate. The total supply capacity of the stations is 27,211 m3/day and the total served population in 189 villages covered by the system is 801,873. From this, the average per capita consumption is calculated as 34 l/day.

All of 82 stations have a similar type of water supply sytem, consisting of wells, pumps, elevated tanks and distribution pipelines. The wells, numbering from one to several for a station, vary from 4 to 10 inches in the diameter with 52 to 60 m depth. All stations use both of electric and diesel pumps including at least one set of standby for each type.

The pumps are capacitated for 6 to 50 l/sec in the discharge and 15 HP to 50 HP in the rating. They are operated for 2 to 9 hours. The elevated tanks are made of reinforced concrete with the capacity of 21 to 200 m3 (average 54.4 m3) and height of 9 to 30 m (average 14.4 m). In total, 160 wells and 89 elevated tanks are placed in the 82 stations.

The lifted groundwater is delivered to the village people, without chlorination, by either house connections or standpipes. Population-wise, about 10 % is the user of house connection delivery while the rest, an overwhelming majority of 90 %, has to depend on the standpipe supply.

In most cases, a groundwater station supplies water to several villages through the distribution pipelines. Inter connecting with different stations by transmission pipelines is not practiced however.

The production capacity of the stations varies from 22 to 756 m3/day (average 330 m3/day), and one station covers a population of 1,600 to 19,300 (average 4,240).

2.3.3.2 Pipelines of Housing Department Systems

Each station has its own distribution networks to supply to villages in the territory. Almost all pipelines consist of asbestos cement pipes and less than 0.3 % of steel pipes in length are utilized for canal crossing works. Summarized pipeline length for different sizes and material is shown below :

Table-2.3.4 DISTRIBUTION PIPELINES OF HOUSING DEPARTMENT

Diameter	Material	Total Length	Remaks
6"	Asbestos cement (ACP)	27 km	Distribution mains
5"	"	45 km	"
4"	"	188 km	"
3"	"	25 km	"
2"	"	9 km	"
5"	Steel (SP)	0.7 km	Canal crossing
Total		294.7 km	

2.3.3.3 Water Tariff and Expenditure

The current water tariff is 2 piasters per cubic meter and it is charged to and paid by the house connection users only while the standpipe users are supplied free of charge. Notable here is the fact that in the rural areas supplied by the Department's systems, 90 % of users are not paying while only about 10 % is paying.

In 1982/1983 fiscal year, the annual expenditure was LE 35,000 for operation and maintenance. It excludes the salary of personnel and the cost of new construction and/or expansion works.

Table-2.3.5 BUDGET FOR HOUSING DEPARTMENT'S WATER SUPPLY SYSTEM IN THE FISCAL YEAR 1983/1984
(1st July 1983 - 30th June 1984)

Expenditure	
- Construction of new elevated tanks	: LE 50,000
- Construction of new wells	: LE 50,000
- Power cost	: LE 25,000
- Installation of mechanical/electrical equipment	: LE 40,000
- Regular maintenance including repair of pipelines	: LE 35,000
Total	: LE 200,000

(Note) The above do not include salary of personnel.

2.3.3.4 Operation and Maintenance

The manager of Housing Department, additionally titled the chief engineer, is responsible for the management of water supply systems including the operation and maintenance.

The engineer/manager of the Mechanical and Electrical Divison, under the chief engineer, controls four maintenance centers located in Zagazig, Bilbeis, Diarb Nigm and Minyet el Qamh Markazes which cover the area of seven Marakaz where 82 stations are distributed.

Each maintenance center is staffed with a chief engineer, several engineers, and sub-engineers, skilled workers for operation. Maintenance and repairing machines, motors, cars and pipelines are, in all, cared by them. Unskilled workers work as guards, sweepers and porters. Each maintenance center has stores for spare parts of machines, motors, cars, pipes and valves.

Each maintenance center controls all groundwater stations in its territory. For instance, the center in Zagazig Markaz controls the stations in the Marakaz of Zagazig, Hihya and Ibrahimiya.

Each groundwater station is staffed by a number of mechanics and skilled workers working for operation and maintenance with unskilled workers guarding the facility.

Table-2.3.6 NUMBER OF PERSONNEL OF HOUSING DEPARTMENT'S WATER SUPPLY SYSTEM (1983)

Maintenance Center	Administrative Staff	Operation and Maintenance Staff					
		Chief Eng.	Engineer	Co-Eng.	Technicians	Workers	Total
1) Zagazig	40	1	4	43	60	25	173
2) Bilbeis	10	-	-	4	15	70	99
3) Diarb Nigm	10	1	2	4	20	60	97
4) Minyet el Qamh	2	1	1	2	30	120	156
5) Mashtul el Souk	5	1	-	2	8	12	28
Total	67	4	7	55	133	287	553

The locations of the groundwater pumping ststions, wells, elevated tanks, population, per capita consumption of Housing Departments' systems are described in detail in Working Paper No.4, Existing Water Supply Systems.

Table-2.3.7 SUMMARY OF HOUSING DEPARTMENTS WATER SUPPLY SYSTEM
(Sharqiya Governorate; 1983)

No.	Markaz	Number of Ground-Water Station	Number of Wells	Production (m3/day)	Number of Villages Served	Total Population in Served Area	Per Capita Consumption (lcd)	Elevated Tank	
								Number	Volume (m3)
1	Ibrahimiya	1	1	288	1	5,847	49	1	30
2	Hihya	1	1	288	2	5,557	52	1	40
3	Diarb Nigm	19	39	5,382	42	186,660	29	21	1,170
4	Zagazig	11	21	3,798	26	118,573	32	14	1,010
5	Minyet el Qamh	29	58	11,380	75	287,491	39	31	1,780
6	Bilbeis	17	33	4,671	29	149,169	31	17	601
7	Mashtul el Soak	4	7	1,404	14	48,576	29	4	210
	Total	82	160	27,211	189	801,873	34	89	4,841

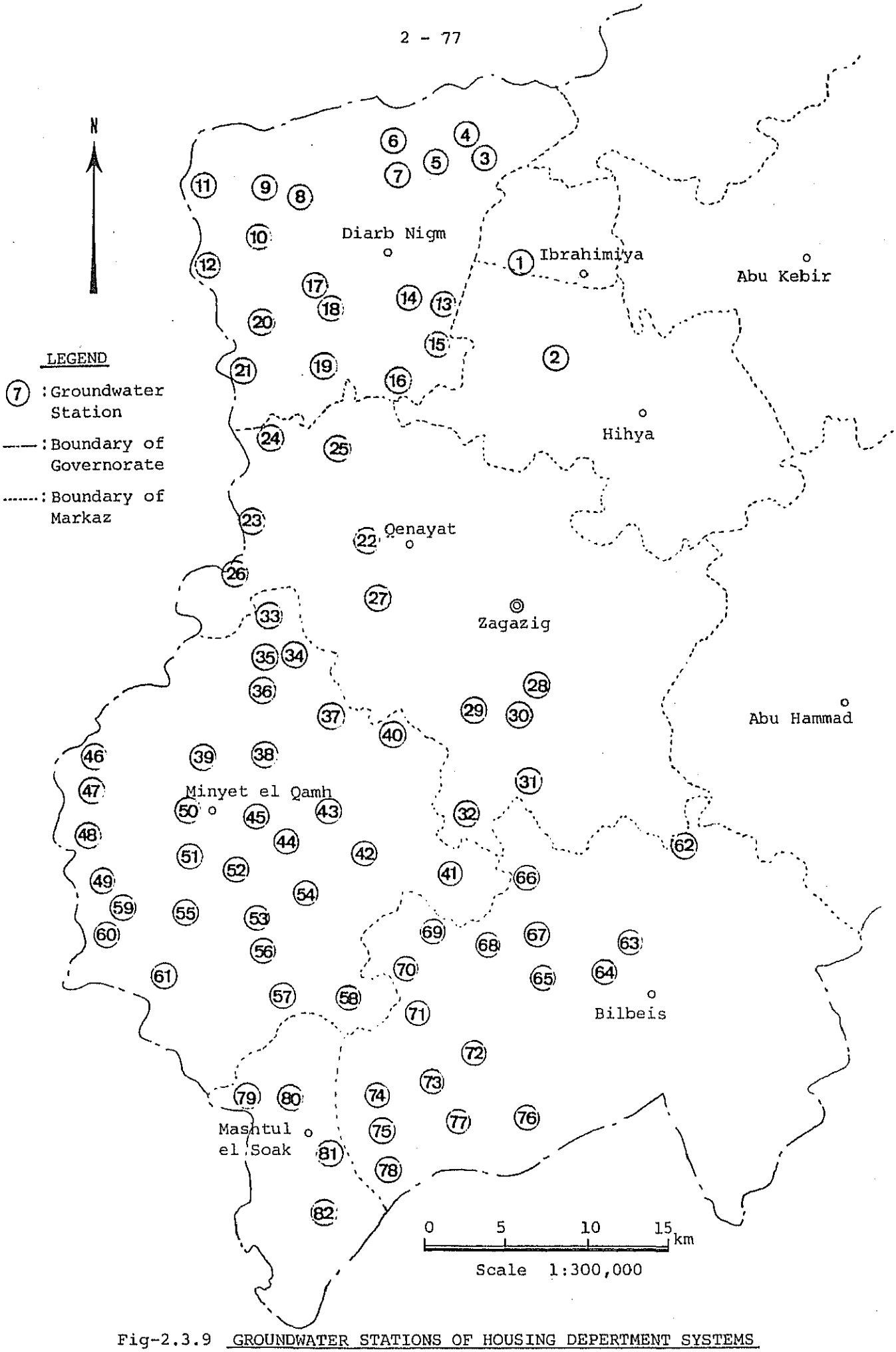


Fig-2.3.9 GROUNDWATER STATIONS OF HOUSING DEPERTMENT SYSTEMS

2.3.4 City-Owned Water Supply Systems

2.3.4.1 Outline of the Systems

As of the year 1983, there exist 13 urban municipalities (city or town) in the Sharqiya Governorate, 12 cities and one town. All fo 12 cities are the capital of each Markaz.

Table-2.3.8 LIST OF CITY AND TOWN

City/Towm	Population (1983)	Water Source	
		City-owned Water Source	From Abbasa Regional Water Supply System
1) Zagazig City	257,000	Yes	-
2) Huseiniya City	18,000	-	Yes
3) Kafr Saqr City	17,000	-	Yes
4) Faqus City	49,000	Yes	-
5) Abu Kebir City	67,000	Yes	-
6) Abu Hammad City	22,000	-	Yes
7) Ibrahimiya City	23,000	Yes	-
8) Hihya City	28,000	Yes	-
9) Diarb Nigm City	27,000	Yes	-
10) Bilbeis City	87,000	Yes	-
11) Minyet el Qamh City	42,000	Yes	-
12) Mashtul el Soak City	27,000	Yes	-
13) Qenayat Town	28,000	-	Yes
Total Population	692,000		

Among the above 13 municipalities, 9 cities (Zagazig, Faqus, Abu Kebir, Ibrahimiya, Hihya, Diarb Nigm, Bilbeis, Minyet el Qamh and Mashtul el Souk) have their own water sources and distribution pipeline networks within their administrative areas.

The remaining 4 municipalities, which are rather smaller in population than others, are supplied with water by the Abbasa Regional Water Supply System; among them three cities (Huseiniya, Kafr Saqr and Abu Hammad) have their own distribution pipeline and maintain them by their own staff; and the last municipality (Qeneyat) is supplied by the Abbasa System and its distribution network is also maintained by the Abbasa System; however, establishing an organization of pipelines maintenance is planned now by the municipality, following the other cities' manner.

The total population of the above 13 municipalities is 692,000 (23 % of the whole Sharqiya Governorate with 3,048,000 people) in 1983. Among them, 607,000 people (88 % of urban population) live in the nine municipalities which have their own water supply systems; and 85,000 people (12 % of urban population) live in the remaining four municipalities which have no their own water sources and are supplied by the Abbasa System.

The cities which have their own system have a rather long history of water supply. The system of Zagazig City, the capital of the Sharqiya Governorate started in 1909, and Bilbeis City and Minyet el Qamh City commenced the public water supply service in 1928; and Faqus in 1932. As to water sources, Zagazig city and Faqus city have treatment plants taking raw water from nearby canals' surface water, while the remaining cities depend on the groundwater source of deep wells of 50 - 70 meter depth.

2.3.4.2 Zagazig City Water Supply System

Zagazig city, the capital of Sharqiya Governorate, has a population of 257,000 and they are supplied by city-owned public water supply system. The city keeps one treatment plant and 18 groundwater stations as water sources. The system originally commenced in 1909 with the treatment plant taking water from Muweis Canal. The Zagazig water supply system is one of the oldest ones in Egypt. Presently the people is supplied with 40,900 m3/day through 40,000 individual connections.

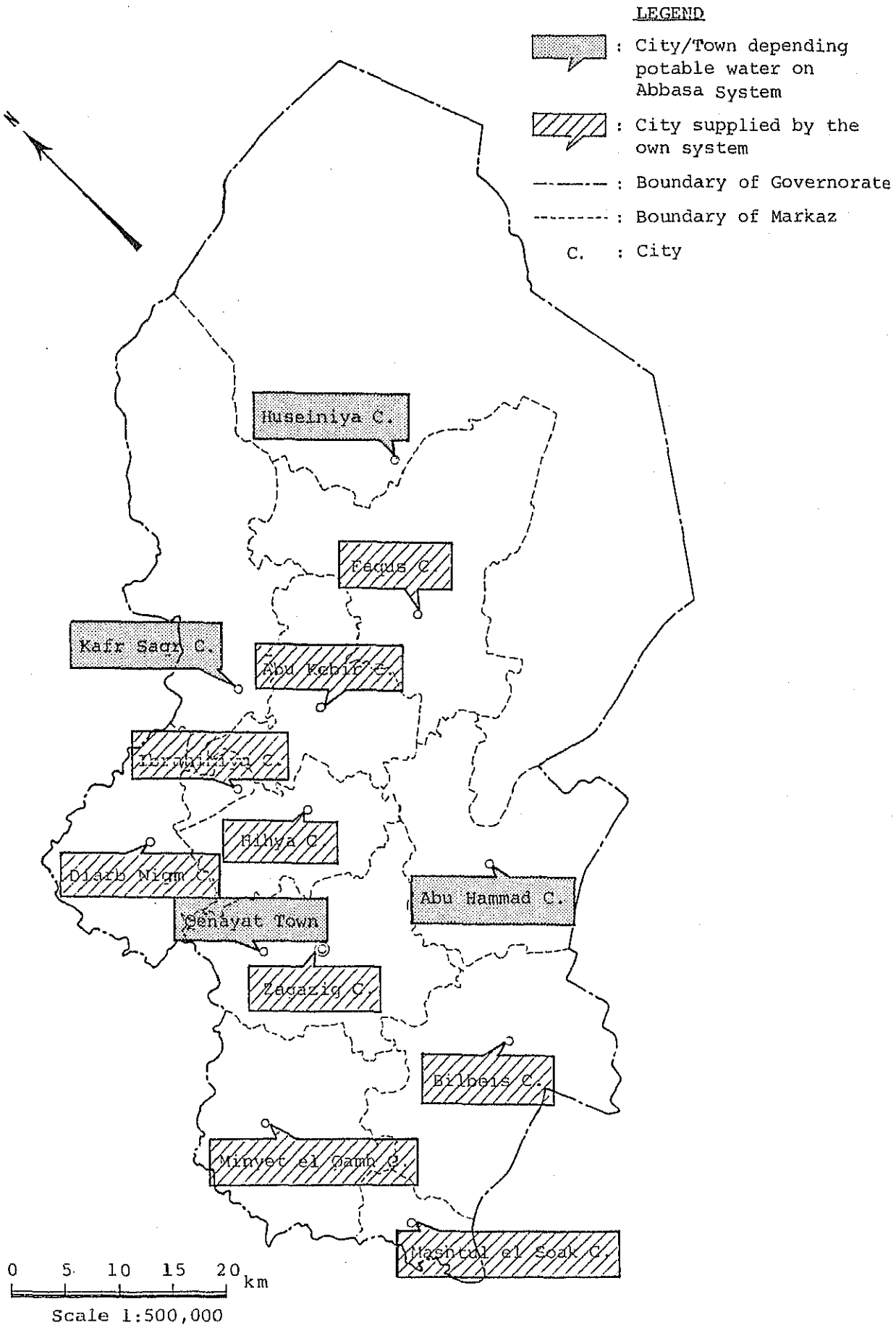


Fig-2.3.10 CITY/TOWN CATEGORIZED BY SUPPLY SOURCE

1) Treatment Plant

In 1909, the old treatment plant was commissioned after being constructed with German technology. The source was Muweis canal's surface water and the treatment process was sedimentation and filtration. In 1950, it was put out of operation coming to the end of service life.

The present treatment system was constructed in 1950, at a site adjacent to the old system's with British technology. Taking water from the same canal at a rate of 200 l/sec, it has treated the raw water by a series of coagulation, sedimentation, filtration and chlorination.

The raw water passes, by gravity, through an intake screen and gate, and flows into a receiving well by way of a 20" cast iron pipeline. Pre-chlorination dosage is fed at a junction well in the pipeline and then alum at the receiving well. It is lifted into a clarifier by three low-lift pumps, including one standby, of 20 m head, 100 l/sec discharge and 50 HP rating.

The clarifier, circular shaped and two hours detention capacity, functions as a coagulation/sedimentation basin. The settled water, supernatant overflowing the clarifier, is led to two sand filters of 88 m2 to be filtered.

The filtrated water falls into a reservoir of 400 m3 capacity constructed beneath the filters, for storage and post-chlorination. Four pump including one standby, of 60 m head, 100 l/sec discharge and 140 HP rating, lift and distribute the finished water to consumers. An elevated tank, 47 m high and of 1,000 m3 capacity, regulates the inflow by pumps and outflow for distribution.

To supplement the plant's output, four wells are constructed in the plant compound to collect groundwater which is lifted by three pump sets, including one standby, of 25 l/sec capacity for distribution. The water is not chlorinated, but mixed with the treated and finished water of the canal water.

The plant output is 200 l/sec finished surface water and 50 l/sec groundwater, totalling 250 l/sec.

In addition to the said system, an emergency groundwater system is made ready for operation, as the canals water level is lowered in winter periodically for maintenance work of the canal and it results in a drastic reduction of the intake flow.

The major problems are the shortage of production capacity and obsolescence of almost all equipment. Large-scaled repair and replacement works are needed badly.

The layout of plant is shown on the following page.

2) Groundwater Stations

Muweis canal flows passing through the central area of Zagazig city and a substantial amount of the canal water seems to be infiltrating to the underground aquifer around the city. Owing to the favourable conditions, many wells have been built in the city area and the groundwater stations drawing water from the wells, as listed below, are supplying water to the people, to meet the demand which cannot covered by the before mentioned treatment plant.

The locations of the groundwater stations are as shown on Fig-2.3.12.

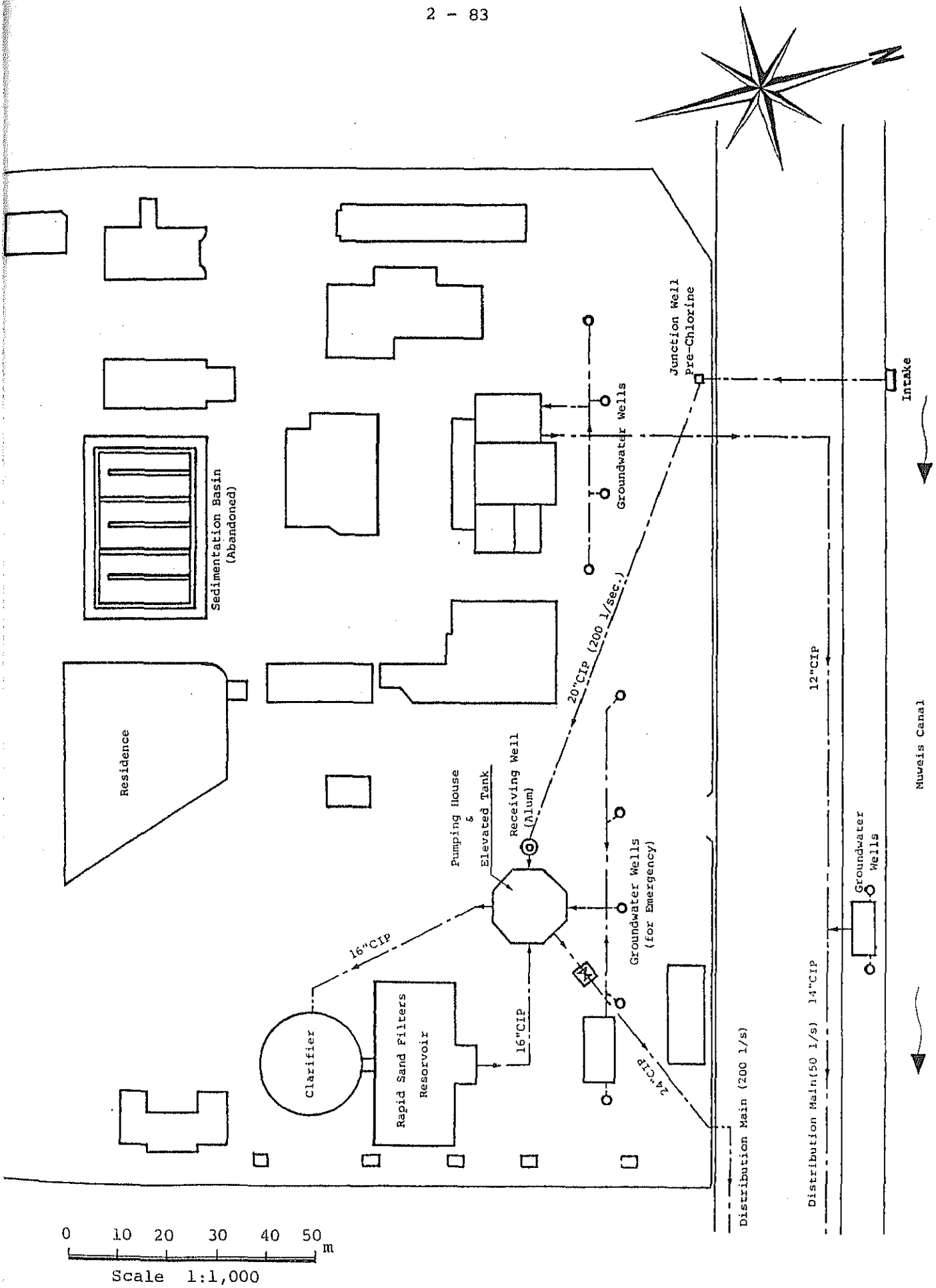


Fig-2.3.11 GENERAL PLAN OF ZAGAZIG PLANT

Table-2.3.9 LIST OF GROUNDWATER STATIONS

(Zagazig City)

No.	Location	No. of well	Dia. (inch)	No. of pump	Pump capacity (l/sec)	Year of construction
1	Bahr	2	10	2	30	1968
2	Mohaphza	1	10	2	30	1967
3	Mabarra	1	10	2	30	1967
4	El Shamss	1	10	2	30	1975
5	Abu Aamer	1	10	2	30 & 25	1974
6	Hassan Saleh	1	10	2	30	1975
7	Souk el Gomla	1	10	2	30	1975
8	El Tagnied	1	10	2	30 & 25	1975
9	Agriculture Faculty			3	30	1969
10	" "	2	10	2	30	1979
11	Abu Khalil Square	1	10	2	25	
12	Galaa St.	4	10		25	
13	Kafr Abd el Aaziz	1	10		25	
14	Zagazig North	1	10		25	
15	Sia Dien District	1	10		25	
16	Hosania District	1	10		25	
17	Souk el Tholatha	1	10	2		
18	Gamal Abdel Nasr School	2	10	2		1983
19	El Mahad el Diny in Hassiniya					1983

Note: Pumps at stations No.1 - No.10 and No.17 are of horizontal centrifugal type. Pumps at stations No.11 - No.16 and No.18 are of submersible type.

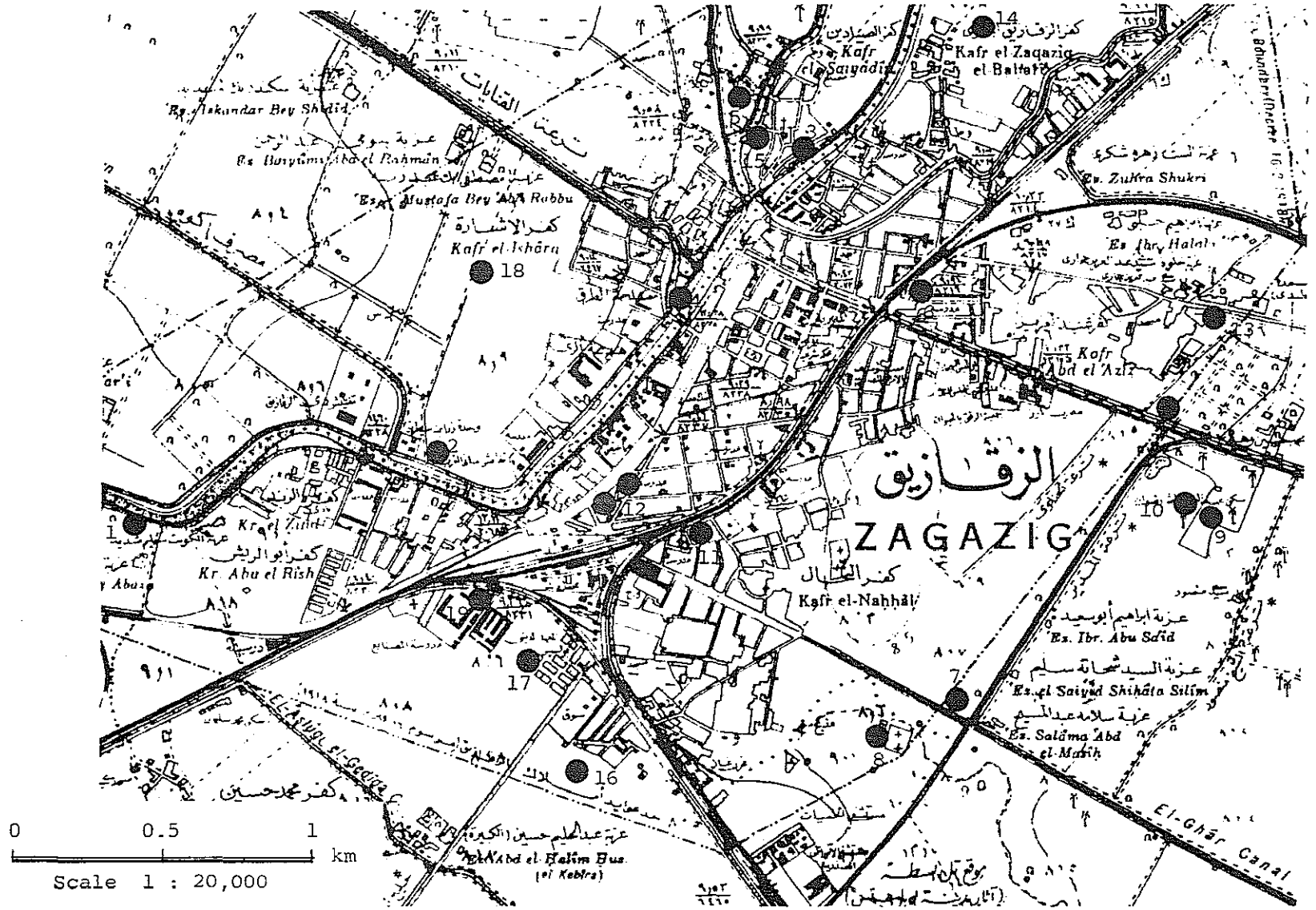


Fig-2.3.12 LOCATION OF GROUNDWATER STATIONS

3) Pipelines

All distribution pipelines are installed in the populated area of Zagazig city, the service area. The length of distribution pipelines more than Ø200 (8") in diameter is about 25.9 km as of 1983. The pipe material of distribution mains installed from 1909 to 1960 are cast iron, and the mains set after 1960 are asbestos cement.

Steel pipes are used only for canal/river crossing and road crossing works. Valves, air release valves and drain valves are installed at convenient places for the maintenance. Fire hydrants and standpipes are set in the city area although their number is limited.

The more detailed information of the pipelines is described in Working Paper No.4.

2.3.4.3 Faqus City Water Supply System

Faqus city is one of the two cities which have city-owned water treatment plants in the Sharqiya Governorate. The system started in 1932 with the treatment plant of 40 l/sec capacity; thereafter groundwater stations were added to the system, and presently the city supplies 9,500 m3/day to the city of 49,000 population.

1) Treatment Plant

Faqus treatment plant was constructed in 1932 with the assistance of British engineering, taking water from Faqus canal which flows through Faqus city. The treatment method is sedimentation, rapid sand filtration and chlorination.

The original production capacity was 40 l/sec in 1932, and in 1940 groundwater was added to it by 40 l/sec, and in 1974 an extention work of canal water treatment was made. The present production capacity, therefore, is 100 l/sec including groundwater.

Raw water is taken from Faqus canal, passes through the intake screen/chamber/gate and flows into a receiving well by gravity, by way of an intake pipeline of 600 mm steel pipe. Pre-chlorine is dosed in the receiving well. Then raw water is lifted to a mixing well by intake pumps (80 l/sec x 15 m x 2 units, including one standby).

Aluminum sulphate is added to the water in the mixing well at 25 ppm, and the water flows to a coagulation basin for flocculation. The mixing well equipped with a flash mixer and coagulation basin with a vertical shaft flocculater were installed in 1974, when the plant was extended. The coagulated and flocculated water flows into two sedimentation basins of 60 l/sec capacity each. The sedimentation basins are horizontal/spiral flow type.

The settled water is filtered by three rapid sand filters with 20 l/sec capacity each (two constructed in 1932 and one added in 1974). The filtrate water is stored in the reservoir constructed beneath the filters and there post-chlorine is fed at 2 ppm.

The finished water is supplied to the consumers by the distribution pumps (40 l/sec x 50 m x 3 units, including one standby, two installed in 1932 and the third in 1972), and the difference between pump inflow and supply outflow is regulated by the elevated tank (350 m3, H=40 m) erected in the plant site.

In addition, groundwater wells were constructed in 1940 in the plant site, to supplement the surface water's output. The nominal capacity of 40 l/sec of the groundwater is fed into the distribution main, 400 mm steel pipe, without chlorination.

As to the measurement of flows in the plant, no equipment has been in working order since the original ones went out of service many years ago.

2) Groundwater Stations

The before-mentioned station, called Principal Groundwater Station, was constructed in 1940. The station's two wells were rehabilitated in 1972, because of the capacity decrease due to a faulty screen.
Groundwater Station comprises three wells and two pump houses. Although one well of the three constructed in 1945 has been stopped since the summer in 1982, because of decreased capacity, it will be reconstructed within 1983. Said Hessien Groundwater Station has three wells and two pump houses, of which two wells and one pump house will start operation in the near future.

3) Pipelines

When the treatment plant was constructed in 1932, the pipelines were also laid to convey the produced water. In those days, cast iron was the main material for water pipes. Since asbestos cement pipes were produced domestically, almost all pipelines are installed with this pipe material. The total length of distribution pipelines are about 21.1 km.

Stop valves installed in the valve chambers are located less than 1,000 m of interval along the pipelines and at key points in the pipeworks. Drain valves, called wash valves here, are installed at proper locations for convenience of maintenance work. No air valves are installed although the ground levels differ from place to place within the city area. Water taps at the end of house connections function in releasing air from the pipelines, in place of the air valves.

About 95 % of the served population is supplied with the house connections while the rest is depending on the standpipes which are free of charge. Although all house connections are equipped with water meters, almost 90 % of them are said to be faulty.

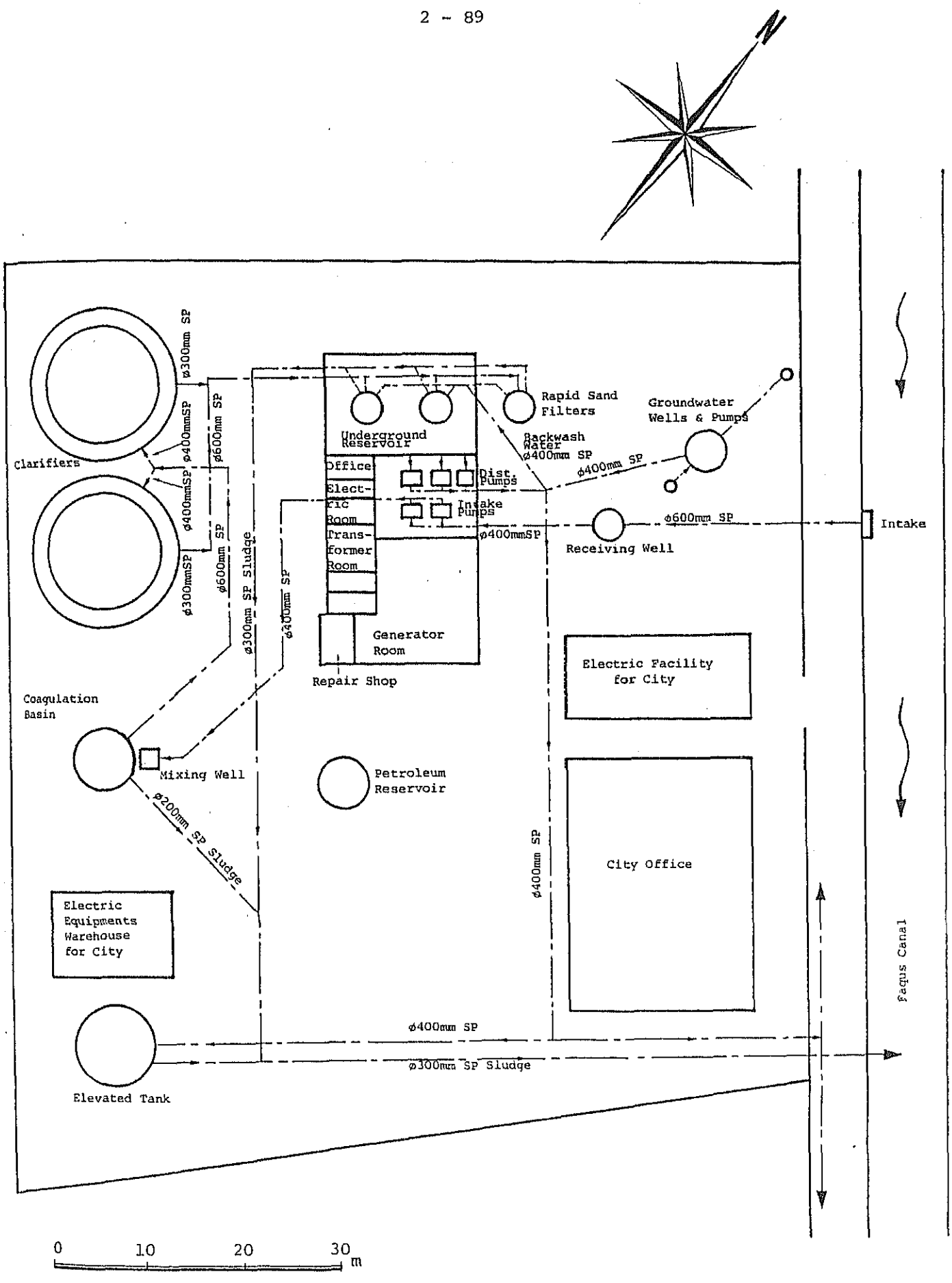


Fig-2.3.13 GENERAL PLAN OF FAQUS PLANT

4) Operation and Maintenance

Engineering Division of Faqus city, placed under the authority of the Head Master and his Deputy, Secretary General, manages the water supply system. Plant Maintenance Section, belonging to the division and staffed with one Chief Engineer, 10 assistants and 60 workers, is responsible for the maintenance of the treatment plant and groundwater stations. For supplying water continuously, the operators work in three shifts a day.

Maintenance of the city's pipelines is handled by Pipeline Section which belongs to the Engineering Division, too. It consists of one chief technician, 4 technicians and 20 workers. The maintenance work covers the service pipes to water meters, besides the distribution pipes.

2.3.4.4 Other City-Owned Systems

Other capitals of 11 Marakaz other than Zagazig and Faqus cities have their own water supply systems except for Qenayat Town, whose consumers are obtaining water from Abbasa pipelines by the individual house connections. These Markaz capitals are divided into two groups; one is a group which has their groundwater stations, and another a group which has no stations.

Every city of Abu Kebir, Ibrahimiya, Hihya, Diarb Nigm, Bilbeis, Minyet el Qamh and Mashtul el Soak belongs to the aforenamed former group with Zagazig and Faqus cities as already mentioned. Huseiniya, Kafr Saqr and Abu Hammad cities belong to the latter group and their water is supplied from Abbasa system in bulk.

All types of groundwater stations belonging to the former group resemble closely Zagazig and Faqus' and the depth of wells is about 60 m from the surface. The distribution pipeline as well is similar to Zagazig or Faqus' system in structure.

The following table summerizes features of the systems. For details refer to Working Paper No.4.

Table-2.3.10 PRESENT STATUS OF CITY-OWNED WATER SUPPLY SYSTEMS (A)

(1983; Sharqiya Governorate)

City/Town	(A) Total Population 1/	(B) Number of Service Connection	(C) Year of Service Commencement	(D) Number of Stations owned by the City: Treatment Plant	(E) Number of Stations owned by the City: Ground-Water Station	(F) Distribution Pipelines
1) Zagazig	257,000	40,000	1909	1	18	24"-8" 25,850 m
2) Huseiniya	18,000	1,033	(1959 by Abbasa System)			7"-4" 25,800 m
3) Kafr Saqr	17,000	3,000	(1959 by Abbasa System)			10"-2½ 17,360 m
4) Faqus	49,000		1932	1	3	12"-3" 21,050 m
5) Abu Keibr	67,000	7,000	1945	-	4	4"-2" 3,500 m
6) Abu Hammad	22,000		(1959 by Abbasa System) 2/			6"-4" 22,240 m
7) Ibrahimiya	23,000	1,664	1948	-	3	8"-2" 11,970 m
8) Hihya	28,000	3,800	1948	-	3	12"-4" 13,006 m
9) Diarb Nigm	27,000		1954	-	3	8"-3" 14,970 m
10) Bilbeis	87,000	10,500	1928	-	4	12"-4" 20,954 m
11) Minyet el Qamh	42,000	12,160	1928	-	4	12"-3" 23,850 m
12) Mashtul el Souk	27,000	4,000	1948	-	1	8"-4" 17,228 m
13) Qenayat	28,000		(1959 by Abbasa System)			—
Total	692,000			2	43	24"-2" 217,778 m

Note: 1/ Population in 1983 is estimated based on 1976 Census data.

2/ Abu Hammad City has one groundwater station in the city as standby.

Table-2.3.10 PRESENT STATUS OF CITY-OWNED WATER SUPPLY SYSTEMS (B)
(1983; Sharqiya Governorate)

City/Town	(G)	(H)	(I)	(J)	(K)	(L)	(M)
	Nominal Production (m^3/day)	Actual Production Estimated (m^3/day)	Rate of Productivety	Per Capita Production (liter/day)	Number of Personnel		
					For Water Stations	For Pipelines	Total
1) Zagazig	50,976	40,867	80 %	159	200	75	275
2) Huseiniya	600 m^3/day from Abbasa system 1/			33	-	9	9
3) Kafr Saqr	1,500 m^3/day from Abbasa system 1/			88	-	10	10
4) Faqus	12,096	9,504	79 %	194	71	25	96
5) Abu Kebir	7,290	5,103	70 %	76	40	25	65
6) Abu Hammad	1,500 m^3/day from Abbasa system 1/			68	-	20	20
7) Ibrahimiya	2,376	1,663	70 %	72	11	11	22
8) Hihya	5,490	3,294	60 %	118	19	21	40
9) Diarb Nigm	5,256	3,679	70 %	136	25	33	58
10) Bilbeis	23,760	14,256	60 %	164	51	50	101
11) Minyet el Qamh	7,776	4,666	60 %	111	48	35	83
12) Mashtul el Souk	3,240	1,944	60 %	72	15	11	26
13) Qenayat	1,674 m^3/day from Abbasa system 2/			62	6	-	6
Total	118,260 3/	84,976 3/	72 %	140	486	325	811

Note: 1/ In the manner of bulk supply to the city.
2/ Supplied from Abbasa pipelines to individual house connections in the town.
3/ Not including Abbasa water, but city-owned water only.

2.4 Levels of Services

In this section the undermentioned aspects are taken up for assessing the present levels of services :

a) Service Ratio and Accessibility to Systems,
b) Quantity and Quality of Available Water,
c) Pressure and Continuity of Water Supply, and
d) Private Water Supplies.

2.4.1 Service Ratio and Accessibility to Systems

The population of Sharqiya Governorate is estimated at 3,048,000 in 1983, and 692,000 or 23% of the said population live in the urban area and the remaining 2,356,000 or 77% in the rural. The present supply condition is summarized in Table-2.4.1.

Two types of public water supply, house connections and standpipes, are widely used throughout the Governorate. In addition, indirect water supply service is practiced through private water vendors employing water tank lorries to distribute water to isolated communities in Huseiniya and Kafr Saqr Marakaz.

As shown below in the urban area, 85% of population obtain water through their privately installed house connections and 2% through standpipes. Contrarily in the rural area, 65% population use standpipes and 7% house connections.

Table-2.4.1 SERVED POPULATION

Area	Classification	Service Ratio (%)	Population
Urban	House Connection	85	588,000
	Standpipe	2	14,000
	Unserved	13	90,000
	Sub-Total	100	692,000
Rural	House Connection	7	172,000
	Standpipe	66	1,548,000
	Unserved	27	636,000
	Sub-Total	100	2,356,000
Governorate	Consumer	76	2,322,000
	Unserved	24	726,000
	Total	100	3,048,000

The proportion of the classified consumers is estimated as shown below:

Table-2.4.2 DOMESTIC CONSUMERS

(As of 1983)

Class	Per Capita Consumption (lcd)	Urban Population (%)			Rural Population (%)
		City 1	City 2	City 3	
A	183	15	8	-	-
B	118	27	26	17	-
C1	90	58	66	83	3
C2	65	-	-	-	7
D	45	-	-	-	90

(Note) City 1: Zagazig city
City 2: Faqus, Bilbeis, Abu Kebir and Minyet el Qamh cities.
City 3: Other cities and Qenayat town.
A,B,C1,C2 & D: Refer to Section 3.3.2.

The existing standpipes are inconvenient to many consumers. Sometimes they are too few in number resulting in long average distances between houses and standpipes. At other times there are too few taps per standpipe, resulting in long queues. Often available water is insufficient at the standpipe due to low supply pressure or short operating hours of the system.

The supply by water vendors are at present privately practiced in the northern area of the Governorate, Huseiniya and Kafr Saqr Markazes, to sell water to consumers in isolated village areas. Although the water, obtained from Abbasa system, is good in quality, the tank cars and receiving vessels of consumers are not always hygienic.

2.4.2 Quantity and Quality of Tap Water

According to the study result, the per capita consumption in the urban area is larger than in the rural area as shown in Table-2.4.2, and the bigger the population of the city is, the more the consumption in general. As

consumers are compelled to use water in severe shortage of supply capacity, the consumers who need more water than supplied utilize shallow wells and/or canal water unavoidably for washing of clothes or kitchenware. As for present supply condition, the details are presented in Working Paper Nos. 4 and 5.

The water quality supplied from public systems is acceptable, conforming to the drinking water quality standard in Table-2.4.3. No residual chlorine is detected in almost all tap water, although at distribution mains just after treatment plants chlorine is detected as 1 - 1.5 ppm. As for the biological examination of water, all fecal-coli tests show negative results, and general bacterial tests positive (less than 10/ml).

2.4.3 Pressure and Continuity of Water Supply

The shortage of the supply water is very severe throughout the Governorate at present. The main technical reasons for such condition are listed below.

a) Insufficient capacity of every system,
b) Restricted operation hours of groundwater stations and others, especially in Housing Department systems,
c) Wastage in water use.

Under the defective conditions stated above, every water supply system in the Governorate does not necessarily meet the fundamental requirements such as continuous supply and appropriate pressure. Some of major reasons for the above are as follows:

a) *New Application for Connection*
Every system accepts new applications for service connection. In the case of Abbasa system, for instance, about 12,600 new connections were installed during 1983. These newly increased consumers worsen not only the original consumers' supply condition but themselves also. It is necessary for water supply systems to decide whether such applications are acceptable based on the total supply plan.

b) Private Booster Pump

A number of private booster pumps are installed to improve their own supply condition. By this sucking, a very low pressure or sometimes a negative pressure is caused in the main, resulting in worsening supply condition. It is necessary that such private installation of pump is strictly prohibited.

2.4.4 Private Water Supplies

There is no private water supply systems to supply water to the public in the Governorate. Some of non-domestic consumers, particularly in the industrial processing and manufacturing fields, have their own private water supplies, although their detailed data are not known yet.

For the domestic use, about 730,000 persons rely for drinking water on shallow wells, sometime equiped handpumps, in spite of questionable water quality.

Table-2.4.3 DRINKING WATER QUALITY STANDARDS

Item	Unit	GOGCWS (Tentative)	W H O Target	W H O Permissible Maximum	Japan
A. Physical					
Color	ppm		5	50	5
Turbidity	"	5 (filtered w.) 10 (groundwater)	5	25	2
Odor, Taste		tolerable	not unpleasant		not abnormal
B. Chemical					
Lead	ppm	0.05	0.1 (Tentative)		0.1
Arsenic	"	0.1	0.05(Tentative)		0.05
Chromium (6 valent)		0.05	-	-	0.05
Cyanide	"	0.02	0.05(Tentative)		ND
Fluoride	"	0.5	0.6 - 0.8 (Recommended)		0.8
Sulphate	"	10.0	-	-	10

Item	Unit	GOGCWS (Tentative)	W H O Target	W H O Permissible Maximum	Japan
Total Dissolved Substances	ppm	1,000	500	1,500	500
Iron	"	1.0	0.1	1.0	0.3
Manganese	"	0.5	0.05	0.5	0.3 (0.05)
Copper	"	1.5	0.05	1.5	1.0
Zinc	"	15	5.0	15	1.0
Magnesium	"	75	30(SO_4<250) 150(SO_4>250)	150	-
Calcium	"	125	75	200	-
Total Hardness	"	400	100	500	300
Sulphate ion	"	300	200	400	-
Chloride ion	"	400	200	600	200
Phenol	"	0.002	0.001	0.002	0.005
pH	"	6.8 - 8.5	7.0-8.5	6.5-9.2	5.8-8.6
Anionic Surfactant	"	-	0.2	1.0	0.5
Cadmium	"	-	0.01 (Tentative)		0.01
Mercury	"	-	0.01 (Tentative)		ND

C. Bacterial

Coliform group or E. Coil	MPN/100 ml	treated water: in 100 ml less than one group untreated groundwater: in 100 ml less than ten groups and no parasite	treated water: (1) in 95% of 100 ml samples taken throughout a year, no detection of group (2) in 100 ml, no E.Coli (3) in 100 ml, less than ten Coliforms (4) in consecutive samples of 100 ml, no detection of group untreated water: (1) in 100 ml, no E.Coli (2) through periodical and frequent tests, less than three groups in 100 ml	

(Note) ND : not to be detected or no detection
GOGCWS: General Organization for Greater Cairo Water Supply

2.5 Institution and Management

2.5.1 Existing Organizational Framework

2.5.1.1 National Level

The present organization responsible for the development of all provincial water supply systems is National Organization for Potable Water and Sanitary Drainage (NOPWASD) established in 1981 by president decree No. 197, 1981 merging General Organization for Potable Water (GOPW) and former General Organization for Sewerage and Sanitary Drainage, while there are other organizations responsible exclusively for water supply in the specific areas such as General Organization for Greater Cairo Water Supply (GOGCWS), Alexandria Water General Authority (AWGA), and Suez Canal Authority (SCA).

This NOPWASD with its headquarters in Cairo, under the Ministry of Housing, Reconstruction and Land Reclamation, is undertaking the following tasks:

1) Identification of the potable water supply and water resources development project and preparation of technical report defining the objectives of the project,

2) Studies, investigation, analysis, planning, designing and overseeing project implementation for water supply system development project,

3) Establishment of the national water supply standards and its control,

4) Engineering consulting services for the water supply works if required by local government agencies,

5) Development of the training program for the personnel to be engaged in water supply works in order to upgrade the quality of the works such as designing and construction of water supply systems including their maintenance/operation.

The eleven regional water supply systems were formerly established by the national government throughout the provinces including Abassa regional water supply system in Shargiya Governorate and placed under direct operation of the General Organization for Potable Water (GOPW), the original water supply authority of present NOPWASD.

Under the general decentralization policy the government handed over direct operational responsibility of the regional systems to the local governorates. This transfer has not, however, become fully functional yet due to manpower and financial resources shortage of the local governorates to manage the system operation taken over. NOPWASD is therefore, still continuing the major tasks for plans, designs and implementation of system expansions as well as improvements. The organization chart of NOPWASD is provided by Fig-2.5.1.

In addition to this organization, there are several organizations more or less related to technical or administrative aspects of water supply system development such as Ministry of Health, Ministry of Finance, Ministry of Planning, Ministry of Local Government, and Ministry of Irrigation.

The total number of the present staff of NOPWASD is 1,362 including high ranking officers as directors and general managers, 226 engineers, 15 legal officers, 3 surveyors, 4 researchers, 4 public relation experts, 41 accountants and financial experts, 45 management staff, 145 skilled laborers, 322 unskilled laborers, 322 clerks and typists and 205 unskilled laborers.

2.5.1.2 Local Level

There are three major water supply systems operated by separate organizations under the administration of Shargiya Governorate, namely, the municipal water supply system, Abassa regional water supply system, and rural groundwater supply system. In addition to above, there are thirty two(32) small local units distributed in rural areas of Marakaz, not specialized for water supply operation, but performing local water supply services as one of the general public services.

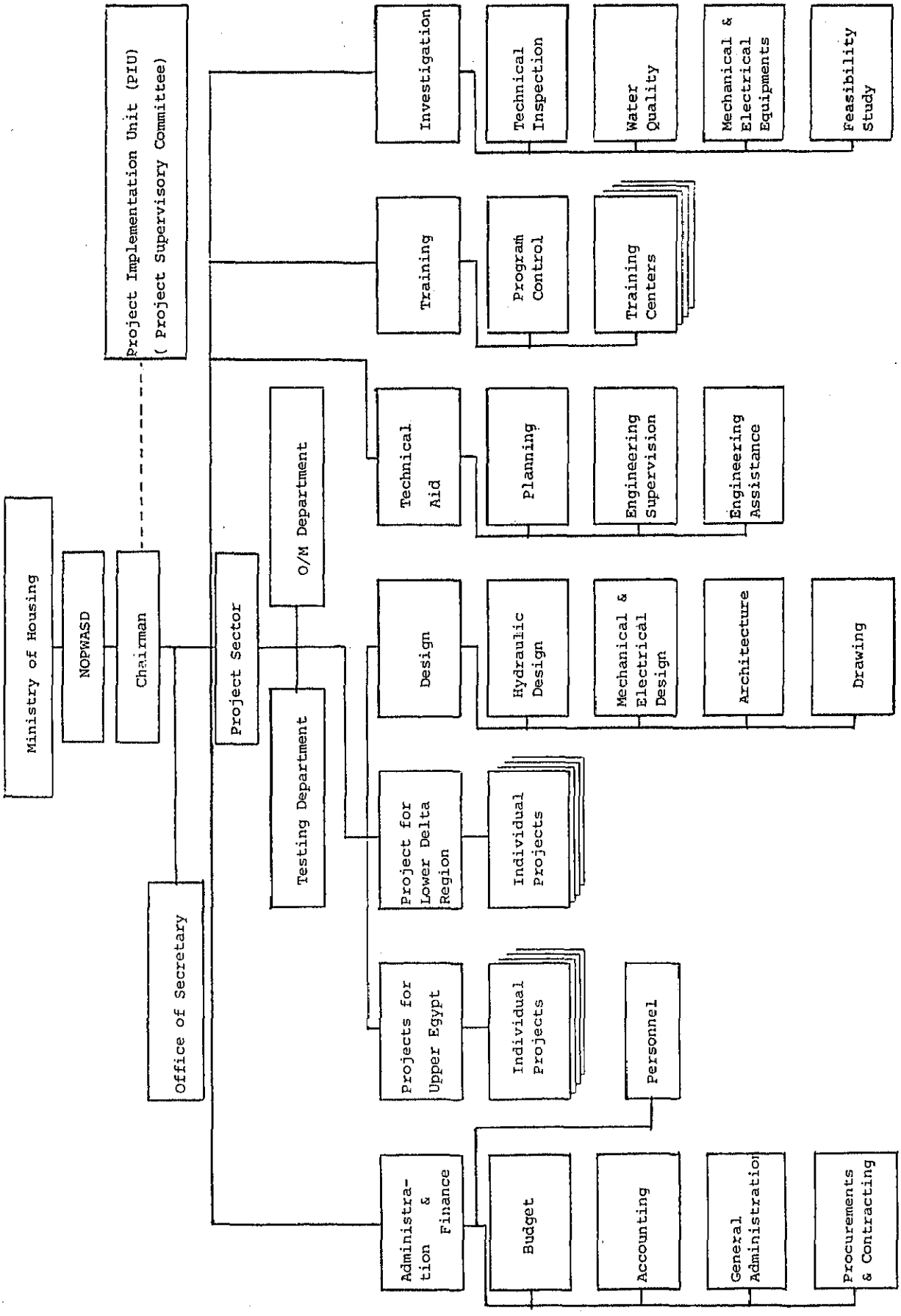


Fig-2.5.1 ORGANIZATION CHART OF NOPWASD

Such separate water supply organizations have been created in accordance with historical development of Shargiya water supply systems. The construction of old municipal water supply systems was started in 1909 and continued until the year 1954. During the years 1950 to 1956 after the revolution and independence, the Egyptian government accelerated development of village water supply systems digging many wells in the rural areas.

The Abassa regional water supply system was subsequently completed in 1959 to supply the water to the areas where neither municipal nor village water supply system existed.

Until recently the latter two systems were under control of national government but in 1981 the operational responsibility was transferred to the Shargiya Governorate.

1) Municipal water supply organization:

Shargiya Governorate is administratively divided in twelve(12) Marakaz and one(1) town and urban areas of above are provided with the municipal water supply systems.

Twelve Marakaz and one town are Zagazig, Faqus, Abukebir, Ibrahimiya, Hihya, Diarb Nigm, Bilbeis, Minyet el Qamh, Mashtul el Souk, Huseiniya, Kafr Saqr, Abu Hammad and Qenayat town. Among above, cities of Kafr Saqr, Huseiniya, Abu Hammad, Bilbeis and Qenayat town are receiving bulk water supply from Abassa regional water supply system paying a nominal price of Pts 1.0/ m^3.

Those which have their own production systems maintain an engineering department consisting of two sections, one for groundwater station or treatment of canal water and another for distribution pipe network. Those supplied with the bulk water from the Abassa systems maintain only one section for the pipe network.

The staffing situation of each engineering department is indicating severe shortage of engineers with qualified technics and experience. Each department consists of a few engineers and technicians and majority of normal laborers. Such shortage of professional and experienced staff is a main cause of poor maintenance and operation of water supply systems which is manifested by the tremendous numbers of broken meters left unrepaired in each city.

In addition to the shortage of the qualified staff, the morale of existing staff is poor due probably to the low wage and inelastic management systems. The highest wage for the chief engineer is more or less LE 100 monthly and lower wage for laborer ranges LE 30 - 40 monthly. There is no incentive system to encourage the work such as payment for the overtime work and bonus.

There is another section related to water supply, i.e., section of water measurement and bill collection which is posted in municipal general income department. The only coordination between the engineering department and this income section is in the process of house connecting in which the engineering department takes part of engineering work for house connection and the income section registers each meter of the house connection.

2) Abassa Water Supply Organization

This organization was established in 1959 to provide supplemental water supply to the areas where existing supply of water provided by other entities are shorted, under the direct control of national water supply agency. Recently this organization was incorporated into the Housing Department of Shargiya Governorate in accordance with the decentralization policy of Egyptian government.

The water supply of this organization is largely divided in two categories, one for rural areas of every Marakaz and another for bulk water supply to some urban cities and outside the Governorate.

Presently most area of the Governorate is in support of such supply from Abassa system due to the increasing water demand in the respective areas.

Abbasa regional water supply organization is composed of three functional units of 1) administration and accounting, 2) maintenance and, 3) technical. The major works of the maintenance of all distribution pipeline are undertaken by the technical division which control eleven maintenance groups stationed strategically in some Marakaz of the service area. All maintenance groups keep approximately 260 technicians and skilled laborers.

Although the magnitude of the staffing is the largest among others due to its extensive service area, the staffing situation is mostly similar to other organizations with respect to the shortage of qualified engineers and other administrative problems. It has been observed that the staff of income department of this organization acutely shorted as apparent from an incredible fact that only seven(7) staff for water meter measurement and other seven(7) bill collectors are dealing with 62,000 house connections(meters).

3) Housing Department's Water Supply Organization

The Housing Department was responsible to construct the extensive groundwater supply system in 1950s to improve the deficient water supply conditions in rural areas. Presently the control of this groundwater system is delegated to the Mechanical & Electrical Division of Housing Department, but the system is conveniently called as the Housing Department's Water Supply System. This organization is in charge of groundwater supply and its development mostly in southern part of the Governorate where groundwater is still in good condition with low salinity.

Their functions have been changed since four(4) years ago by transferring their responsibility for local distribution services such as maintenance and extension of service pipes, house connections,

and standpipes to the other small administrative divisions, located in the villages, called "local unit". Therefore billing and collection of water charge from consumers were transferred also to those local units.

Their functions are therefore concentrated to the construction and operation/maintenance of the groundwater station, elevated tank, wells and major engineering works which the local units can not undertake. They maintain five maintenance centers distributed in five key Marakaz to control the groundwater stations covering the service areas in seven Marakaz where 82 groundwater stations are distributed. The shortage of the qualified and experienced engineers is in common with other organizations.

The division of responsibility between this organization and local unit is causing some administrative conflicts and unnecessary disputes are frequently arising.

4) Local Unit

The municipalities in every Marakaz maintain several local units distributed in the rural areas to perform the general public services locally.

Some local units are performing village water supply services as one of the general public services as mentioned in the previous paragraphs. The units are, however, not specialized in the water supply engineering works and have no qualified and professional staff for such works.

The distribution of such local units in Marakaz performing the water supply services are: one(1) in Kafr Saqr, two(2) in Mashtur El Soak, eight(8) in Bilbeis, six(6) in Zagazig, five(5) in Diarb Nigm, one(1) in Ibrahimiya, nine(9) in Minyet El Qamh.

The organization chart of existing water supply organizations and their administrative boundaries are indicated by Figures-2.5.2 and 2.5.3 respectively.

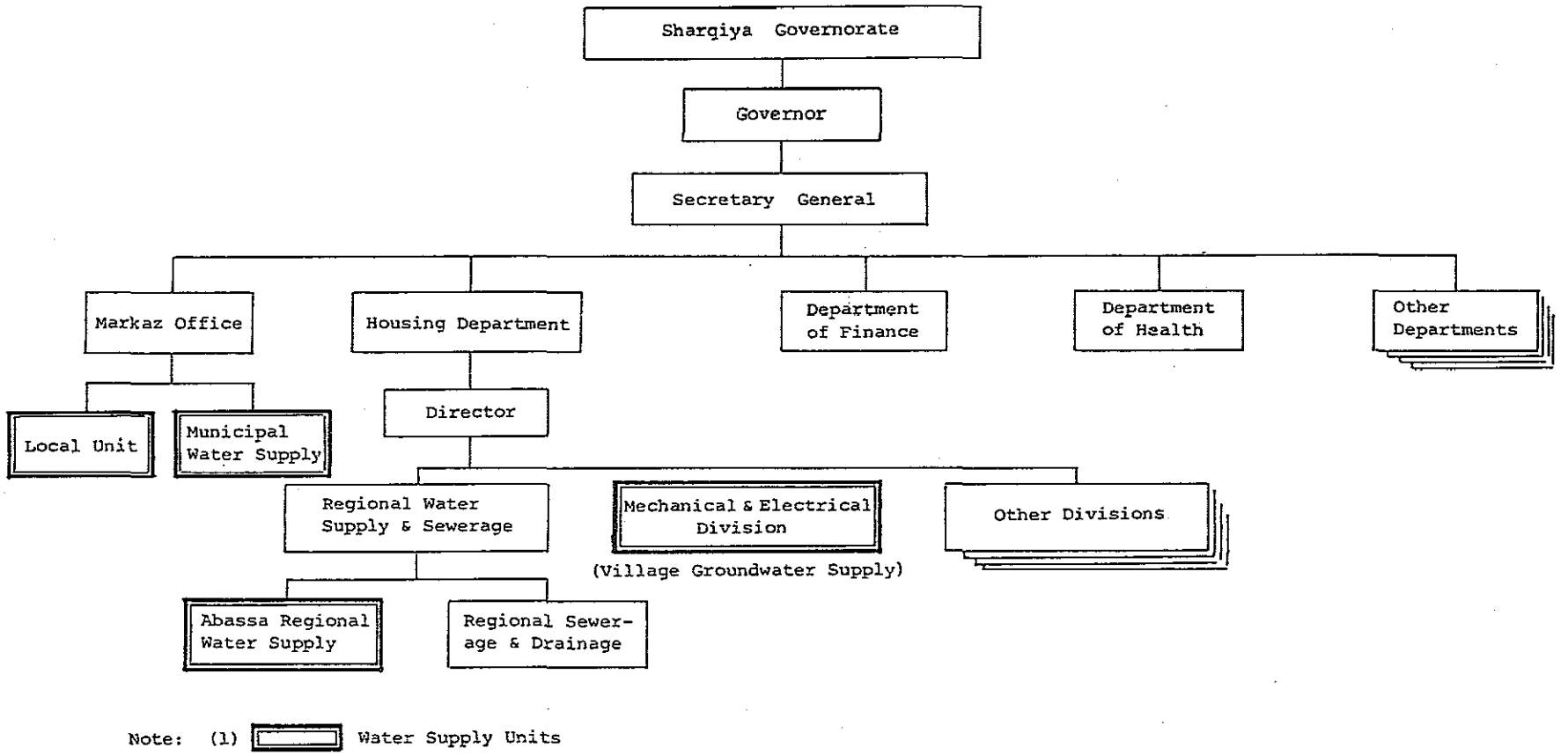


Fig - 2.5.2 WATER SUPPLY ORGANIZATION OF SHAROIYA GOVERNORATE

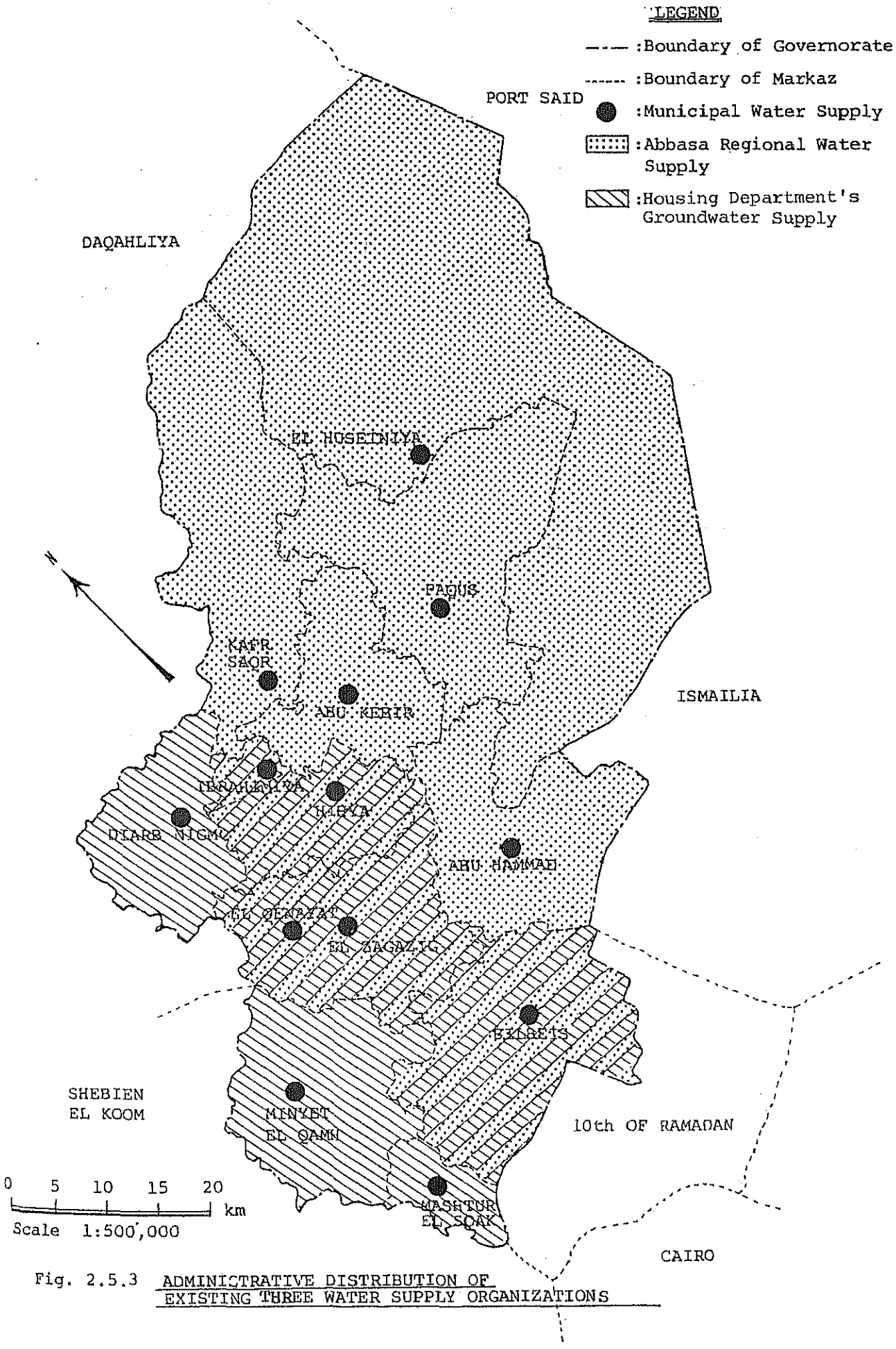


Fig. 2.5.3 ADMINISTRATIVE DISTRIBUTION OF EXISTING THREE WATER SUPPLY ORGANIZATIONS

2.5.2 Existing Financing Status

The present three water supply units in Sharqiya have been examined to identify their financing status.

Among above units Abassa regional water supply system organization had been under direct financial control of NOPWASD of the central government until the recent national decentralization which has alienated the Abassa water supply organization from the control of NOPWASD.

The village groundwater supply system administered by Housing Department had also been under the control of the central government, Ministry of Housing. The two water supply systems in addition to the municipal water supply systems are presently under the control of Sharqiya Governorate which was given extended budgetary power and use of financial resources by the Local Government Decree No. 43/1979.

Although it was difficult to obtain sufficient financial data covering all systems for the past and present years, some data have been obtained to indicate a overall financial situation of the systems.

An example of the financial record of Abassa system in 1983 indicates the expense of LE. 573,000 for the system construction and maintenance against the revenue of LE. 76,000 raised through water tariff of 2 piasters/cubic meter. The Housing Department expended, about LE. 300,000 for the year 1983. The revenue of this system is about LE. 45,000 which is collected through other local units belonging to the municipal offices.

As for the municipal water supply system, the consolidated data for the financial performance are not available but through the questionary survey it has been assumed that they are collecting the revenue approximately 30 % of the expenditure. This revenue portion is higher than other two separate systems because they maintain higher chargeable connection ratio.

As indicated above the existing entities are consistently sustaining overall deficits. The major reasons for their poor financial performances in common are:

1) Inadequate pricing policy with very low water tariff which has remained unchanged since 1961
2) Approximately 90 % of water production is supplied through free standpipes mostly in rural areas.
3) Insufficient bill collection due to overwhelming malfunction of water meters.
4) High rate of water loss due to deterioration of the water supply facilities and poor maintenance.

In general the expenditure and revenue are dealt separately without concerns for the normally practiced accounting procedures to consolidate the revenue and expenditure in one accounting system. Their revenue can not be used for their own expenditure but are reverted to general treasury of Ministry of Finance and in return their expenditures are subsidized by fund from the central government providing, however, within the limit of the approved budget.

It is apparent that the local entities have not been provided sufficient fund allocation for the required renewal and maintenance of the facilities due to scarce resources of the central government and its restriction for the subsidy allocations.

The followings are exixting financing and accounting performance of each water supply unit in Shargiya Governorate.

1) Municipal Water Supply

As a source of income for the municipal water supply services, the water charge ranging Pts 2 - 2.5/m^3 is imposed on all water consumers except for religious institutions as Mosques and churches and other public use for fire hydrant, parks and roads. The consumers of water from standpipe enjoy free charge water. Some municipalities are still maintaining 10 - 15 standpipes in the cities.

The measurement of water meters and collection of water charge are performed in every three months or monthly dependent on municipalities. The numbers of staff in charge of meter measurement and bill collection are apparently shorted and the staffs in some municipalities are responsible for more than 2,000 house connections.

The significant numbers of out-of-order meters have been reported in every municipalities ranging 50 - 90% of existing meters.
The reasons for such high rate of default meters are assumed to be shortage of spare-parts, salty contents of water, shortage of skilled monpower to repair them. The present low tariff is also considered to be obstacle in motivating for meter repairs.

The water charge collected by the income department is sent to the Ministry of Finance through Governorate.

The expenditure for water supply is consisted of capital expenditure for rehabilitation, replacement and minor extensions of water supply facilities, and recurrent costs for wages, electricity and chemicals. The capital expenditure is allocated from the central government annual budget through the Governorate ranging LE 30,000-50,000 in each municipality. The recurrent costs are also met by annual allocation from general fund of the Governorate.

The normal accounting control exclusive for water supply operation is not performed even for the simple comparison of annual water income and expenditure. It has been found by the survey, however, the income by the water charge is less than one third of the expenditure which is far less than the amount required for normal operation and maintenance of the system in most of municipalities.

There is no accounting data to indicate income and loss, cash flow and balance sheets which are required in normal accounting performance to assess the outstanding financial situation and estimate the depreciation costs for the future replacement of the facilities.

2) Abassa Water Supply

The revenue of Abassa system consists of water sales to every consumers connected and bulk water sales to some municipalities of the Marakaz and other two governorates.

The water charges are varied dependent on different consumers, i.e., Pts $2/m^3$ for ordinary households and other dealing with commerce and shops, Pts $1/m^3$ for hospitals, public medical & health units, government buildings, Pts $0.5/m^3$ for gymnasium, youth clubs, Pts $1/m^3$ for bulk water supply. The water charge for Mosques and churches and standpipe users are free.

The measurement of water meters and bill collection are performed every three months by limited number of staff. Therefore a significant amount of written off account can be assumed as manifested by the water income of about LE 76,000(1983 - 1984) from household connections compared with 62,000 connections.

In comparison with income, the annual expenditure is large, amounting to about LE 424,000 for normal maintenance work and about LE 150,000 for the capital investment(1983 - 1984).

The financial and accounting procedures for the income and expenditure and budget allocation are same with those of municipal water supply except for that income is directly sent to the Ministry of Finance.

3) Housing Department's Water Supply

The housing department is not presently dealing with water revenues which are being dealt by the local units.
They are provided with annual budget allocation from the central government through the Governorate amounting to LE 10,000 and LE 200,000 respectively(1983 - 1984).

4) Local Unit Water Supply

Local units are collecting water charge from the consumers mainly in the village by Pts 2/m^3 except for other free taps for standpipes and Mosques and churches.

The most recent income of all local units is LE 45,160 per year and this income is sent to the municipal office and then to the Governorate and finally to the Ministry of Finance.

The overall financial performance of the Shargiya Governorate for the years 1980 - 1982 and the data which indicate the financial status of each water supply organization of the Governorate are shown in Table - 2.5.1 and 2.5.2 respectively.

Table-2.5.1 Revenue and Expenditure of Sharqiya Governorate

(Unit: LE)

	1980	1981	1982
Revenue			
Taxes	6,247,013	8,588,444	7,459,246
Public charge	3,111,899	5,240,999	7,950,925
Capital surplus	10,848,140	10,975,544	13,236,937
Miscellaneous	3,774,163	595,687	405,713
Sub-total	23,981,215	25,400,674	29,052,821
Government Subsidy	40,437,235	66,474,683	87,306,433
Total revenue	64,418,450	91,875,357	116,359,254
Expenses			
General administrative expense	22,363,976	24,141,019	31,738,544
Education dept.	23,522,158	36,998,790	43,721,608
Health dept.	8,433,849	13,814,047	15,733,847
Housing dept.	757,482	1,219,285	2,194,454
Social service	1,188,768	2,320,503	2,569,425
Commerce	624,366	1,037,688	1,198,799
Agriculture	3,747,916	6,263,310	7,186,014
Recruiting & training	255,690	420,142	474,904
Transportation	905,021	1,544,680	1,654,761
Youth & sport dept.	243,964	446,068	600,428
Total expenses	62,043,190	88,205,532	107,072,784

Data source: Department of Finance, Sharqiya Governorate

Table-2.5.2 Summary Data related to Financial Status of Existing Water Supply Organization

August, 1984

Organization	Water Charge	No. of Connection	Default Meters	Water Income	Maint. Costs	Capital Costs	Engr.	Skilled Labor	Normal Labor	Wage (high)	Wage (low)	Average Wage
Abekebir City	PTS 2/m^3	8,550	65%	26,656	84,650	40,000	9	11	45	100	40	60
Bilbeis "	2	11,000	90%	42,000	65,000	30,000	1	2	90	90	35	55
Diarb Nigm "	2.5	3,600	65%	19,000	20,000	N.A.	3	9	54	100	35	50
Faqus "	2.5		75%	66,000	133,000	50,000	3	13	90	100	40	60
Hihya "	2	4,000	10%	8,000	13,000	30,000	3	38	14	70	45	55
Ibrahimiya "	2	1,800	35%	4,500	15,000	N.A.	3	5	15	75	20	60
Kafr Saqr "	2	4,360	95%	13,000	Abassa	50,000	2	6	7	100	45	50
Mashtur El Soak	2	4,000	60%	8,000	26,000	15,000	6	3	13	70	40	50
Minyet El Qamh	2	6,000	95%	28,000	25,000	15,000	3	19	59	100	40	45
Qenayat Town	----------Under Abassa's Control----------						4	2	5	60	40	50
Abu Hammad City	2	2,900	10%	2,500	5,000	Abassa	4	5	12	70	35	60
Huseinya "	2.5	1,080	50%	1,900	14,000	30,000	2	5	8	80	35	60
Zagazig "	2.5	35,000	95%	233,000	40,000	115,000	18	53	223	120	40	60
Abassa System	2	62,000	50%	76,000	424,000	149,000	8	238	161	197	60	100
Housing Dept.	2 -Local Units's Control-			45,160	10,000	200,000	12	50	250	120	35	70
Total		144,290		573,716	874,650	724,000	110	407	1049			

Re: 1. Water Charge is manifested by Piastles per cubic meters

2. Unit price of income and cost is Egyptian Pound(LE)

3. Wage is based on monthly at Egyptian Pound(LE)

4. Maintenance costs do not include wages

5. Abassa's water income does not include bulk water sales to other entity

6. Income(water charge) of Housing Dept. is collected by Local Units

2.6 Leakage

2.6.1 Leakage Survey

The field surveys were carried out from May to August 1984 at nine sites, including three of Zagazig City-owned System, two of the Housing Department System and four of Abbasa Regional Water Supply Systems. One of the three of Zagazig was a failure due to a high groundwater table.

2.6.1.1 Classification of Water Use and Definition of Terms

Regarding the use of water supplied by the public services, the common sense questions will be if the water is used effectively and if the used water is bearing revenue for the supply services.

Using the term "accounted for" which means "revenue bearing", a rough classification of the water use will be as follows:

a) effective and accounted for,
b) effective and unaccounted for,
c) ineffective and accounted for, and
d) ineffective and unaccounted for

a) is the most and normal use of water, unnecessary for further explanation, while d) is mostly the leakage from the publicly owned pipelines.

b) is usually understoods as used for the public installations like fountains, standpipes, fire-hydrants and it also includes the use in mosques, in the Egyptian cases. c) is a use, even though it is paid for, which is not effective: for instance the water being discharged from faulty taps and taps left open by negligence.

Findings in Sharqiya Governorate surveys indicates that a substantial water is being wasted in the uses of b) and c). Calling it "wastage" as a whole, the leakage of d) and the wastage as defined will be quoted in the later description.

2.6.1.2 General Situation

The locations of the surveyed sites are shown in Fig-2.6.1, and the results are tabulated in Table 2.6.1.

Prior to the leakage survey, it was anticipated that there would be a considerable leakage along the pipelines in Sharqiya Governorate, as it was described in the Beheira study report made in 1979 which had resulted from the first and sole leakage survey conducted systematically in the country. Contrary to the anticipation formed by the study results in which the leakage ratio was estimated at about 60 %, the leakage of pipelines in the Governorate was not so high as foreseen. Instead however, much wastage was observed everywhere, especially at the public taps like standpipes and faucets of the mosques.

Generally the leakage from pipelines is comparably low in the Governorate. The reasons seem to be as follows:

a) At present the supply pressure is low as a whole,
b) The shocks of heavy traffic load are not inflicted on the pipes and joints,
c) The service pipes are usually installed by the water supply agencies own personnel,
d) Excavation works for the underground installations like gas pipes, telephone, etc. have not been made along or across the water pipelines, and
e) Most soil in the Governorate generally consists of silt, clay or their mixture originating from alluvium of the Nile. Therefore, a leakage is easily detectable on the ground surface, as water tends to seep upwards due to the low permeability of underground soil.

The present low leakage maintained under the above described conditions will be increased when the conditions changes, and such changes may occur as the area are subjected to a rapid development.

To save the limited budget, the villagers' voluntary labor has been widely employed for the pipelaying works in the rural areas. Where the groundwater table is high, they are compelled to lay the pipes in a shallow depth, because the dewatering pumps are not available usually. It causes leakage in many cases, as found at Elaragy, Kafr Aiyad and Souwa, where the depth are only about 20 to 30 cm at some places.

2.6.1.3 Ratios between Maximum, Average and Minimum

From a 24 hours' continous measurement, the maximum and minimum flow rates of a distribution pipeline can be recorded and by processing the data the average flow rate can be calculated. Table 2.6.2 lists those flow rates and the ratios between the maximum, average and minimum, respectively abbreviated as Max., Ave., and Min.

a) Max./Min. Ratio

The Max./Min. ratios of Aslougy and Kattawia are comparatively lower than those of other areas. Refering Table 2.6.1, it is found to be resulted from the considerably low pipeline pressure possibly. In Aslougy village where leakage has been detected at several spots, a construction work is ongoing for improvement.

b) Max./Ave. Ratio

In the table the ratio ranges from 1.3 to 5.5, averaging 2.2. The two locations of El-Falaha and Bany Coresh show rather high figures, while both of the above mentioned Aslougy and Kattawia show low figures. Where the supply pressure is high and the leakage/wastage ratio is low, the Max./Ave. ratio tends to run high as seen in Tables-2.6.1 and 2.6.2.

This ratio is usually termed and used, in designing a supply system, as a "peak factor".

c) Min./Ave. Ratio

The percentage ratio, varying from 34 to 71, is the ratio including both leakage and wastage. El-Falaha and Bany Coresh, showing zero value, are exceptionally good.

d) Tap Close

To check the wastage occuring in the household uses, the taps leading to the inhouse installations, as many as possible practically, were closed by the supply services personnel during the measurement. Except at Kafr El-Eshara, four cases showed a decrease of the flow rate, further down from the minimum. The substantial decrease itself may be interpreted as the wastage and the "tap close" as the leakage of the public pipelines.

About the 60 % quoted as an approximate leakage ratio in the Beheira report, it is not far from the result of the Sharqiya survey and seems realistic, if the figure includes both leakage and wastage as defined previously.

2.6.2 Reducing Leakage and Wastage

2.6.2.1 Observed Conditions

Beside the quantitative data shown previously, observation during the leakage survey disclosed several facts as described below:

Pipelines

Except a few cases, the public pipelines are laid at a depth which can well stand the traffic load impacts and other disturbances. When the covering earth was excavated for installation of the flow measuring sensor, the pipelines were visually inspected and it was found that they had not been corroded both inside and outside and that few joints were leaking.

Water Meters

While a high portion of the water meters are found faulty or damaged in the urban areas, such cases are seen far less in the rural areas of the Governorate. Some of the damages seems to have been inflicted even intentionally.

Service Pipes

The service pipes installed indoors are mostly exposed and rarely seen leaking, possibly owing to the consumers' good care. However in some cases, the preceeding part installed outdoors are found dripping.

Faucets

Noticable is the finding that many publicly used faucets like in the mosques and outdoor standpipes are in the worst conditions. In an extreme case, a wooden piece plugs the pipe probably after the faucet has been removed.

2.6.2.2 Reducing Leakage

The leakage of pipelines, when detected, shall be immediately repaired and stopped. Not only it saves the loss of water but also it makes the undetected leakage detectable, as the decreased leakage will cause more leakage on the other spots. Moreover, in detecting other leakage the soil condition as described before will affect favourably. Patient repetition of such works will eventually result in a certain low level of the leakage ratio.

For a systematic detection and repair works, the following will be needed essentially:

- keeping well classified and documented records of pipelines and valves,
- managing all pipe materials and valves in stock in an orderly manner,
- preparing the repair works team for an immediate action,
- replacing the missing caps and covers of valves and chambers for easy finding of their locations

2.6.2.3 Reducing Wastage

Reparing a leaking faucet is an easy work once the know-how is leaned and practiced a few times. Neglected wastage comes from the consumers incapability of reparing and/or inattention of wastage.

Related to the wastage problem, maintaining the water meters in accurately-working conditions is indispensable. The responsibility is on both the supply service and consumers. When the water meters conditions are changed for improvement, the water tariff shall be raised to a reasonable and realistic level so that the consumers may realize the value of water and water supply service.

The following steps will be effective in reducing the wastage:

- immediate response to the consumers' request to reparing leaking faucets and teaching them how to do-it-themselves,
- systematic inspection, repair and replacement of the water meters,
- establishment of the realistic water tariff and its structure

2.6.3 Organizational Consideration

A leakage occurs unexpectedly and needs immediate repair, as it may cause damages on the roads and surroundings, not to mentioning the inconveniences on the traffic. In order to reduce the leakage, a preventive maintenance work shall be practiced.

Equipped with the leakage detection tools/devices and repair machines, and staffed with engineers, technicians, skilled and common workers, a special party shall be organized in the public water supply services. While reparing the leakage of pipelines occasionally, the party is engaged in the detection/repair as a daily maintenance work. By its nature it belongs to a technical/engineering department/division responsible for the distribution system.

The wastage from private and public faucets shall be repaired immediately upon the consumers' request and the supply service shall teach them the know-how of reparing by themselves on such occasions. The wastage prevention works are to be considered a service to the consumers, as it intends to save the inconvenience and expense for their sake.

The wastage prevention works, like reading meter, billing and collecting the water tariff and installing the service facilities, shall belong to the public service department/division, because all the said works are similar in that they need the cooperation of the consumers. All the works shall be coordinated and integrated by the management of the department/division.

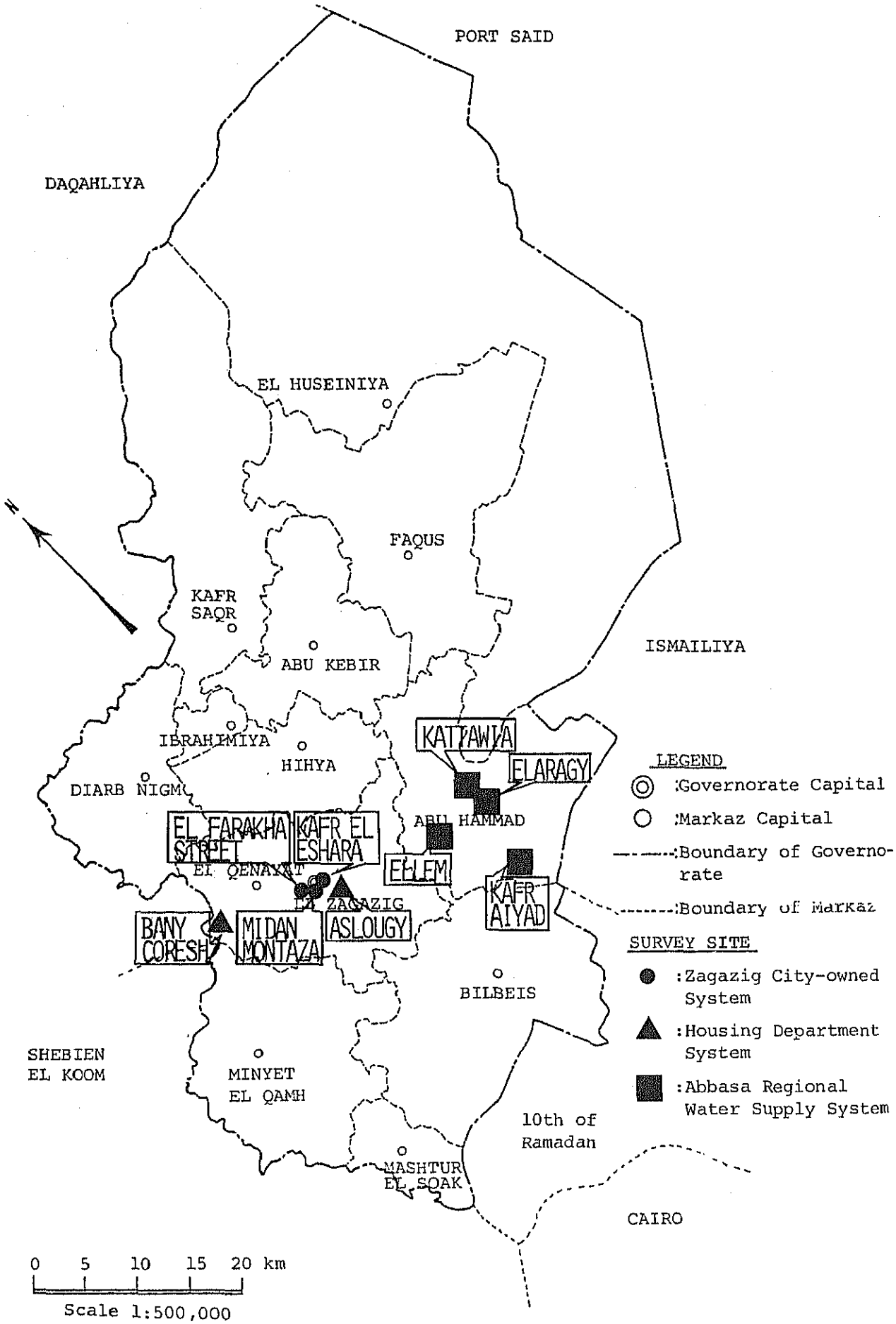


Fig-2.6.1 LOCATION OF LEAKAGE SURVEY SITES

Table-2.5.1 SUMMARY OF SURVEY RESULTS

Control Agency / Item	Zagazig City		Housing Dept.			Abbasa Regional Water Supply			
Survey Site	Kafr El-Eshara	Midan Montaza	El-Falaha	Bany Coresh	Aslougy	Kattawia	Ellem	Elaragy	Kafr Aiyad
Pipe Size (mm)	ø100-75	ø400-250	ø100	ø125-75	ø100	ø100	ø100	ø100	ø300-100
Length (m)	420	230	180	1,095	2,000	980	462	1,980	13,500
Population	2,000*	1,050*	650*			2,940*	1,540*		
Area (m2)	21,500	10,350	8,100	56,250	96,163	50,000	23,500	32,300	675,000
Private Con. No.	273	133	125	40	95	380	200	250	500
Public Con. No.	1	1	1	7	9	1	1	6	39
Builbing No.	43	10	34			430*	230*		
Household No.	286*	150*	130*			420*	220*		
Standpipe No.	0	0	0	4	0	2	0	2	45
Total Consumption (m3/day)	364	-	62	33	509	242	352	275	1,036
Av. Flow (l/s)	4.2	-	0.7	0.4	5.9	2.8	4.1	3.2	11.9
Max. Flow (l/s)	6.1	-	2.0	2.2	7.2	3.7	6.4	7.9	17.9
Min. Flow (l/s)	2.6	-	0	0	4.1	2.0	1.7	1.5	4.1
Tap Close (l/s)	2.8	-	0	0	3.9	0	0	0.8	-
Consumption/Con. (l/Con.)	1,328	-	492	702	4,894	635	1,751	1,066	1,786
Per Capita Consumption (lcd)	182*	-	95*			82*			
Max. Pressure (kg/cm2)	2.0	-	2.0	0.4	0.9	0.7	2.5	4.8	2.4
Min. Pressure (kg/cm2)	1.0	-	1.0	0	0.6	0	0.5	1.0	0.3

(Note) "Con" means an abbreviation of "Connection" employed in the table
" Tap Close" denotes a water flow observed under closed taps by operating stop cocks.
The water flow could not be observed at Midern Montaza, and Tap Close was not carried out at Kafr Aiyad.
* denotes "estimated".

Table-2.6.2 FLOW RATIO

Control Agency / Item	Zagazig City		Housing Dept.		Abbasa Regional			
Survey Site	Kafr El-Eshara	El-Falaha	Bany Coresh	Aslougy	Kattawia	Ellem	Elaragy	Kafr Aiyad
Av. Flow (l/s)	4.2	0.7	0.4	5.9	2.8	4.1	3.2	11.9
Max. Flow (l/s)	6.1	2.0	2.2	7.2	3.7	6.4	7.0	17.9
Min. Flow (l/s)	2.6	0	0	4.1	2.0	1.7	1.5	4.1
Tap Close (l/s)	2.8	0	0	3.9	0	0	0.8	-
Max./Av.	1.5	2.9	5.5	1.2	1.3	1.6	2.2	1.5
Max./Min.	2.4	*	*	1.8	1.9	3.8	4.7	4.4
Min./Av. (%)	62	0	0	69	71	41	47	34
Min/Tap Close	**			1.1			1.9	

(Note) * : Mathematic infinity
**: No measing. Because almost taps were not closed and the obtained figure 2.8 is unreliable.

2.7 Evaluation

Owing to the national policy which has been in effect so far to cover all Sharqiya Governorate area with potable water service, the service ratio in the Governorate is comparatively high, although the supply condition is not always sufficient. Incidentally the service ratio at urban areas of the Governorate is estimated at 87% in 1983, and at rural areas 73%.

Most facilities of water supply systems are well designed and operated satisfactorily in spite of many difficulties to be solved as urgently as possible.

In this chapter the present conditions of the water supply systems located in the Governorate are evaluated from the standpoints of technical and managerial aspects. As detailed evaluation is presented in Working Paper No. 4, the summary thereof will be described hereunder.

2.7.1 Technical Aspects

Water supply systems, operating currently, were categorized into three groups in the preceding capter. As, however, the charactors of every system are similar, the difficulties and problems which occur in them are also similar. Therefore, the evaluation will be made as a whole.

1) Supply Capacity of Potable Water

The water demand has been increasing with growing population and improved living condition year by year. Contrary the production capacity of treatment plants or groundwater stations does not necessarily meet the increasing demand. In addition capacity of pipelines is not sufficient to convey the necessary water. Under such supply condition, residual pressure of water is very low and shortage of water occurs all over the service area.

To cope with the condition every effort has been made for many years such as addition of groundwater stations in Abbasa system and capacity

increase in other systems. In reply to the request of consumers, many pipelines are installed in every area. However, the shortage of production and pipelines' capacity is not improved yet to meet the water demand.

2) Deterioration of Equipments and Pipe Material

The deterioration of the water supply systems has become noticeable in aged facilities like Zagazig, Faqus, Abbasa and so forth. Specially mechanical equipment or devices such as meters, valves, chemical dosing equipments are required to be replaced or repaired.

The distribution pipelines seem not to urgently necessitate replacements or repairs in their wide range in spite of the age.

3) Stock of Spare Parts

Stock of spair parts for equipments and machinery is indispensable to maintain the facilities in working condition. For almost all facilities of systems spare parts are noticed very short. In the case of Abbasa Plant constructed in 1959, it is quite difficult to obtain spare parts because equipments are imported from West Germany and they are outdated models.

4) Supply Capacity of Electric Power

The groundwater stations belonging to the Housing Department's systems are mostly operated for 2 - 9 hours a day in the daytime. Because the supply capacity of electric power is not enough to continuously operate all day long due to isolated areas.

The electric condition of Compact Units which are operated under the management of Abbasa system are similar to the case of Housing Departments'. All Compact Units are set in Huseiniya and Kafr Saqr city where the electric condition is very poor.

Nowadays the electric power for water supply at night is diverted to the lighting power for households, although such condition will be improved in future when strengthening projects, under construction, are completed.

5) Receiving Well of Consumers

At present, consumers illegally install a pump on their service pipes to suck and boost water to the storage tank built on the roof. By this sucking, a very low pressure, or sometimes a negative pressure, is caused in the mains. To avoid this phenomenon, it is recommended to have consumers cease such pump installation and to make it mandatory to install a reveiving tank between the main and the pump.

6) Maintenance Tools and Vehicles

As a result of the field survey it was found that maintenance tools and vehicles are insufficient. To take prompt actions for accidents or damages of the facilities, tools and vehicles must be kept in sufficient numbers.

7) Cooperation and Coordination of Other Projects

Together with the development of the social infrastructure, a number of projects have been and will be planned and constructed. In this connection many sub-surface structures such as telephone cable, gas pipe, electric cable and sewage pipe have been and will be installed along or across pipelines of water supply systems.

As the sub-surface structures will be set along the same street/roads altogether, close cooperation and coordination of executing bodies of the projects are required not only for the timing of installation but for the maintenance and repair work.

2.7.2 Institutional and Management Aspects

While the present water supply being assessed, various deficiencies are found in the aspects of organizational structure and management as follows:

2.7.2.1 Organization and Functions

1) Dislocation of Responsibilities

The existing water supply systems are operated by three separate entities. The distinction of the operative responsibilities among such entities is not clear and functions are sometimes tangled and fragmented to likely cause blaming the responsibilities on others. Such fragmentation of responsibilities prevents efficient and economical operation of the systems and well coordinated system planning.

2) Deficiency of Required Functions

The present activities of entities are mainly limited to day-to-day operation and maintenance of the systems and no coordinated planning for the future system development is effectuated. Further present entities maintain no satisfactory administrative functions to control the personnel and financial matters. The specific organizational units will therefore be required to reinforce the systematic operation.

3) Transitional Decentralization of Power

The transfer of water operation responsibility from the central government to local government including Sharqiya Governorate has not yet been completed in spite of national decentralization policy proclaimed by Decree No.43, 1979. Such prolonged power transfer is affecting adversely on distinction of responsibilitites between existing central water agency of NOPWASD and Sharqiya Governorate with mutual dependency which causes neglect of the required exertion of responsibilities either by NOPWASD or Sharqiya Governorate.

2.7.2.2 Management

1) Staffing

There exists accute shortage of manpower especially of skilled workers in every organization to maintain the minimum level of service and what is worse those scarce personnel are misallocated and dispersed in separate organizations. The efficiency of personnel management to assign the adequate personnel in adequate position will be of vital importance.

2) Wage Level

The present wage level of the working staff is being kept low under strict government control and no incentive system is available. Under such practice the morale of the working staff is not enhanced and they are not motivated to manage the quantity and quality of the work.

3) Finance

The present water supply is operated under persistent financial deficiency without objective financial measurements. The lack of financial measurements prohibits the responsible person to be motivated to control costs and raise revenues for which no efforts have been made to modify the present low water tariff and free tap system. The accounting and budget planning system specifically unified for the water supply operation is not adequately provided, as apparent from a fact that the water charges of a system operated by a certain entity are collected by another separate entity. Such practice also prohibits the reasonable budget planning and measures for adequate government funding.

4) Monitoring System

No adequate monitoring system with sufficient communication media and transportation has not been provided for early detection of troubles and routine maintenance of water supply facilities.

3. Plan for Long Term Program

3.1 General

All basic factors necessary for planning a future water supply system in the study area have been studied and clarified so far in the preceding chapter. Employing the results thereof, this chapter will develop a long range water supply program for the study area, supplemented, as required, with additional studies.

In planning the long range program, discrete consideration will be made to realize a most reliable and least-cost water supply system, and with regard to institutional aspect of the project, to establish a workable and efficient organization backed-up with effective regulations.

The population of Sharqiya Governorate estimated at about 3.0 million in 1983 will increase to 4.9 million in 2005. Together with the population increase, the rising living standard causes severe shortage of the water. The future water demand in 2005 will be 687,000 m3/day which is about 3 times the existing supply capacity of the systems 227,000 m3/day.

Characteristics of water supply system between urban and rural areas are greatly different in magnitude of water demand and water sources.

The rural area is to be supplied by groundwater due to limited water demand and isolation of the area. The urban area will be covered by treated canal water because of comparatively concentrated and large capacity of water demand. The northern part of the Governorate including the rural area will be supplied with treated canal water due to its salinity of groundwater.

In principle, existing groundwater stations and treatment plants will be used continuously in future with periodical rehabilitation and/or replacement work.

The capacity to be expanded will be 309,000 m3/day by canal water with four new treatment plants, and 151,000 m3/day by groundwater which will be obtained from groundwater stations scattered mainly in the southern area of the Governorate. In addition the existing system 227,000 m3/day will be maintained with rehabilitation.

Four new treatment plants, planned from the technical and economical feasibleness fit for the locality and dispersion of unforeseeable risks, will be constructed by 2005. The construction cost is estimated at LE 430.0 million at 1984 prices, including the rehabilitation and/or replacement cost of existing groundwater stations and pipelines.

3.2 Target Year and Served Area

3.2.1 Target Year

The Long Term Program of the current study is targeted at the year of 2005 in accordance with the agreement between NOPWASD and JICA which is attached in Appendix of the Report.

3.2.2 Served Area

The served area of the Long Term Program covers the administrative area of Sharqiya Governorate, and excludes the area of 10th of Ramadan.

The served area is as shown in Fig-1.2 in Part One "General".

3.3 Projection of Population and Water Demand

3.3.1 Population Forecast

1) Future Population

The future populations in the study area are estimated in the following manner:

- The whole Governorate population is estimated to increase at 2.2% per annum from 1976 up to 1990, then at 2.15% per annum up to 2005,
- The rural population is assumed to grow at 1.9% per annum up to 2005, and
- The total urban population is assumed to grow at about 3% per annum, though the growth rate differs city to city.

The results are summerized in Table-3.3.1 Projected Population. For further details, see the Working Paper No.5.

2) Served Population

The future served population is projected taking into consideration the population increase in the Governorate, the expansion of the service area, socio-economic conditions, availability of alternative sources, and the target of the Master Plan of prepared by the World Bank. Although the Master Plan sets the target that the 100% population shall have an access to the piped water supply by 2000, the present study envisages that the target will be accomplished by 2005. The delay of the target year is due to the late start of the present project.

The 1983 served populations are estimated at 602,000 in urban and 1,720,000 in rural totaling to 2,322,000. The total served population of the Governorate is projected at 3,455,000 in 1995 and 4,885,000 in 2005. The details are shown on Table-3.3.2 Served Population Estimated. The future service ratios are summerized on Table-3.3.3 Estimated Service Ratio and Consumer Classification. Fig-3.3.1 shows total and served populations projected.

Table-3.3.1 PROJECTED POPULATION

(1000 persons)

		1976 CENSUS*	1983	1985	1990	1995	2000	2005
1. EL ZAGAZIG	U	202,575	257	276	325	379	442	514
	R	312,336	356	371	407	447	491	539
	T	514,911	613	647	732	826	933	1,053
2. EL HUSEINIYA	U	14,385	18	19	23	27	31	36
	R	185,100	211	219	241	265	291	319
	T	199,485	229	238	264	292	322	355
3. KAFR SAQR	U	13,726	17	18	21	24	28	32
	R	191,632	219	227	249	274	301	331
	T	205,358	236	245	270	298	329	363
4. FAQUS	U	39,090	49	52	61	70	81	93
	R	251,747	287	298	328	360	395	435
	T	290,837	336	350	389	430	476	528
5. ABU KEBIR	U	54,858	67	71	81	92	103	117
	R	115,661	132	137	151	165	182	200
	T	170,519	199	208	232	257	285	317
6. ABU HAMMAD	U	17,595	22	23	26	29	33	37
	R	180,739	206	214	235	258	283	312
	T	198,334	228	237	261	287	316	349
7. EL IBRAHIMIYA	U	18,522	23	24	27	31	35	39
	R	52,674	60	62	69	75	83	91
	T	71,196	82	86	96	106	118	130
8. HIHYA	U	22,774	28	30	36	42	48	56
	R	86,594	99	103	113	124	136	149
	T	109,368	127	133	149	166	184	205
9. DIARB NIGM	U	21,535	27	29	34	39	45	52
	R	162,374	185	192	211	232	255	281
	T	183,909	213	221	245	271	300	333
10. BILBEIS	U	69,112	87	94	108	125	145	167
	R	208,550	238	247	271	298	328	360
	T	277,662	325	341	379	423	473	527
11. MINET EL QAMH	U	33,609	42	45	53	61	70	81
	R	266,145	304	315	346	381	418	459
	T	299,754	346	360	399	442	488	540
12. MASHTUL EL SOAK	U	22,270	27	28	33	37	42	47
	R	51,658	59	61	67	74	81	89
	T	73,928	86	89	100	111	123	136
13. EL QENAYAT	U	22,677	28	29	34	39	44	49
		—	—	—	—	—	—	—
TOTAL	U	552,728	692	738	862	995	1,147	1,320
	R	2,065,210	2,356	2,446	2,688	2,953	3,244	3,565
	T	2,617,938	3,048	3,184	3,550	3,948	4,391	4,885

* Presented in persons and adjusted according to the present boundaries.
U: Urban R: Rural T: Total

Table-3.3.2 SERVED POPULATIONS ESTIMATED

(1,000 persons)

		1983	1985	1990	1995	2000	2005
1. EL ZAGAZIG	U	224	243	292	360	433	514
	R	260	278	326	380	466	539
	T	484	521	618	740	899	1,053
2. EL HUSEINIYA	U	16	17	21	26	30	36
	R	154	164	193	225	276	319
	T	170	181	214	251	306	355
3. KAFR SAQR	U	15	16	19	23	27	32
	R	160	170	199	233	286	331
	T	175	186	218	256	313	363
4. FAQUS	U	43	46	55	67	79	93
	R	210	224	262	306	375	435
	T	253	270	317	373	454	528
5. ABU KEBIR	U	58	62	73	87	101	117
	R	96	103	121	140	173	200
	T	154	165	194	227	274	317
6. ABU HAMMAD	U	19	20	23	28	32	37
	R	150	161	188	219	269	312
	T	169	181	211	247	301	349
7. EL IBRAHIMIYA	U	20	21	24	29	34	39
	R	44	47	55	64	79	91
	T	64	68	79	93	113	130
8. HIHYA	U	24	26	32	40	47	56
	R	72	77	90	105	129	149
	T	96	103	122	145	176	205
9. DIARB NIGM	U	23	26	31	37	44	52
	R	135	144	169	197	242	281
	T	158	170	200	234	286	333
10. BILBEIS	U	76	83	97	119	142	167
	R	174	185	217	253	312	360
	T	250	268	314	372	454	527
11. MINYET EL QAMH	U	37	40	48	58	69	81
	R	222	236	277	324	397	459
	T	259	276	325	382	466	540
12. MASHTUL EL SOAK	U	23	25	30	35	41	47
	R	43	46	54	63	77	89
	T	66	71	84	98	118	136
13. EL QENAYAT	U	24	26	31	37	43	49
TOTAL	U	602	651	776	946	1,122	1,320
	R	1,720	1,835	2,151	2,509	3,081	3,565
	T	2,322	2,486	2,927	3,455	4,203	4,885

U: Urban R: Rural T: Total

Table-3.3.3 ESTIMATED SERVICE RATIO AND CONSUMER CLASSIFICATION

(%)

	1976*	1980	1983	1985	1990	1995	2000	2005
Urban								
Service Ratio	82	85	87	88	90	95	98	100
Classification								
Individual Connections	78	90	98	100	100	100	100	100
Standpipes	22	10	2	0	0	0	0	0
Rural								
Service Ratio	67	70	73	75	80	85	95	100
Classification								
Individual Connections	4	5	10	13	15	20	23	25
Standpipes	96	95	90	87	85	80	77	75

* Based on 1976 census and UNDP/IBRD Study (1981)

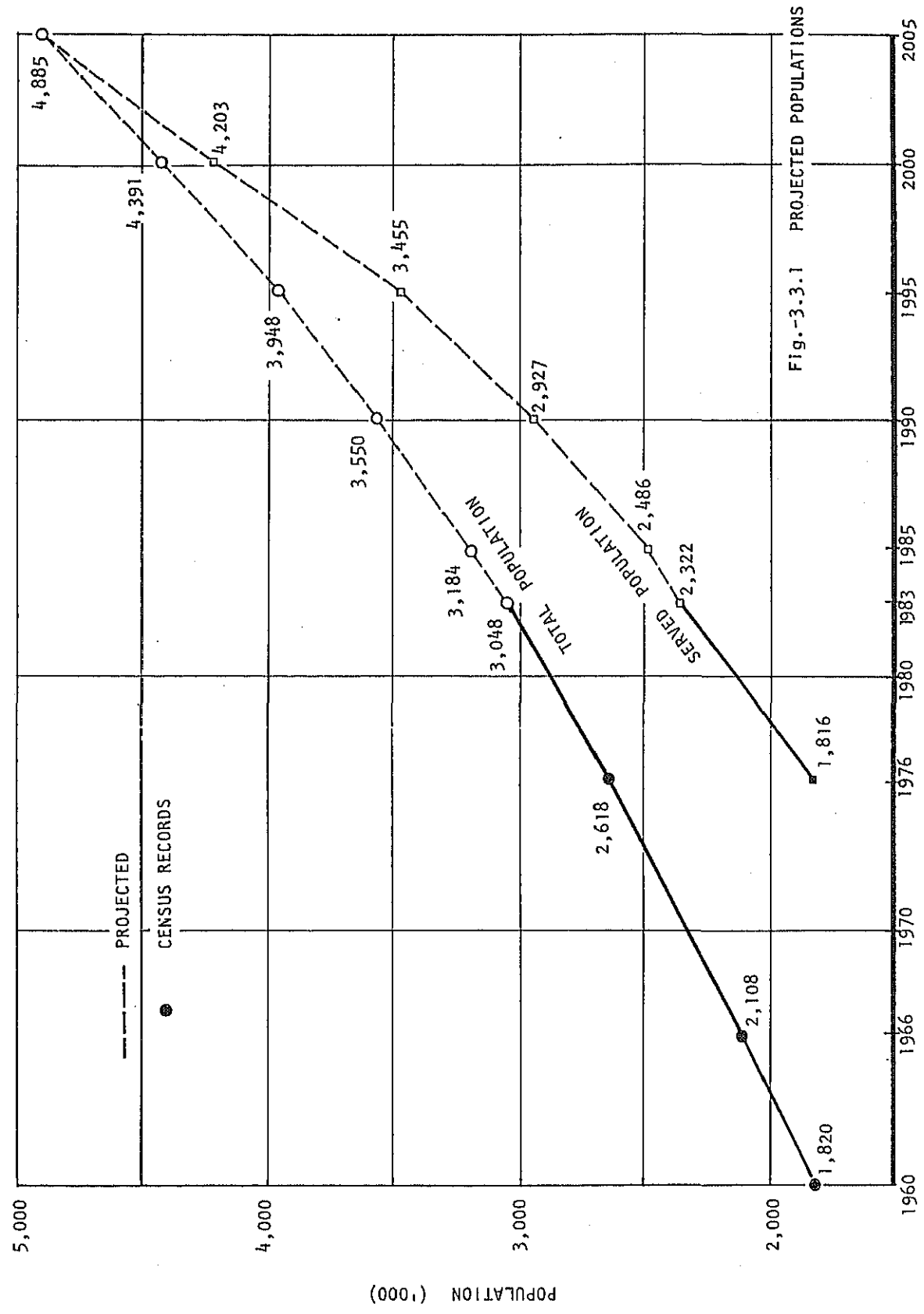

PROJECTED POPULATIONS
PROJECTED
CENSUS RECORDS
TOTAL POPULATION
SERVED POPULATION
4,885
4,391
3,948
3,550
3,184
3,048
2,618
2,108
1,820
4,203
3,455
2,927
2,486
2,322
1,816
5,000
4,000
3,000
2,000
1960
1966
1970
1976
1980
1983
1985
1990
1995
2000
2005
POPULATION ('000)

Fig.-3.3.1

3.3.2 Unit Water Consumption and Water Demand

The water consumption is defined in the study as the quantity of water to be consumed by the population served of the water supply system, while the demand refers to the necessary amount of water to be produced and supplied by the system. The demand is obtained as the sum of water consumption and losses of the system. These consumptions and demands are discussed on the average daily basis unless otherwise indicated.

The unit water consumptions are discussed on the basis of the following consumer categories:

- Urban domestic;
- Rural domestic;
- Non-domestic;
  - Commercial;
  - Industrial; and
  - Institutional.

1) Urban Domestic

"Urban" refers to the Governorate Capital, the Markaz Capitals, and El Qenayat Town. The urban domestic consumers are classified as follows:

- Class A:
  High living standards, 3 or more taps, 2 or more WCs, occasionally with a bath tub, and connection provided to the sewerage system;

- Class B:
  Medium standard of living, 2 or 3 taps, 1 WC or a pour-flush squatting-type toilet, connected to the sewerage system; and

- Class C1:
  Low standard of living, 1 tap a household, pour-flush squatting-type toilet, occasional connected to the sewerage system.

The present and future urban standpipe consumers are included in the low class house-connection users in the study, since the urban standpipe

users are limited and diminishing. The future unit water consumptions by category and class are presented in Table-3.3.4 and 3.3.5.

2) Rural Domestic

"Rural" refers to the villages of the Markaz. The rural domestic consumers are classified as follows:

- Class C1:
  Same as the urban consumer Class C1;
- Class C2:
  Lowest class of house-connection users, generally in rural areas only, 1 tap, sewage disposed of in field or at canal; and
- Class D:
  Standpipe users, majority of rural served populations.

Refer to Table-3.3.5 for estimated per capita consumptions.

3) Non-domestic

The non-domestic consumers refer to such consumers as offices, schools, shops, and hospitals. The rural non-domestic consumption is assumed to be included in the rural domestic since the former is insignificantly small.

4) Commercial

The commercial consumptions are such trades as shops, hotels, and restaurants. According to the Master Plan, the unit water demand for the category is assumed as 10 lcd on the total served population in urban.

5) Industrial

This category refers to all factories and manufacturers. For example, Zagazig City holds the following factories:

Table-3.3.4 URBAN DOMESTIC CONSUMER POPULATIONS BY CLASSIFICATION AND PER CAPITA DEMANDS

YEAR	CLASS	PER CAPITA CONSUMPTION (lcd)	ZAGAZIG (%)	Fagus, Bilbeis, Abu Kebir & Minyet el Qamh (%)	Other Cities and El Qenayat (%)
1980	A	180	14	7	-
	B	115	26	25	15
	C1	90	60	68	85
1983	A	183	15	7.5	-
	B	118	27	26.0	16
	C1	90	58	66.5	84
	Average		(112 lcd)	(104 lcd)	(94 lcd)
1985	A	185	16	8.0	-
	B	120	28	26.5	16.5
	C1	90	56	65.5	83.5
	Average		(114 lcd)	(106 lcd)	(95 lcd)
1990	A	190	17	8.5	-
	B	125	30.5	27.5	17.5
	C1	90	52.5	64.0	82.5
	Average		(118 lcd)	(108 lcd)	(96 lcd)
1995	A	195	19	9.5	-
	B	130	33	28.5	19
	C1	90	48	62.0	81
	Average		(123 lcd)	(111 lcd)	(98 lcd)
2000	A	200	20	10	-
	B	140	35	30	20
	C1	90	45	60	80
	Average		(130 lcd)	(116 lcd)	(100 lcd)
2005	A	205	20	10	-
	B	150	35	30	20
	C1	90	45	60	80
	Average		(134 lcd)	(120 lcd)	(102 lcd)

Table 3.3.5 ESTIMATED PER CAPITA CONSUMPTIONS

(lcd)

CATEGORY			1980	1983	1985	1990	1995	2000	2005
DOMESTIC (lcd)	House-Connection	A	180	183	185	190	195	200	205
		B	115	118	120	125	130	140	150
		C1	90	90	90	90	90	90	90
		C2	65	65	65	65	65	65	65
	Standpipe	D	40	45	48	55	55	55	55
NON DOMESTIC	URBAN								
	Industrial		10% of domestic and commercial demands in the following towns:						
	Zagazig & Bilbeis								
	Abu Kebir								
	Faqus								
	Minyet El Qamh								
	Commercial		10 lcd on served population						
	Institutional		15% of domestic and commercial demands for Zagazig 10% for others						
	RURAL		Included in domestic demands						

- soft drinks;
- ice;
- cotton oil processing and soap;
- textile (wool and cotton); and
- cattle feeds processing.

The large cotton oil processing factory mentioned above operates own wells which are used for processing and domestic purpose within the premises and no public water supply was undertaken to the factory and some of the other major factories also have supplemental supply by own wells. If an industrial development project is implemented, supplemental wells will be installed for new factories. The fact and the current practice are the basis of the assumptions of the study that the industrial consumptions are 10% of the sum of the domestic and commercial consumptions in the cities where populations exceed 75,000 and gradual increase of the industrial water demand is envisaged up to the year 2005.

6) Institutional

This includes such establishments as governorate offices, educational institutions, railway stations, mosques, churches, and hospitals. The military installations are excluded from the present study since no mojor military facilities are located in the Governorate.

The unit consumption for the institutional use is assumed as 15% of the sum of domestic and commercial consumptions for Zagazig, and 10% for the other cities and El Qenayat Town.

7) Water Consumptions

As described in the previous section, the water consumption is computed from unit water consumptions and served population forecast. The served population is categorized and classified according to the methodology of the Master Plan.

The summary of water consumptions are shown in Table-3.3.6 Water Consumptions.

Table-3.3.6 WATER CONSUMPTIONS

Markaz		Average Daily Basis (m^3/day)					
		1983	1985	1990	1995	2000	2005
1. EL ZAGAZIG	U	34,023	37,544	46,410	59,917	75,505	92,520
	R	12,415	14,229	18,786	22,230	27,506	32,003
	T	46,438	51,773	65,196	82,147	103,011	124,523
2. EL HUSEINIYA	U	1,832	1,962	2,252	3,078	3,630	4,435
	R	7,354	8,394	11,122	13,163	16,291	18,941
	T	9,177	10,356	13,374	16,241	19,921	23,376
3. KAFR SAQR	U	1,709	1,847	2,218	2,723	3,267	3,942
	R	7,640	8,701	11,467	13,631	16,881	19,653
	T	9,349	10,548	13,685	16,354	20,148	23,595
4. FAQUS	U	5,404	5,845	7,147	8,945	11,944	14,452
	R	10,028	11,465	15,098	17,901	22,134	25,828
	T	15,432	17,310	22,245	26,846	34,078	40,280
5. ABU KEBIR	U	7,290	7,880	10,347	12,672	15,272	18,182
	R	4,584	5,272	6,973	8,190	10,211	11,875
	T	11,874	13,152	17,320	20,862	25,483	30,057
6. ABU HAMMAD	U	2,165	2,309	2,685	3,314	3,872	4,558
	R	7,163	8,241	10,834	12,812	15,878	18,525
	T	9,328	10,550	13,519	16,126	19,750	23,083
7. EL IBRAHIMIYA	U	2,279	2,424	2,802	3,432	4,114	4,805
	R	2,101	2,406	3,169	3,744	4,663	5,403
	T	4,380	4,830	5,971	7,176	8,777	10,208
8. HIHYA	U	2,735	3,002	3,736	4,734	5,687	6,899
	R	3,438	3,941	5,186	6,143	7,614	8,847
	T	6,173	6,943	8,922	10,877	13,301	15,746
9. DIARB NIGM	U	2,620	3,002	3,399	4,379	5,324	6,406
	R	6,446	7,371	9,739	11,525	14,284	16,684
	T	9,066	10,373	13,138	15,904	19,608	23,090
10. BILBEIS	U	10,419	11,509	13,750	17,332	21,470	25,953
	R	8,309	9,469	12,505	14,801	18,416	21,375
	T	18,728	20,978	26,255	32,133	39,886	47,328
11. MINYET EL QAMH	U	4,650	5,084	6,237	7,744	9,563	11,588
	R	10,601	12,080	15,962	18,954	23,443	27,253
	T	15,251	17,164	22,199	26,698	33,006	3,841
12. MASHTUL EL SOAK	U	2,620	2,886	3,502	4,143	4,961	5,790
	R	2,053	2,355	3,112	3,686	4,545	5,284
	T	4,673	5,241	6,614	7,829	9,506	11,074
13. EL QENAYAT	U	2,735	3,002	3,399	4,379	5,203	6,037
TOTAL	U	80,472	88,296	107,884	136,792	169,812	206,567
	R	82,132	93,924	123,953	146,780	181,866	211,671
	T	162,604	182,220	231,837	283,572	351,678	418,238

Table-3.3.7 WATER DEMANDS

(m^3/day)

	1983	1985	1990	1995	2000	2005
Urban *						
Consumption	80,472	88,296	107,884	136,792	169,812	206,567
Losses	53,647	58,862	71,924	58,627	72,775	68,855
Demand	134,119	147,158	179,808	195,419	242,587	275,422
Max. Daily Demand	167,652	183,950	218,934	244,276	303,235	344,277
Rural						
Consumption	82,132	93,924	123,953	146,780	181,866	211,671
Losses	48,229	52,191	68,863	54,163	67,105	62,521
Demand	130,361	146,115	192,816	200,907	249,071	274,192
Max. Daily Demand	162,954	182,645	241,022	251,178	311,216	342,741
Total						
Consumption	162,604	182,220	231,837	283,572	351,678	418,238
Losses	101,876	111,053	140,787	112,790	139,880	131,376
(%) **	(39)	(38)	(38)	(28)	(28)	(24)
Demand	264,480	293,273	372,624	396,326	491,658	549,614
Max. Daily Demand	330,606	366,595	465,782	495,454	614,451	687,018

* Including non-domestic demands.

** Percentage of losses to demands.

3.3.3 Water Demand

The water demand is the quantity of water to be supplied by the system: it consists of the water consumption and the losses of the system. For the study, the following assumptions are made on the losses of the water supply systems in the Governorate:

Table-3.3.9 SYSTEM LOSSES

(% of Water Demand)

Water Supply Undertaking	Current	Target		
		by 1985	by 1995	by 2005
Housing Dept.	30	25	20	18
Abbassa System	40	40	30	25
City-owned Systems	40	40	30	25

Thus the demand is obtained by combining the water consumption and the system losses, and it is shown in Table-3.3.7 Water Demands.

In estimating the maximum daily demands, the peaking factor is assumed as 1.25 for both the urban and rural demands. Refer to Table-3.3.7 and Fig-3.3.2 for the maximum daily demands. For further detailed maximum daily demands by Markaz, see Table-3.3.8 Maximum Daily Demands. The consumptions, losses, and water demands are shown in Fig-3.3.2 Water Demands.

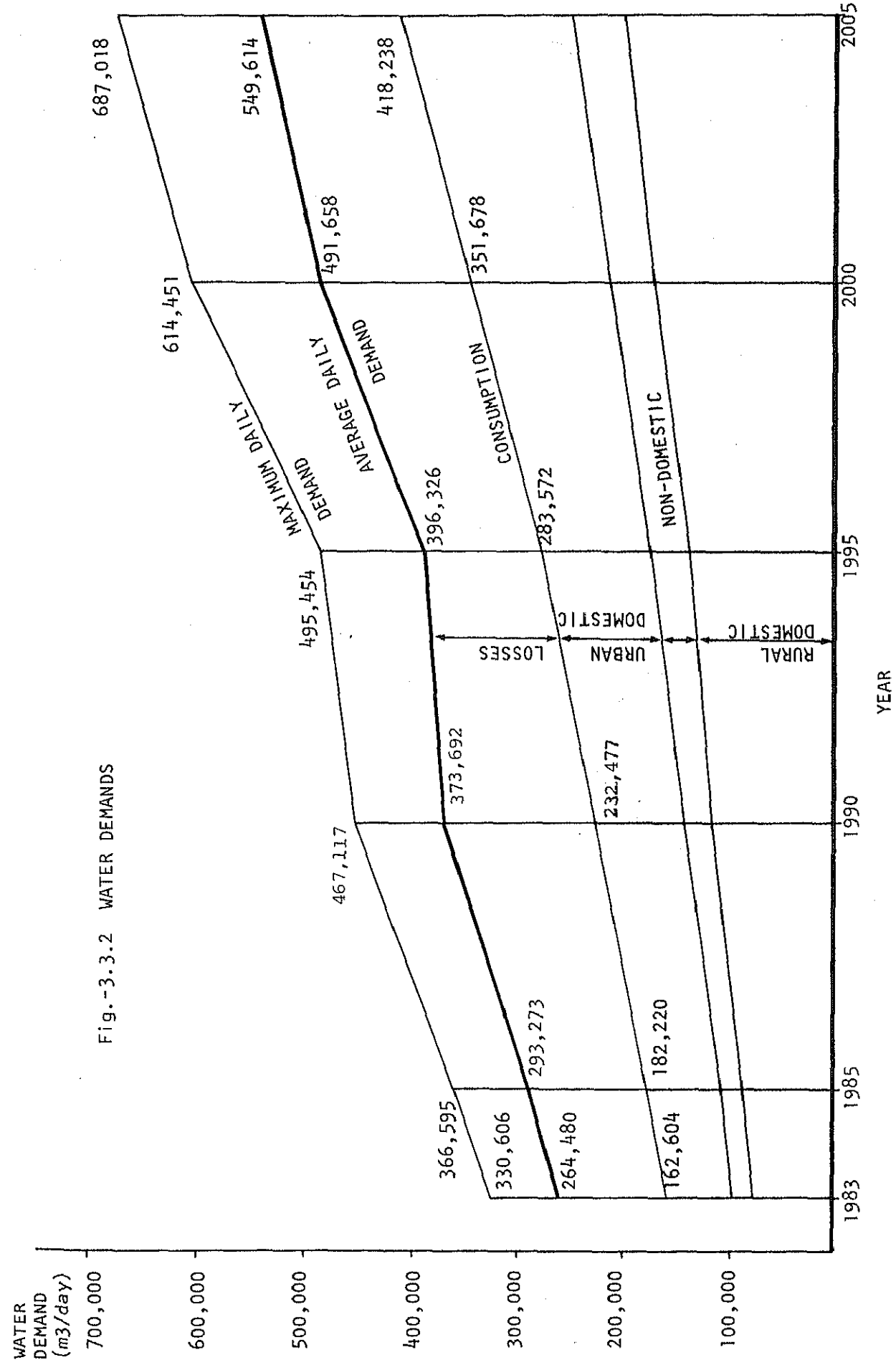


Fig.-3.3.2 WATER DEMANDS

Table-3.3.8 MAXIMUM DAILY DEMANDS

(m3/day)

MARKAZ		1983	1985	1990	1995	2000	2005
1. EL ZAGAZIG	U.	70,881	78,216	96,688	106,995	134,830	154,200
	R.	25,865	29,644	39,138	39,696	49,118	53,338
	T.	96,746	107,860	135,826	146,691	183,948	207,538
2. EL HUSEINIYA	U.	3,798	4,088	4,691	5,496	6,483	7,391
	R.	15,321	17,487	23,171	23,505	29,091	31,568
	T.	19,119	21,575	27,862	29,001	35,574	38,959
3. KAFR SAQR	U.	3,560	3,848	4,621	4,863	5,834	6,570
	R.	15,917	18,128	23,890	24,341	30,145	32,755
	T.	19,477	21,976	28,511	29,204	35,979	39,325
4. FAQUS	U.	11,259	12,178	14,890	15,974	21,329	24,086
	R.	20,892	23,855	31,454	31,966	39,525	43,047
	T.	32,151	36,063	46,344	47,940	60,854	67,133
5. ABU KEBIR	U.	15,188	16,416	21,556	22,629	27,271	30,304
	R.	9,550	10,984	14,527	14,625	18,234	19,792
	T.	24,738	27,400	36,083	37,254	45,505	50,096
6. ABU HAMMAD	U.	4,511	4,810	5,594	5,918	6,914	7,596
	R.	14,923	17,169	22,571	22,879	28,354	30,875
	T.	19,434	21,979	28,165	28,797	35,268	38,471
7. IBRAHIMIYA	U.	4,748	5,050	5,838	6,129	7,346	8,009
	R.	4,378	5,013	6,603	6,686	8,327	9,005
	T.	9,126	10,063	12,441	12,815	15,673	17,014
8. HIHYA	U.	5,698	6,254	7,784	8,454	10,155	11,499
	R.	7,163	8,210	10,804	10,970	13,596	14,745
	T.	12,861	14,464	18,588	19,424	23,751	26,244
9. DIARB NIGM	U.	5,459	6,254	7,081	7,820	9,508	10,676
	R.	11,511	12,285	16,232	18,008	22,319	25,433
	T.	16,970	18,539	23,313	25,828	31,827	36,109
10. BILBEIS	U.	21,706	23,978	28,646	30,950	38,339	43,255
	R.	14,838	15,782	20,842	23,126	28,775	32,584
	T.	36,544	39,760	49,488	54,076	67,114	75,839
11. MINYET EL QAMH	U.	9,688	10,591	12,994	13,829	17,076	20,980
	R.	18,930	20,133	26,604	29,616	36,630	41,544
	T.	28,618	30,724	39,598	43,445	53,706	62,524
12. MASHTUL EL SOAK	U.	5,459	6,013	7,296	7,399	8,859	9,650
	R.	3,666	3,925	5,186	5,760	7,102	8,055
	T.	9,125	9,938	12,482	13,159	15,961	17,705
13. EL QENAYAT	U.	5,698	6,254	7,081	7,820	9,291	10,061
TOTAL	U.	167,652	183,950	224,760	244,276	303,235	344,277
	R.	162,954	182,645	241,022	251,178	311,216	342,741
	T.	330,606	366,595	465,782	495,454	614,451	687,018

3.3.4 New Requirement of Supply Capacity

Comparing the future water demand shown in the preceding section and the existing supply capacity, future requirement of water supply capacity which shall be newly developed is summarized in Table-3.3.9 and illustrated in Fig.-3.3.3.

According to the result of the demand study, total water demand in the whole governorate, in daily maximum basis, is:

- 495,400 m^3/day in the year 1995, and
- 687,000 m^3/day in the year 2005.

On the other hand, existing water supply capacity is:

- 226,900 m^3/day.

Therefore, in the future, water requirement to be newly developed is:

- 268,500 m^3/day by the year 1995, and
- 460,100 m^3/day by the year 2005.

Table-3.3.9 Future Water Requirement to be Developed

(Unit: m^3/day)

Markaz		Existing Capacity	Future Water Demand (Daily Maximum)		Requirement to be Newly Developed	
		1983	1995	2005	by 1995	by 2005
1) Zagazig	Urban	40,867	106,995	154,200	66,128	113,333
	Rural	20,584	39,696	53,338	19,112	32,754
2) Huseiniya	Urban	600	5,496	7,391	4,896	6,791
	Rural	7,903	23,505	31,568	15,602	23,665
3) Kafr Saor	Urban	1,500	4,863	6,570	3,363	5,070
	Rural	10,419	24,341	32,755	13,922	22,336
4) Faqus	Urban	9,504	15,974	24,086	6,470	14,582
	Rural	16,991	31,966	43,047	14,975	26,056
5) Abu Kebir	Urban	5,103	22,629	30,304	17,526	25,201
	Rural	13,876	14,625	19,792	4,358	5,916
6) Abu Hammad	Urban	1,500	5,918	7,596	4,418	6,096
	Rural	24,598	22,879	30,875	-	6,277
7) Ibrahimiya	Urban	1,663	6,129	8,009	4,466	6,346
	Rural	5,078	6,686	9,005	1,608	3,927
8) Hihya	Urban	3,294	8,454	11,499	5,160	8,205
	Rural	7,726	10,970	14,745	3,244	7,019
9) Diarb Nigm	Urban	3,679	7,820	10,676	4,141	6,997
	Rural	5,382	18,008	25,433	12,626	20,051
10) Bilbeis	Urban	14,256	30,950	43,255	16,694	28,999
	Rural	11,335	23,126	32,584	11,791	21,249
11) Minyet el Qamh	Urban	4,666	13,829	20,980	9,163	16,314
	Rural	11,380	29,616	41,544	18,236	30,164
12) Mashtul el Soak	Urban	1,944	7,399	9,650	5,455	7,706
	Rural	1,404	5,760	8,055	4,356	6,651
13) Qenayat	Urban	1,674	7,820	10,061	6,146	8,387
TOTAL	Urban	90,250	244,276	344,277	154,026	254,027
	Rural	136,676	251,178	342,741	114,502	206,065
	Total	226,926	495,454	687,018	268,528	460,092

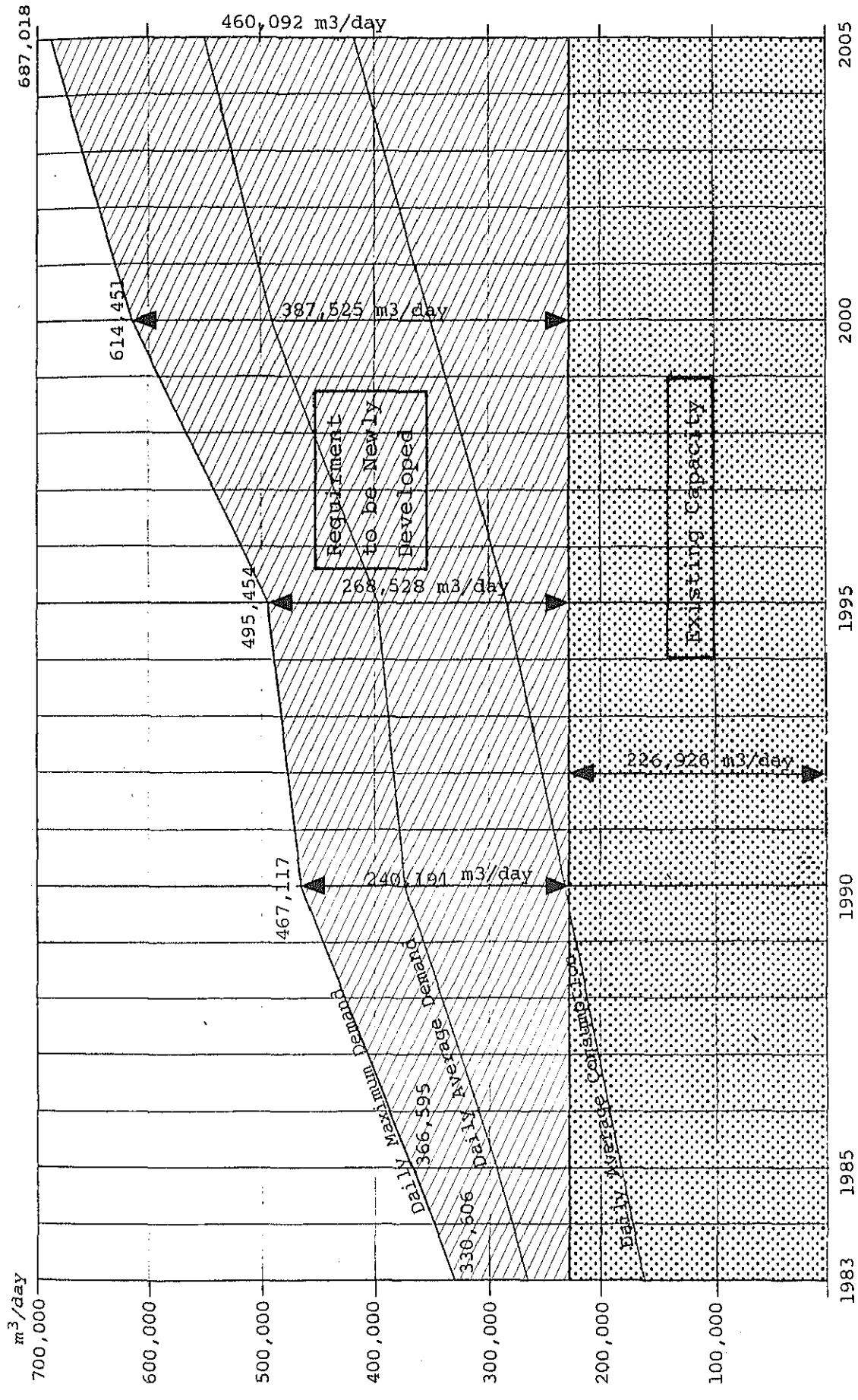


Fig-3.3.3 FUTURE WATER REQUIREMENT

(Unit : m3/day)

3.4 Water Sources

3.4.1 Outline of Water Sources

As reported in the Working Paper No.1 "Water Resources Study", in the study area water sources are abundantly available. As for surface water there are many canals flowing in the Governorate, and as for groundwater the area is blessed with aquifers throughout the Governorate.

Selection of water sources for the present planning will be made, taking into consideration the following:

1) Some portion of canals are polluted receiving domestic and agricultural wastewater.
2) Groundwater in the northern area contains salinity and is not suitable for water supply use.
3) Groundwater at some places contains iron and manganese and requires treatment to remove them.

3.4.2 Canal Water

In the Governorate several large canals with enough discharge are flowing. From a view point of water quality, canals which are considered feasible as water source for treatment are shown in Fig-3.4.1, and listed below:

Table-3.4.1 Canals with Suitable Quality

Name of Canal	Discharge	Remarks
1) Ismailiya Canal	332.0 m3/sec	- Flowing throughout the year.
2) Sulheiya Canal	83.3 m3/sec	- Under construction. - Not available for water supply use.
3) Saidiya Canal	35.0 m3/sec (Max) 10.5 " (Min)	- Not available in January.
4) Abu el Akhdar Canal	46.3 m3/sec (Max) 13.8 " (Min)	- Not available in January.
5) Muweis Canal	111.1 m3/sec (Max) 23.1 " (Min)	- Not available in January.

The canals 3), 4), and 5) are originally constructed for irrigation purpose and maintained by the Irrigation Authority. During winter season, for maintenance work the flow is scheduled to be stopped (about 3 weeks in January), unless particular agreement/approval of the authority is made.

As for treatment of the canal water, the conventional treatment method of rapid sand filtration is recommended. Process of the method is : coagulation + sedimentation + rapid sand filtration + chlorination.

Regarding the sedimentation in the above process, currently employed facilities of clarifiers seem uneffective so much for coagulation and sedimentation. For the new treatment plants, horizontal-flow type of sedimentation basin is recommendable.

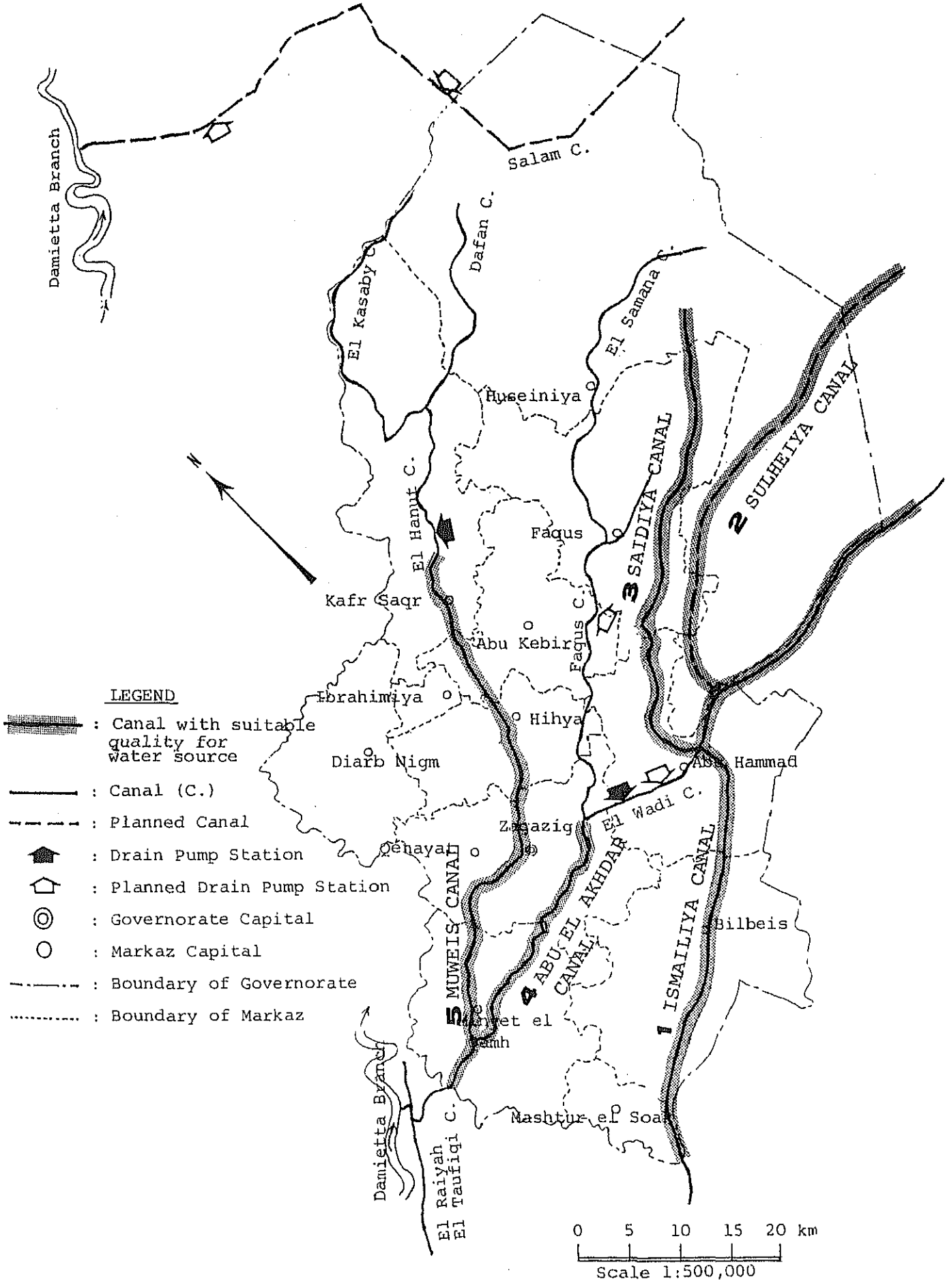


Fig-3.4.1 CANALS WITH SUITABLE QUALITY FOR WATER SOURCE

3.4.3 Groundwater

Area where potable groundwater is available is shown Fig-3.4.2. As the result of the field survey, it is found that in the above area drinkable groundwater is obtainable under the following condition:

- Distance between two wells : Not less than 500 meters, and
- Discharge of a well : 30 - 25 l/sec.

As for treatment of groundwater which contains high level of iron/manganese, please refer to 3.5.4.3 Unit System of a Groundwater Station.

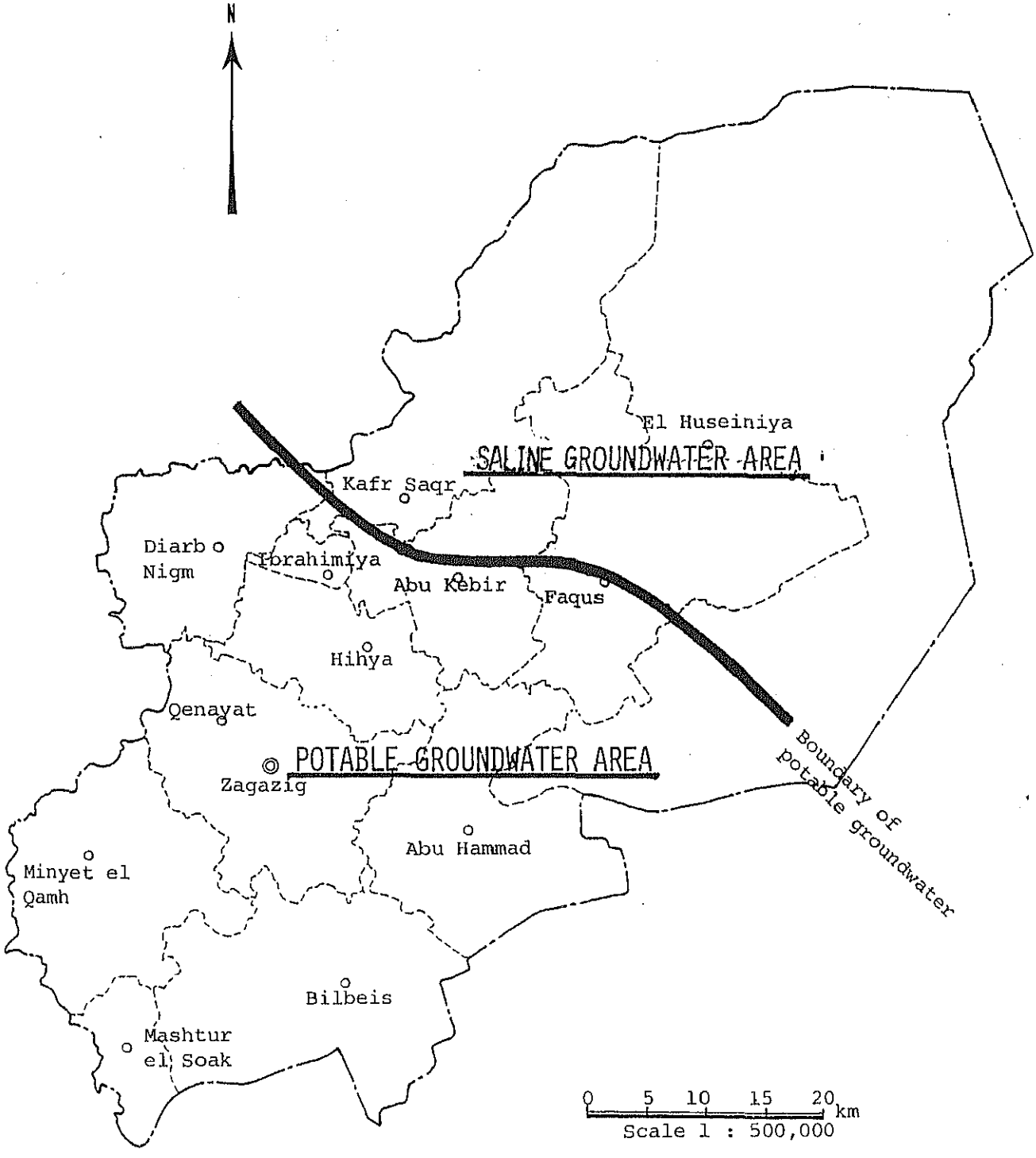


Fig-3.4.2 AREA OF POTABLE GROUNDWATER

3.5 Planning of Water Supply Systems

3.5.1. Future Water Demand

Water demand in the future, details of which are discussed in Working Paper No.5 "Population and Water Demand Forecast", is summarized below:

Table - 3.5.1 Summary of Future Water Demand

(Unit: m^3/day)

	Existing Capacity	Future Water Demand	
Year	1983	1995	2005
Urban Area	90,250	244,276	344,277
Rural Area	136,676	251,178	342,741
Total	226,926	495,454	687,018

From the above, water supply system in the Sharqiya Governorate will be expanded up to the magnitude of 2.2 times the present capacity by the year 1995; and 3.0 times by the year 2005.

Future water demand of urban area and rural area by each Markaz is shown in Table - 3.5.2.

Table - 3.5.2 Future Water Demand by Markaz

(Unit: m^3/day)

Markaz		Existing Capacity	Future Water Demand (Daily Maximum)	
		1983	1995	2005
1) EL ZAGAZIG	Urban	40,867	106,995	154,200
	Rural	20,584	39,696	53,338
2) EL HUSEINIYA	Urban	600	5,496	7,391
	Rural	7,903	23,505	31,568
3) KAFR SAQR	Urban	1,500	4,863	6,570
	Rural	10,419	24,341	32,755
4) FAQUS	Urban	9,504	15,974	24,086
	Rural	16,991	31,966	43,047
5) ABU KEBIR	Urban	5,103	22,629	30,304
	Rural	13,876	14,625	19,792
6) ABU HAMMAD	Urban	1,500	5,918	7,596
	Rural	24,598	22,879	30,875
7) IBRAHIMIYA	Urban	1,663	6,129	8,009
	Rural	5,078	6,686	9,005
8) HIHYA	Urban	3,294	8,454	11,499
	Rural	7,726	10,970	14,745
9) DIARB NIGM	Urban	3,679	7,820	10,676
	Rural	5,382	18,008	25,433
10) BILBEIS	Urban	14,256	30,950	43,255
	Rural	11,335	23,126	32,584
11) MINYET EL QAMH	Urban	4,666	13,829	20,980
	Rural	11,380	29,616	41,544
12) MASHTUL EL SOAK	Urban	1,944	7,399	9,650
	Rural	1,404	5,760	8,055
13) EL QENAYAT	Urban	1,674	7,820	10,061
TOTAL	Urban	90,250	244,276	344,277
	Rural	136,676	251,178	342,741
	Total	226,926	495,454	687,018

3.5.2 Concept of Future Development Plan

Between urban area and rural area, characteristics of water supply system such as magnitude of water demand and water sources are greatly different; therefore, development plan will be made separately.

3.5.2.1 Rural Area

The rural area consists of 429 villages distributed in 12 Marakaz. Water demand of each village is not large, and it has been found that the demand will be covered by groundwater except the northern area.

As the result of the study, future development plan for the rural area is summarized by category as follows and illustrated in Fig-3.5.1:

Category A

Villages which are presently supplied by the Housing Department system (water source = groundwater) will be supplied by groundwater development following the increase of water demand in the future at each groundwater station.

They are:

- All villages in Mashtul el Soak Markaz,
- All villages in Minyet el Qamh Markaz,
- All villages in Diarb Nigm Markaz,
- About a half of all villages in Zagazig Markaz,
- More than a half of all villages in Bilbeis Markaz,
- Some southwestern villages in Ibrahimiya Markaz, and
- Some villages in Hihya Markaz.

Category B

Villages which are presently supplied by Abbasa Treatment Plant (water source = Ismailiya Canal water) and located nearby the Abbasa Plant will be supplied by the plant with the existing capacity in the future as well.

They are:

- All villages in Abu Hammad Markaz,
- About a half of all villages in Abu Kebir Markaz,
- Some southern villages in Faqus Markaz,
- Some eastern villages in Zagazig Markaz,
- Some eastern villages in Abu Kebir Markaz, and
- Some eastern villages in Hihya Markaz.

Category C

Villages which are presently belonging to Abbasa System and are supplied with groundwater of the system will be supplied by groundwater, as far as it is available locally, through Abbasa distribution pipelines.

They are:

- About a half of all villages in Bilbeis Markaz,
- About a half of all villages in Zagazig Markaz,
- More than a half of all villages in Hihya Markaz,
- More than a half of all villages in Ibrahimiya Markaz, and
- More than a half of all villages in Abu Kebir Markaz.

Category D

Villages which are located in the northern area of the Sharqiya Governorate where groundwater is not drinkable due to salinity and canal water is highly polluted will be supplied with treated water of new trewtment plants.

They are:

- All villages in Kafr Saqr Markaz,
- All villages in Huseiniya Markaz, and
- Almost of all villages in Faqus Markaz.

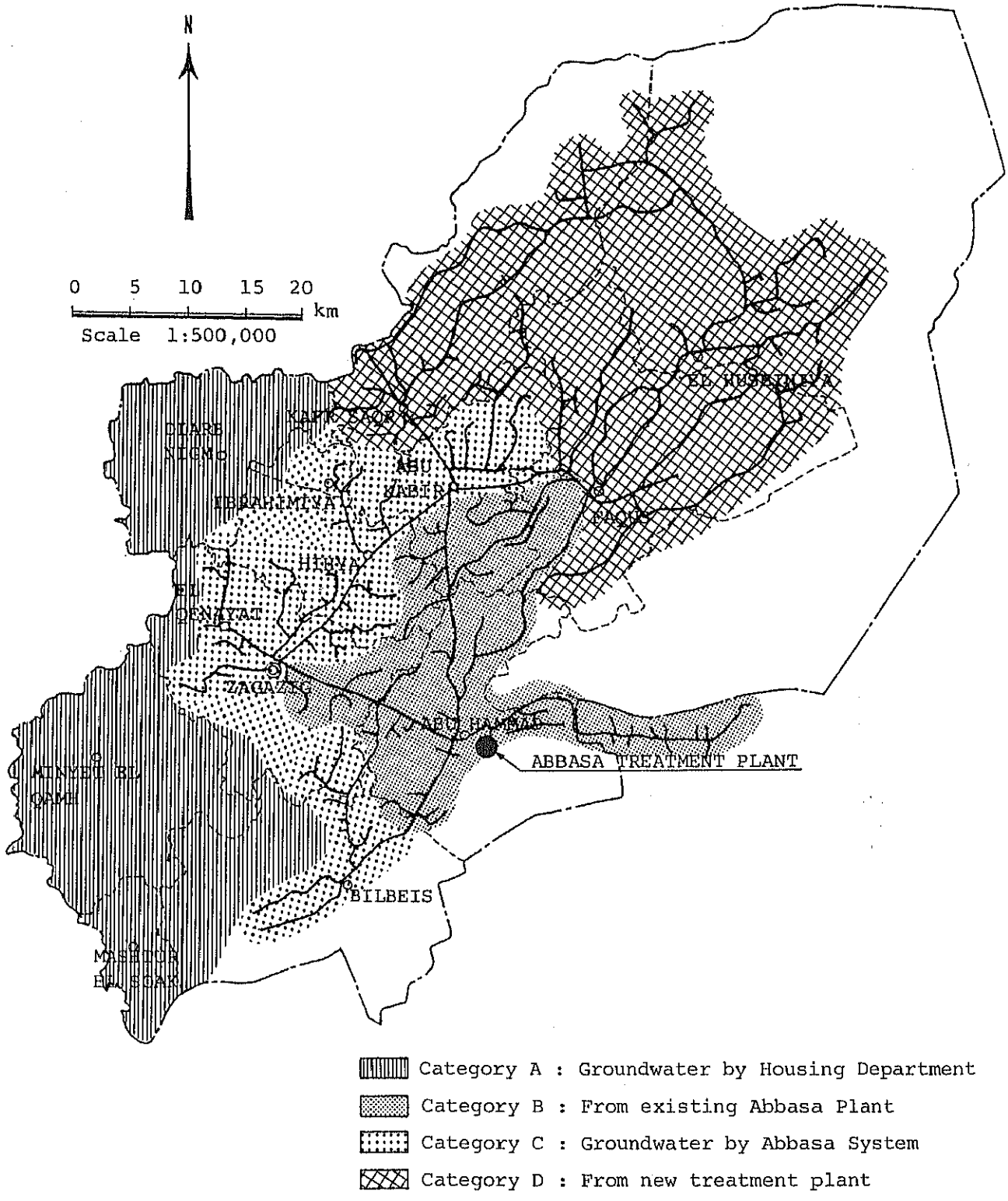


Fig-3.5.1 FUTURE WATER SUPPLY DEVELOPMENT PLAN OF RURAL AREA

3.5.2.2 Urban Area

Urban area consists of 12 cities, Markaz capitals, and one town.

As the result of the study, future development plan for the urban municipalities is summarized by category as follows :

Category K

The city which is presently supplied by Abbasa Treatment Plant (water source = Ismailia Canal water) will be continuously supplied by the existing plant in the future.

It is:

- Abu Hammad City.

Category L

Cities/town which, presently supplied by local groundwater, have not so large water demand, will be supplied by groundwater development at each municipality.

They are:

- Mashtul el Soak City,
- Minyet el Qamh City,
- Diarb Nigm City,
- Ibrahimiya City,
- Hihya City, and
- Qenayat Town.

Category M

Cities with rather large water demands and their own water sources will be supplemented by new treatment plants.

They are:

- Zagazig City,
- Bilbeis City,
- Faqus City, and
- Abu Kebir City.

Category N

Cities located in the northern area where groundwater is not drinkable due to salinity will be supplied by new treatment plants.

They are:

- Huseiniya City, and
- Kafr Sagr City.

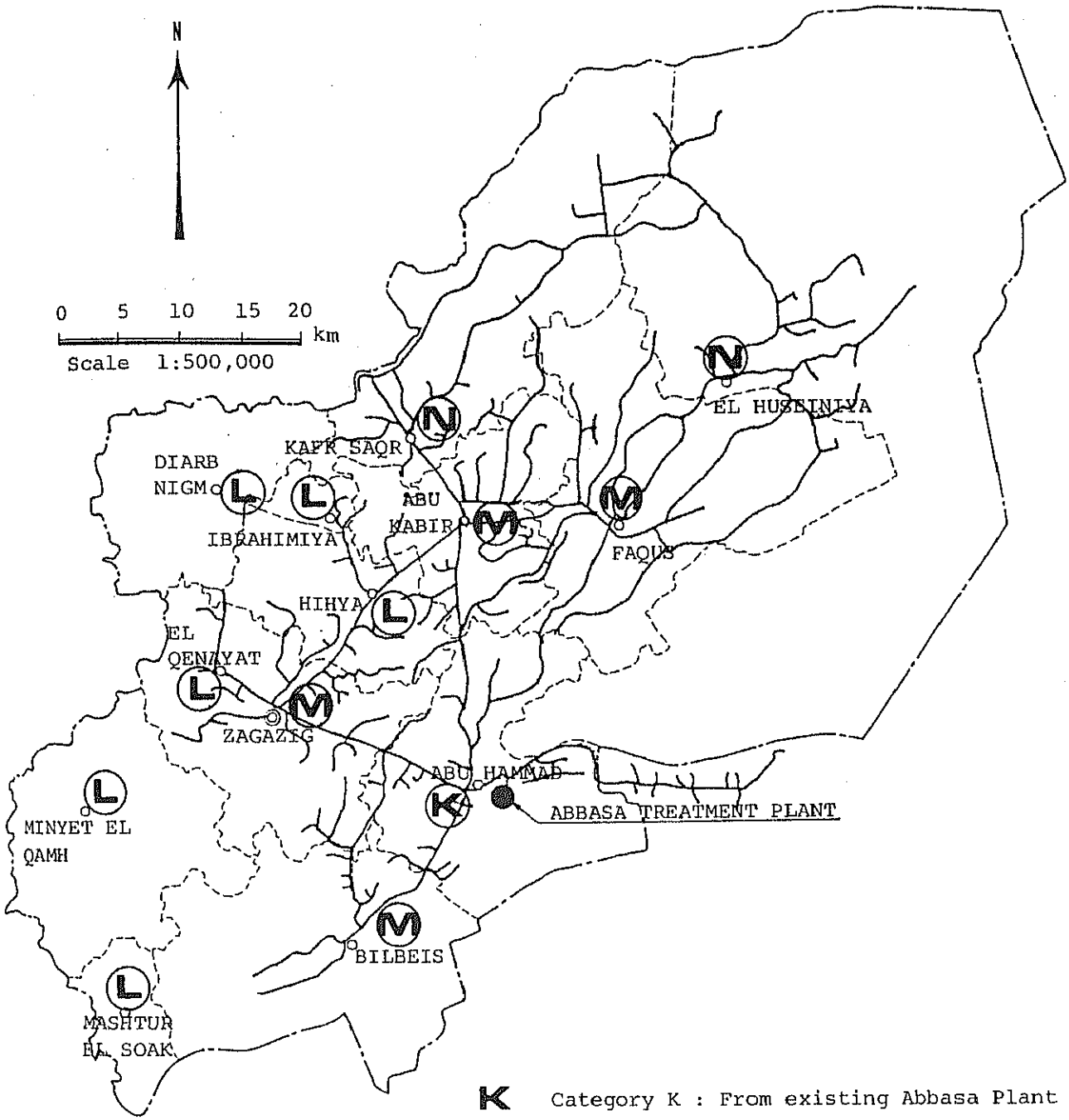


Fig-3.5.2 FUTURE WATER SUPPLY DEVELOPMENT PLAN OF URBAN MUNICIPALITIES