3.5.3 Plan of New Treatment Plant

The study of the future water supply development made in the preceding section requires construction of new water treatment plants.

The planning of the new plants will be studied in the following:

3.5.3.1 Areas and Required Capacity

The areas to be covered by the new treatment plants will be the municipalities of the Categories D, M and N as defined in the preceding section. Some municipalities belonging to Category M will have their-own water sources and the future water demand over city-owned water source will be supplemented by the new plant.

Municipalities to be supplied by the new plants are listed below:

Table-3.5.3 Areas and Required Capacity by the New Treatment Plants (Year: 2005)

(m^3/day)

Category	Municipality	Water Demand in 2005	City-Owned Water Source in 2005	Balance to be Met by New Treatment Plant
M	Zagazig City	154,200	25,000	129,200
	Bilbeis City	43,255	12,000	31,255
	Faqus City	24,086	10,000	14,086
	Abu Kebir City	30,304	10,000	20,304
N	Huseiniya City	7,391	-	7,391
	Kafr Saqr City	6,570	-	6,570
D	Villages in Kafr Saqr Markaz	32,755	-	32,755
	Villages in Huseiniya Markaz	31,568	-	31,568
	Villages in Faqus Markaz	43,047 x 83%	-	3 5,730
	Total Capacity of New Plants			308,859

3.5.3.2 Alternative Study of New Treatment Plant Construction

Water source of the new treatment plants will be surface water of large canals which flow in the Shargiya Governorate. As alternative plans for new treatment plans, the following two major cases will be studied, namely, Case A. Ismailiya canal which has a perennial large flow, and Case B, other canals which are located close to the water consuming municipalities. Further the Cases will be studied in plural sub-cases.

As the result of technical preliminary study, the following seven alternatives of construction sites of new treatment plants were planned.

They are:

Case A-1: One integrated plant at Bilbeis (Ismailiya Canal water),

Case A-2: One integrated plant at Abbasa (Ismailiya Canal water),

or,

Case B-1: One integrated plant at Zagazig (Muweis Canal water),

Case B-2: Two plants,

1) Northeast site of the Governorate (Saidiya Canal water)
2) Zagazig (Muweis Canal water)

Case B-3: Three plants,

1) Northeast (Saidiya Canal water)
2) Zagazig (Muweis Canal water)
3) Bilbeis (Ismailiya Canal water)

Case B-4: Three plants,

1) Kafr Saqr (Muweis Canal water)
2) Zagazig (Muweis Canal water)
3) Bilbeis (Ismailya Canal water)

Case B-5: Four plants,

1) Kafr Saqr (Muweis Canal water)
2) Northeast (Saidiya Canal water)
3) Zagazig (Muweis Canal water)
4) Bilbeis (Ismailya Canal water)

Above plans are shown in the following pages.

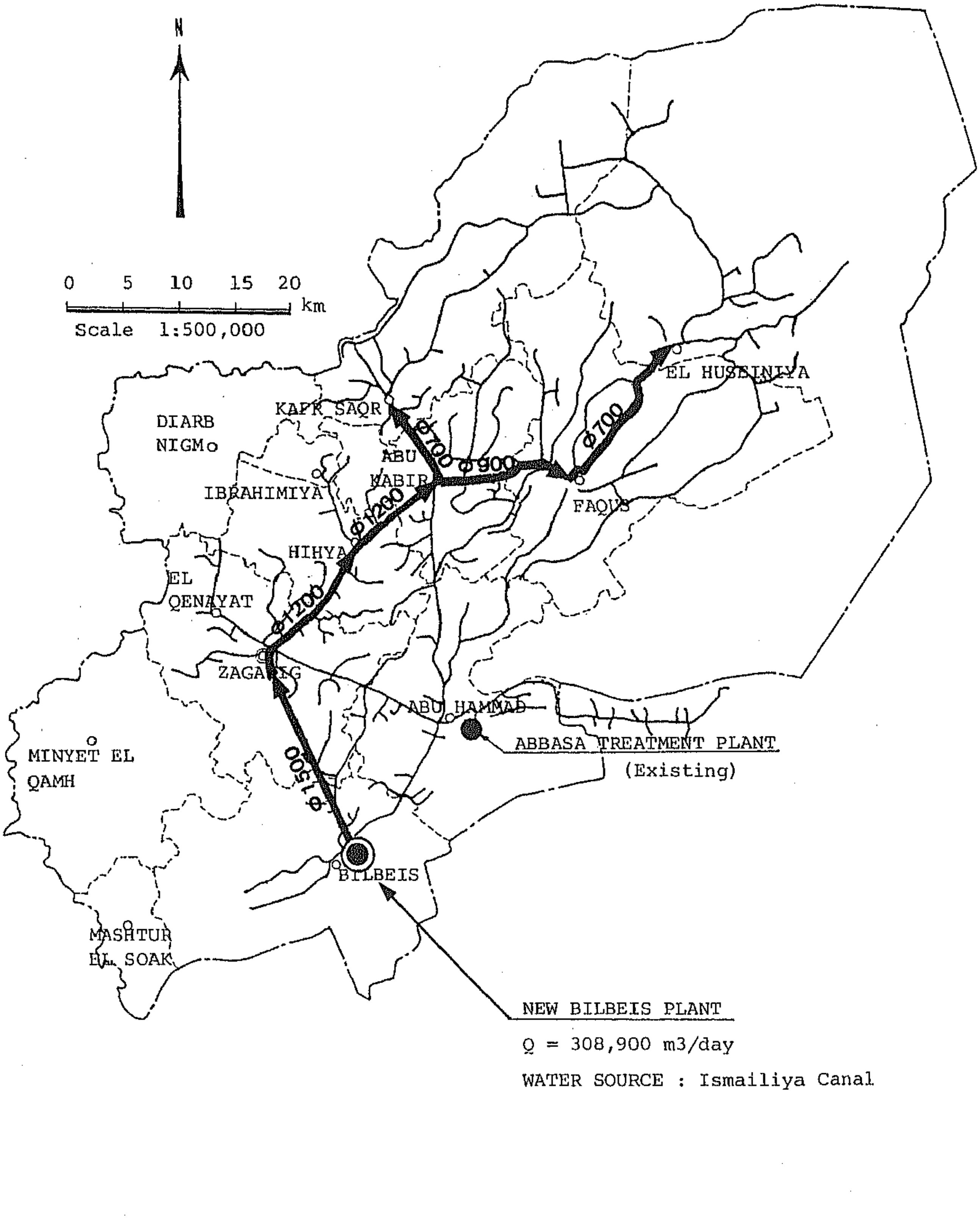


Fig-3.5.3 ALTERNATIVE PLAN OF NEW TREATMENT PLANT, CASE A-1

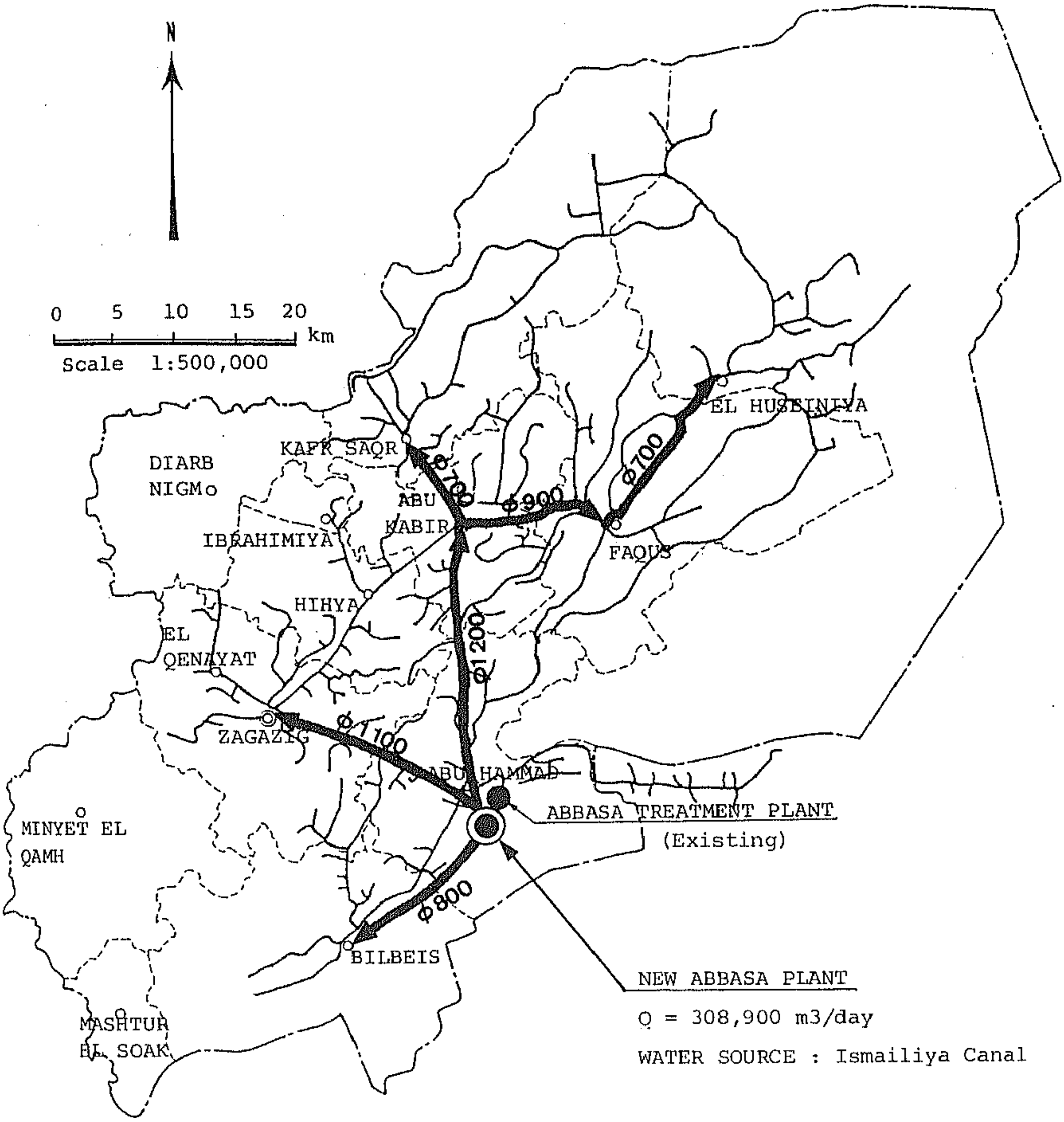


Fig-3.5.4 ALTERNATIVE PLAN OF NEW TREATMENT PLANT, CASE A-2

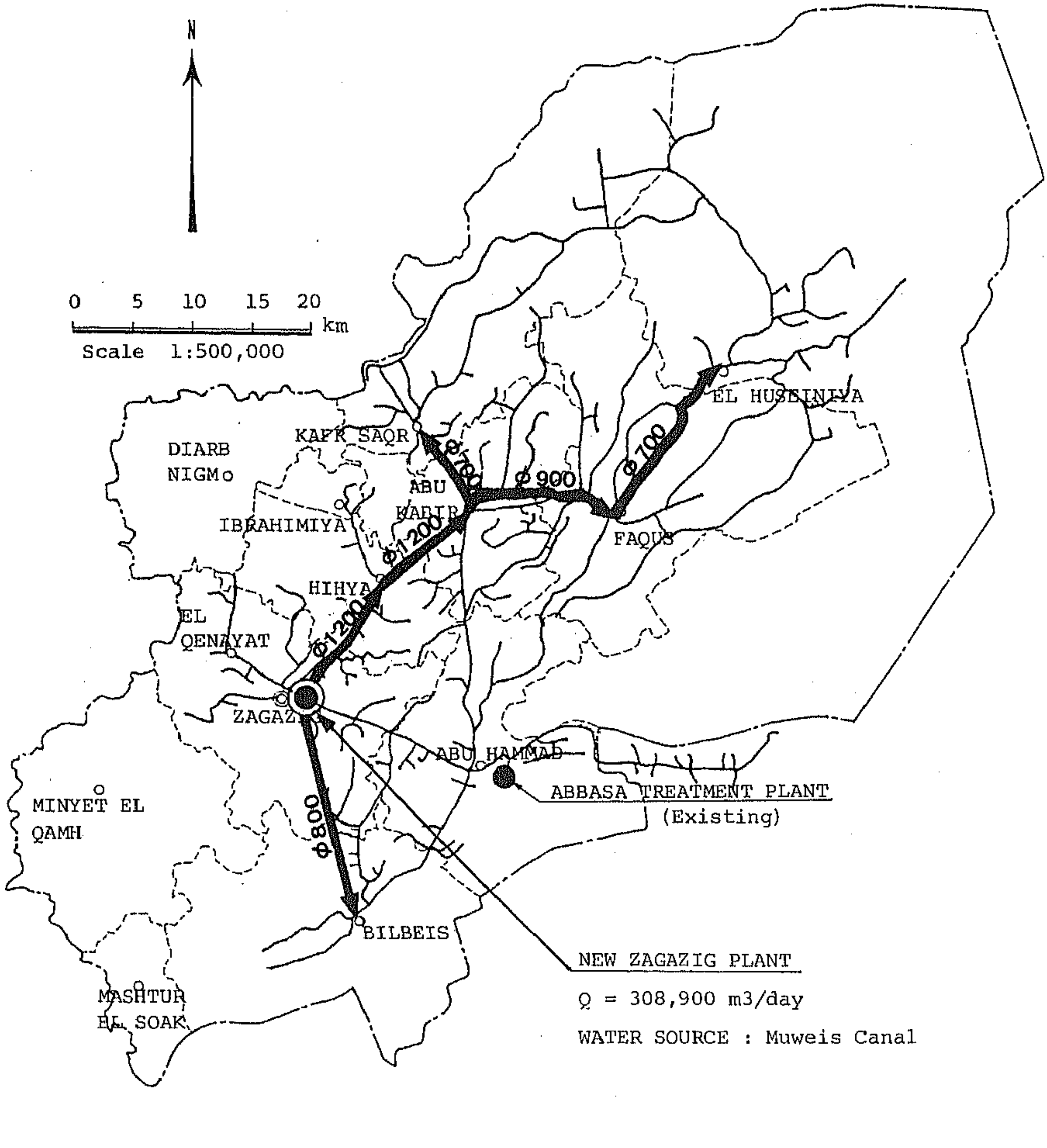


Fig-3.5.5 ALTERNATIVE PLAN OF NEW TREATMENT PLANT, CASE B-1

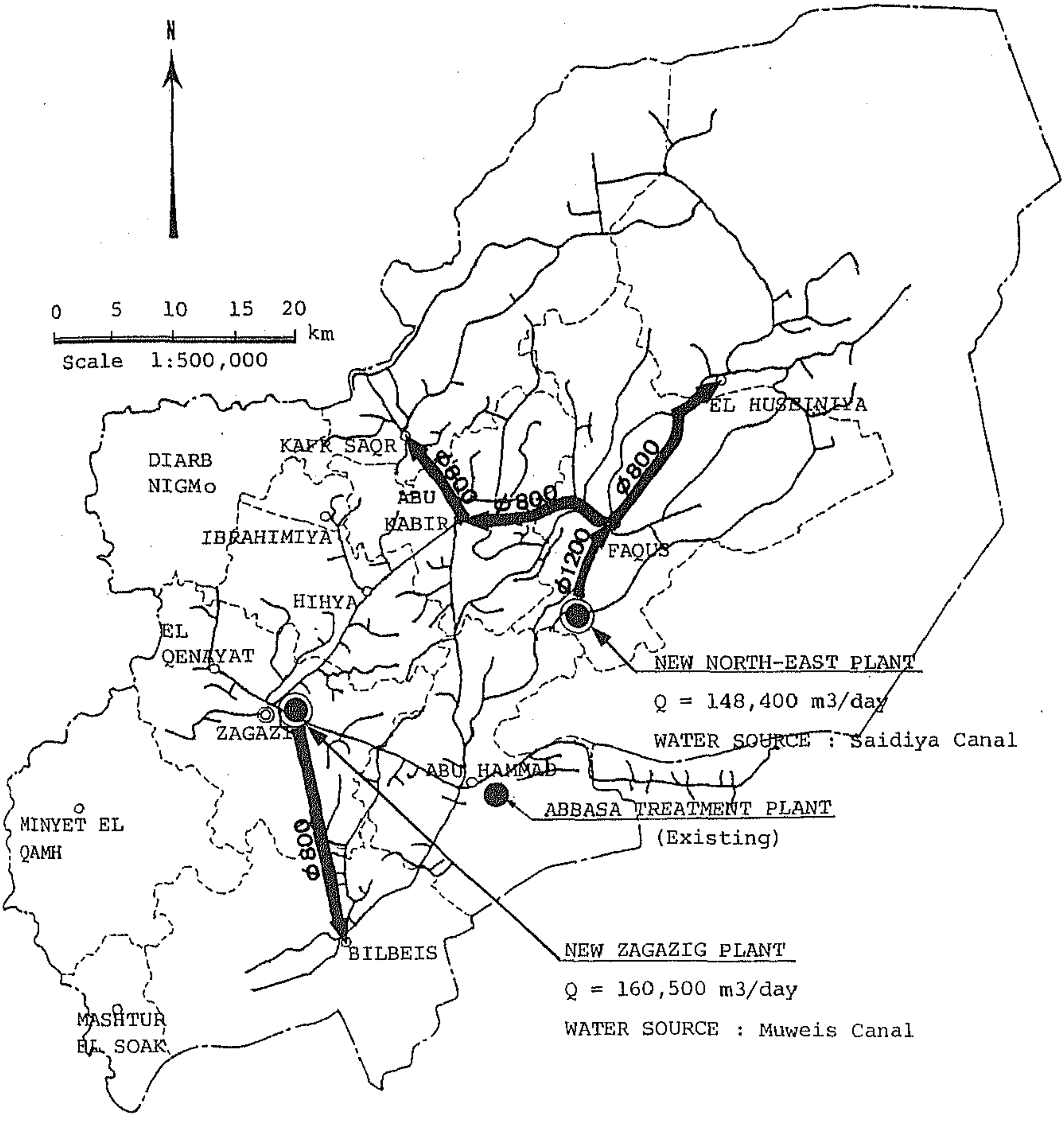


Fig-3.5.6 ALTERNATIVE PLAN OF NEW TREATMENT PLANT, CASE B-2

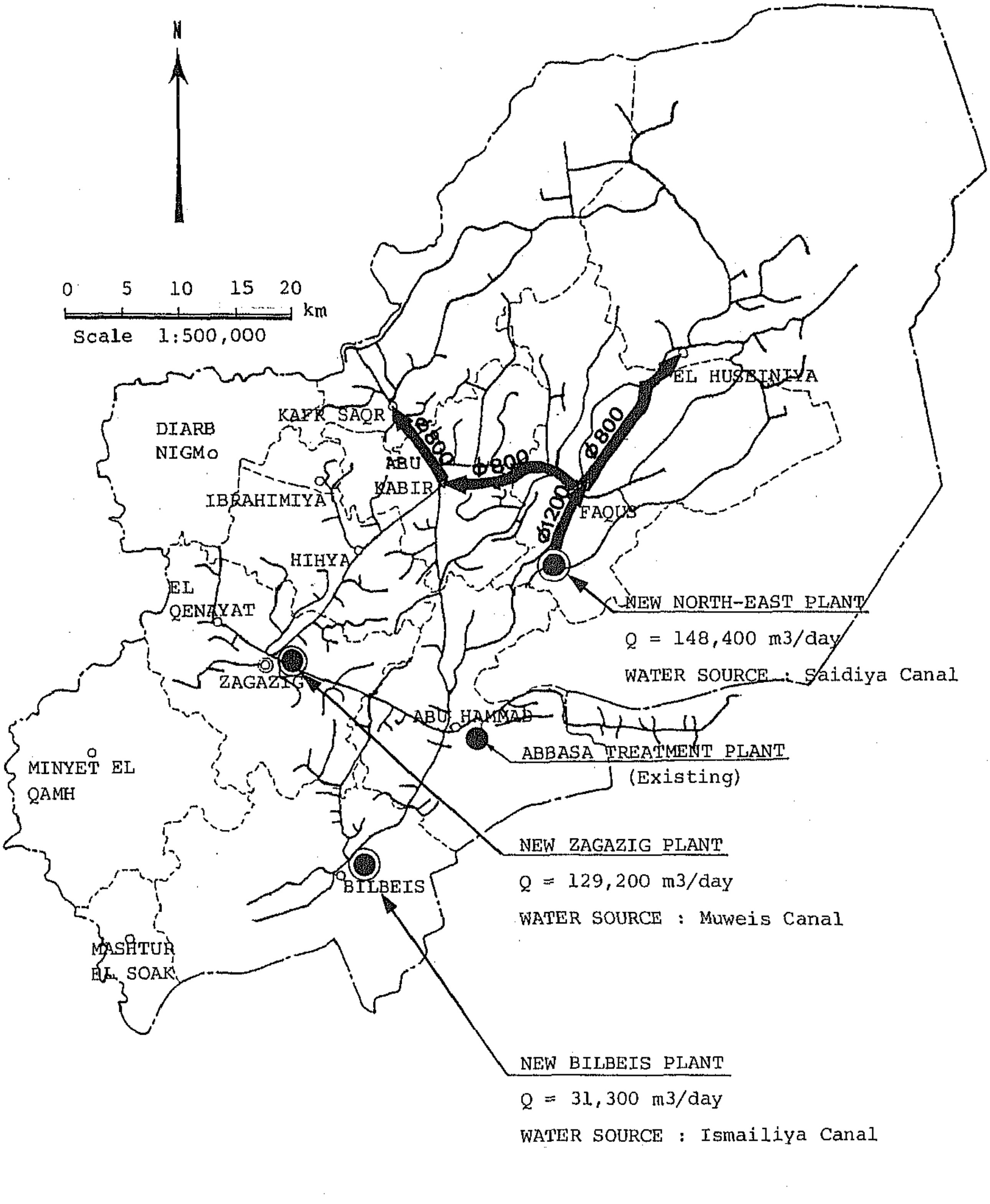


Fig-3.5.7 ALTERNATIVE PLAN OF NEW TREATMENT PLANT, CASE B-3

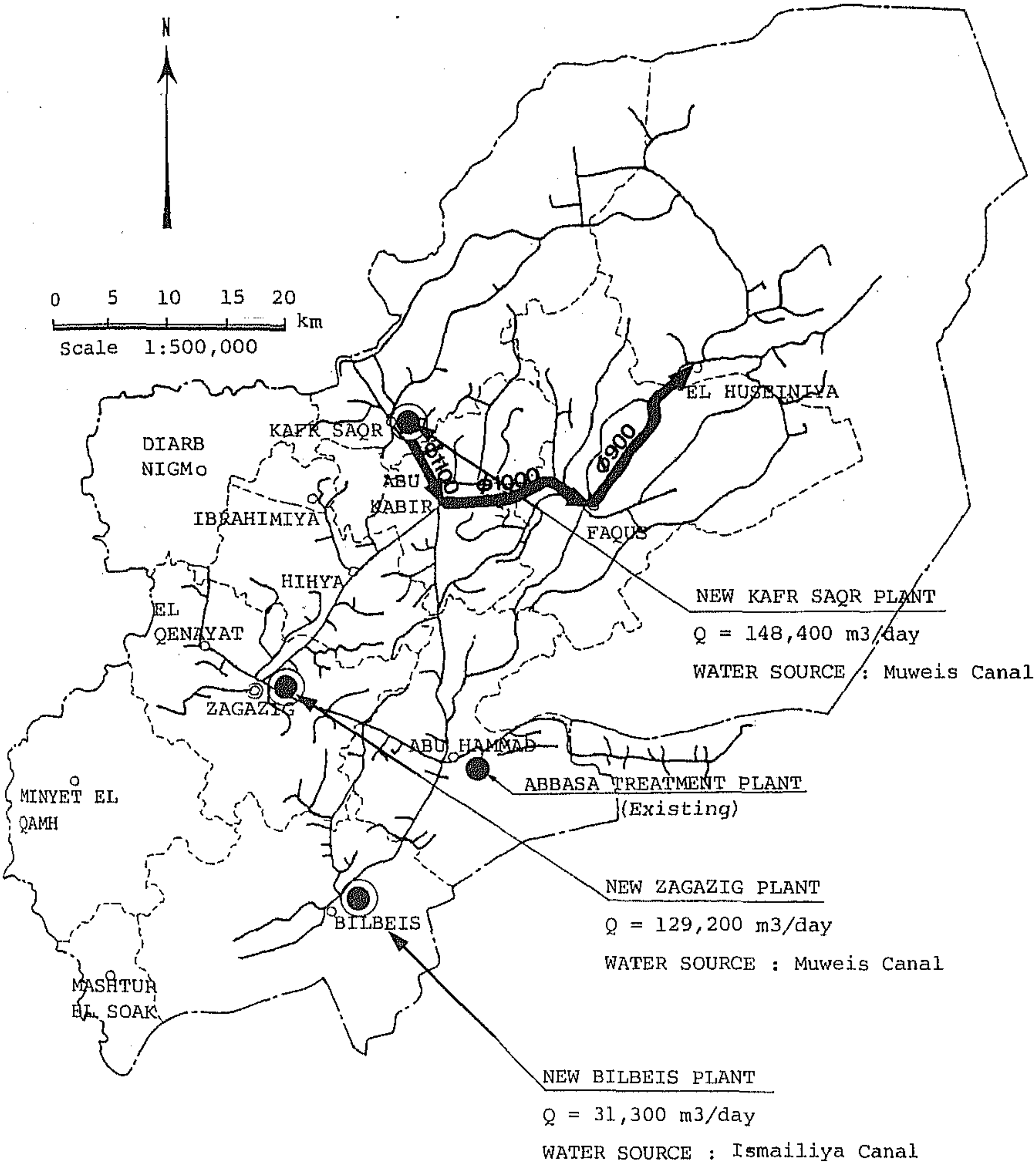


Fig-3.5.8 ALTERNATIVE PLAN OF NEW TREATMENT PLANT, CASE B-4

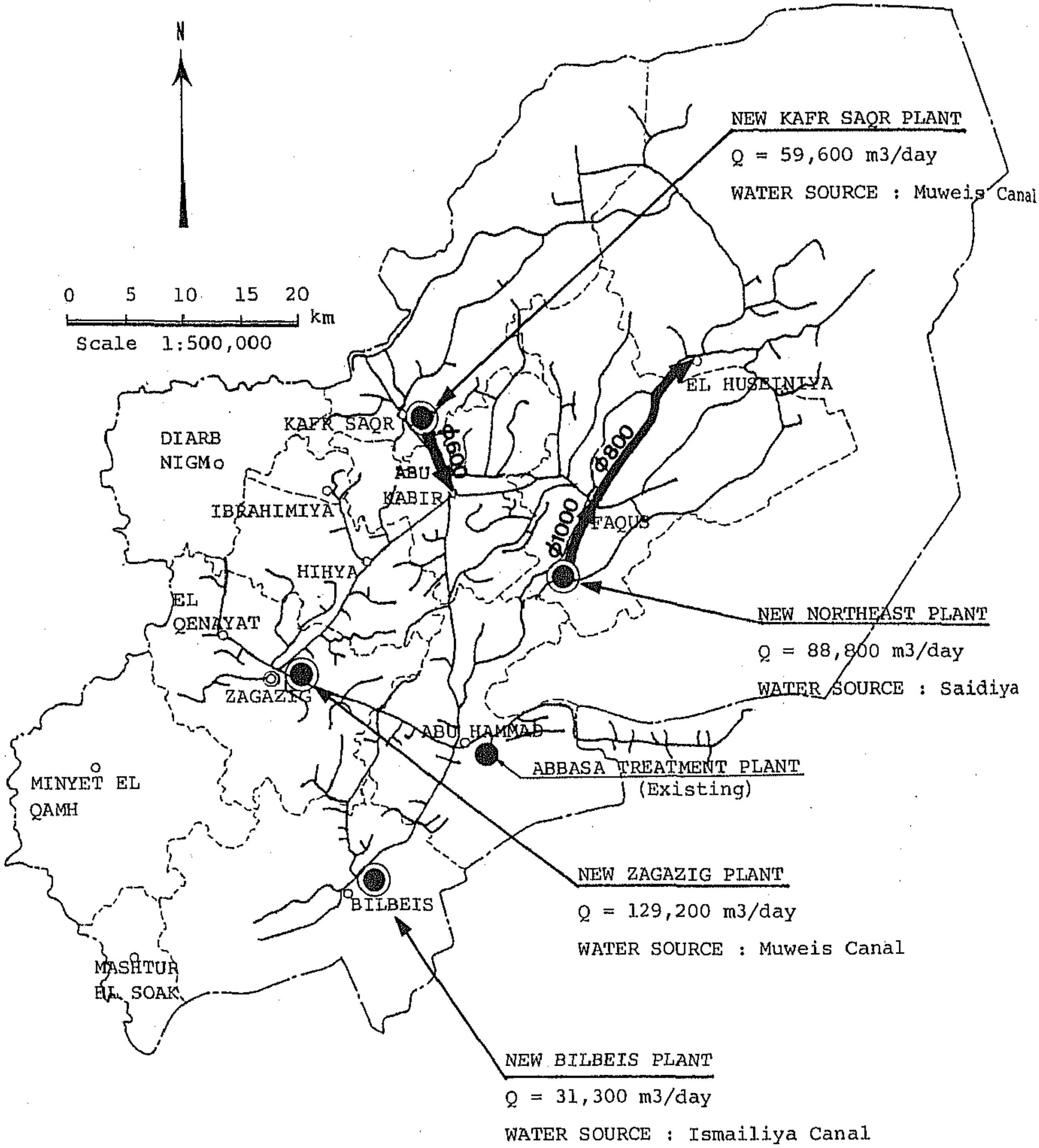


Fig-3.5.9 ALTERNATIVE PLAN OF NEW TREATMENT PLANT, B-5

3.5.3.3 Comparison of the Alternative Plans

From the general point of view, the seven alternative plans are preliminarily evaluated as follows:

Table-3.5.4 Comparison of the Alternative Plans

Item \ Case	A-1	A-2	B-1	B-2	B-3	B-4	B-5
Construction cost (Million LE) 1/	151	150	125	120	117	123	115
Electric power required (kW)							
Total	11,730	10,046	8,632	6,593	6,593	3,509	4,958
Intake pumps	522	522	522	531	504	255	258
Plant operation	1,530	1,310	1,126	860	860	458	647
Distrubution pumps & booster pumps	9,678	8,214	6,984	5,202	5,229	2,796	4,053
Number of personnel for plant operation	109	108	105	198	273	271	365
Operation cost (Million LE) 2/	3.1	2.9	2.8	2.7	2.8	2.5	2.7
Present worth (Million LE) 3/	104.3	103.9	87.9	86.2	85.4	86.1	85.0
Phase-wise construction method	Difficult			Easier			
Water source	Available throughout the year		Approval of the canal authority is required.				

Note: 1/ 1984 prices, including transmission pipelines costs, and excluding distribution and service mains' costs.

2/ Operation cost at the final stage.

3/ Present worth for 20 years and 6% of discount rate.

3.5.3.4 Cost Comparison

The most important factors for evaluation of the alternative plans are considered construction cost and availability of water source. In Egypt, water right and availability of water of canal water are controlled by the authority concerned; therefore, for evaluation of the alternative plans construction cost shall be taken up as high priority.

Construction cost of each alternative plan is shown in the following page. The table of construction costs is prepared for cost comparison purpose and excludes costs for distribution pipelines and groundwater station construction, since their costs are common among the seven alternative plans.

The costs as of 1984 consisting of treatment plant construction, transmission installation and booster pumping station construction are taken up below:

Case A-1: LE 151 Million
Case A-2: LE 150 Million
Case B-1: LE 125 Million
Case B-2: LE 120 Million
Case B-3: LE 117 Million
Case B-4: LE 123 Million
Case B-5: LE 115 Million

Note: LE: Egyptian Pounds
(Exchange rate: 1 US$ = 0.82 LE)

Table-3.5.5 COMPARISON OF CONSTRUCTION COSTS

(Unit : Thousand Egyptian Pounds)

Item	Case A-1		Case A-2		Case B-1		Case B-2		Case B-3		Case B-4		Case B-5	
	Description	Cost	Description	Cost	Description	Cost	Description	Cost	Description	Cost	Description	Cost	Description	Cost
Treatment Plant	Bilbeis Plant (308,900m3/d)	70,400	Abbasa Plant (308,900m3/d)	70,400	Zagazig Plant (308,900m3/d)	70,400	Zagazig Plant (160,500m3/d)	43,771	Zagazig Plant (129,200m3/d)	35,500	Zagazig Plant (129,200m3/d)	35,500	Zagazig Plant (129,200m3/d)	35,500
							Northeast Plant (148,400m3/d)	40,300	Northeast Plant (148,400m3/d)	40,300	Kafr Saqr Plant (148,400m3/d)	40,300	Northeast Plant (88,800m3/d)	27,500
									Bilbeis Plant (31,300m3/d)	13,232	Bilbeis Plant (31,300m3/d)	13,232	Kafr Saqr Plant (59,600m3/d)	20,800
													Bilbeis Plant (31,300m3/d)	13,232
	Sub-Total	70,400	Sub-Total	70,400	Sub-Total	70,400	Sub-Total	84,071	Sub-Total	89,032	Sub-Total	89,032	Sub-Total	97,032
Booster Pumping Station	Zagazig Station	5,257	Zagazig Station	2,948	Abu Kebir Station	2,776	Abu Kebir Station	1,375	Abu Kebir Station	1,375	Faqus Station	4,102	Huseiniya Station	936
	Abu Kebir Station	2,785	Abu Kebir Station	2,776	Faqus Station	1,818	Huseiniya Station	936	Huseiniya Station	936				
	Faqus Station	1,818	Faqus Station	1,818	Huseiniya Station	936								
	Huseiniya Station	936	Huseiniya Station	936										
	Sub-Total	10,796	Sub-Total	8,478	Sub-Total	5,530	Sub-Total	2,311	Sub-Total	2,311	Sub-Total	4,102	Sub-Total	936
Transmission Pipeline	Pipeline ø1500-ø700x88.8 km	65,635	Pipeline ø1200-ø700x115.4 km	67,089	Pipeline ø1200-ø700x88.8 km	46,131	Pipeline ø1200-ø800x75.7 km	31,595	Pipeline ø1200-ø800x54.5 km	24,175	Pipeline ø1100-ø900x44.5 km	27,677	Pipeline ø1000-ø600x40.5 km	16,497
	Pipe Bridge L.S.		Pipe Bridge L.S.		Pipe Bridge L.S.		Pipe Bridge L.S.		Pipe Bridge L.S.		Pipe Bridge L.S.		Pipe Bridge L.S.	
	Valve, Air valve Drain & others	3,997	Valve, Air valve Drain & others	4,105	Valve, Air valve Drain & others	2,841	Valve, Air valve Drain & others	2,045	Valve, Air valve Drain & others	1,578	Valve, Air valve Drain & others	1,716	Valve, Air valve Drain & others	1,023
	Sub-Total	69,632	Sub-Total	71,194	Sub-Total	48,972	Sub-Total	33,640	Sub-Total	25,753	Sub-Total	29,393	Sub-Total	17,520
	Total	150,828	Total	150,072	Total	124,902	Total	120,022	Total	117,096	Total	122,527	Total	115,488

3.5.3.5 Conclusion

The plan of Case B-5 shows smallest in the construction cost and present worth as estimated in the preceding Table-3.5.4. In addition it has the largest number of treatment plants, by which it will be capable of diffusing unforeseeable risk in operation. Considering these matters, the plan of the Case B-5 is recommended for implementation.

It should be noted that water sources of the above plan (Case B-5) are surface water of Muweis Canal, Saidiya Canal and Ismailiya Canal. Therefore, year-round-continuous flow of the canals shall be assured by the authorities concerned.

3.5.4 Groundwater Development Plan

3.5.4.1 Existing Groundwater Production

In the Sharqiya Governorate, there exist numerous groundwater stations which can be classified into three categories.

They are:

1) *Housing Department System*
   82 stations (Total production = 27,211 m^3/day)
2) Abbasa System's groundwater stations
   15 stations (Total production = 64,109 m^3/day)
3) City-owned groundwater stations
   43 stations (Total production = 62,512 m^3/day)

Total = 140 stations with 153,832 m^3/day

In principle, above existing groundwater stations will be used continuously in the future years, by periodical rehabilitation or replacement work.

3.5.4.2 Groundwater to be Developed

In addition to the above, new groundwater stations will be developed to meet water demand increase in the future, together with construction of new treatment plants.

In the whole Sharqiya Governorate, by the year 2005 production to be newly developed by groundwater is estimated at 151,243 m^3/day.
To this end, about 117 new groundwater stations will be constructed (Refer to the following section.).

Note: Total water demand in 2005 is 687,018 m^3/day.
It will be supplied by:

i)	New treatment plants	308,859 m^3/day
ii)	Existing treatment plants	73,094 "
iii)	Existing groundwater stations	153,832 "
iv)	New groundwater development	151,233 "
	Total	687,018 m^3/day

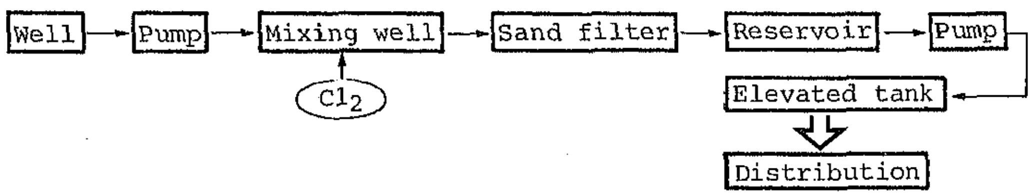
3.5.4.3 Unit System of a Groundwater Station

As a result of the field survey and hydrogeological study, a representative groundwater well is planned as below:

- Production : 30 l/sec x 12 hours = 1,296 m3/day
- Depth : 60 m
- Diameter : 10 inches

Concerning the development of groundwater, it is taken into consideration that groundwater sampled and analyzed in the field contains high value of iron and manganese quite often. The substances will cause coloring trouble in the water, specially in the case of execution of chlorination due to chemical reaction. Currently chlorination is not practiced to groundwater and no trouble of coloring has happened. In other words, chlorination has not been made in order to avoid coloring trouble. From the view point of public health control, however, application of chlorination to groundwater for public water supply should be considered. In this study, groundwater stations will be planned to be equipped with chlorination facilities. Simulteneously with chlorination treatment, treatment facility for iron/ manganese removal will be installed. To this purpose, rapid sand filters with manganese-coated sand will be installed. Field survey reveals that about 70 % in number of groundwater stations require the iron/manganese removal system.

Flow diagram of a groundwater station will be as follows:



A typical layout of the sand filtration facility is shown in Fig-3.5.8.

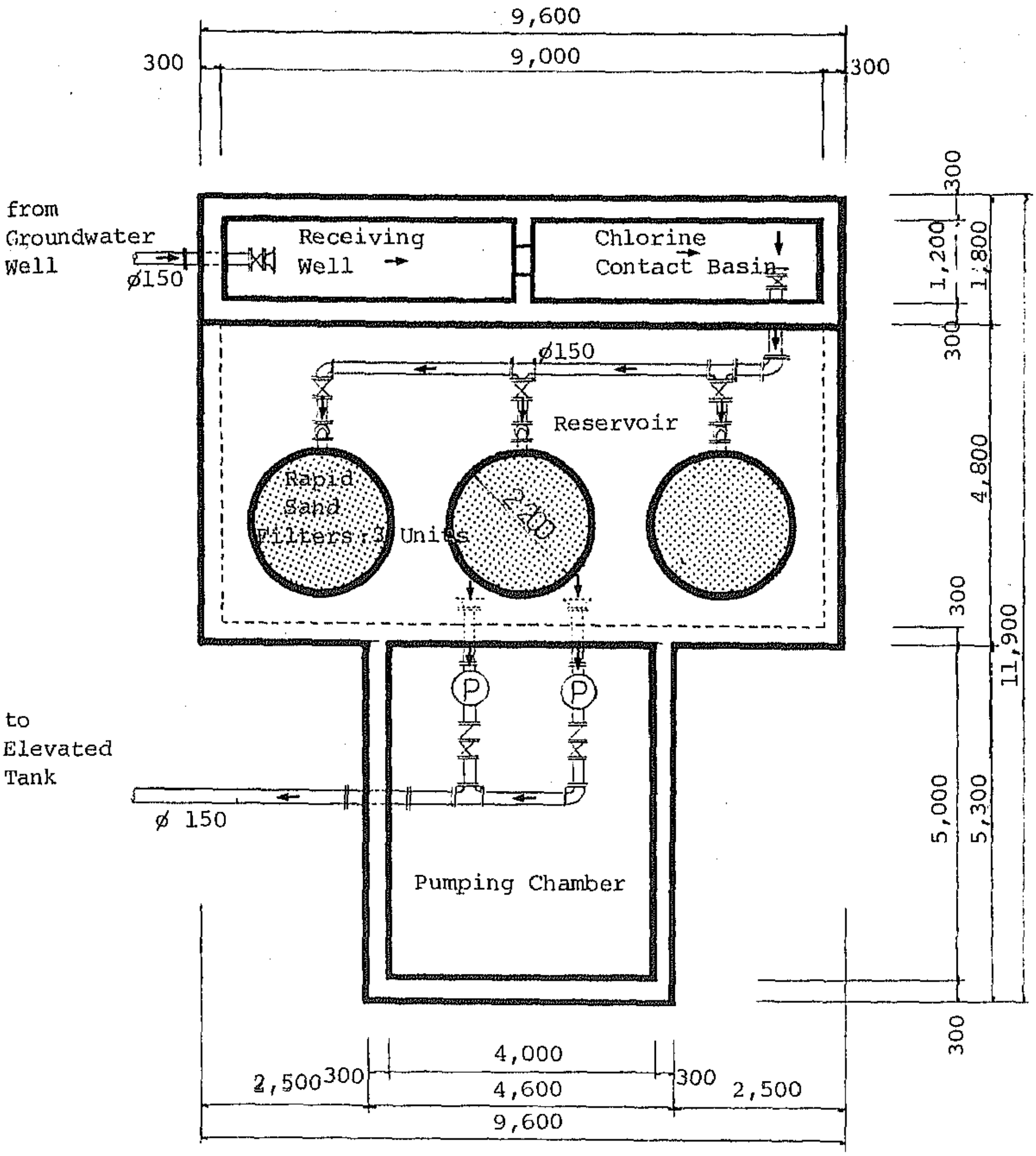


Fig-3.5.10 TYPICAL LAYOUT OF SAND FILTRATION FACILITY FOR GROUNDWATER

(Capacity ; Q = 30 l/sec)

3.5.5 Design Criteria

Taking account of the feature of the Sharqiya Governorate, design criteria for water supply facilities are planned as below. The criteria are applied for the Long-term Program and First Priority-phase Program of Sharqiya Water Supply System.

3.5.5.1 Per Capita Consumption

The average daily per capita consumptions are projected in detail in the preceding chapter based on the study during field surveys. The average daily per capita consumptions are summarized as follows:

PER CAPITA CONSUMPTION

(Unit : lcd)

Item	1985	1995	2005
1) Domestic			
Individual House Connection Consumers			
Class A	185	195	205
Class B	120	130	150
Class C1	90	90	90
Class C2	65	65	65
Standpipe Consumers			
Class D	48	55	55
2) Non-domestic (Urban)			
Commercial : 10 lcd on served population			
Institutional: 15 - 10% of domestic and commercial demands			
Industrial : 10% of domestic and commercial demands			
3) Non-domestic (Rural): Included in domestic consumption			

3.5.5.2 Peak Factor

As data to estimate maximum daily and peak hourly demands are hardly available, both factors of demands are assumed as follows:

Average Daily Demand:	1.00
Maximum Daily Demand:	1.25 x Average Daily Demand
Peak Hourly Demand :	1.20 x Maximum Daily Demand

3.5.5.3 Conception of Facilities

All facilities shall be designed taking into consideration hygienical safty, technical adequacy and practical economy.

Structure and material of facilities shall have sufficient durability and watertightness.

It is desirable that facilities are installed with standby, bypass and partition wall to be divided into plural parts.

3.5.5.4 Capacity of Facilities

The capacity of the intake water source facility, transmission facility, purification facility shall be determined based on Maximum Daily Demand.

The distribution facility shall be designed based on Peak Hourly Demand.

3.5.5.5 Water Pressure

Maximum static pressure of pipelines (Operating Pressure) shall not exceed 6 kg/cm^2.

Minimum water pressure at pipe ends of the distribution system shall not be less than 15 m in head, as far as practicable.

3.5.5.6 C Value

C Value of Hazen and William's Formula to be used for hydraulic calculation of pipelines shall be as follows:

C VALUE OF PIPELINES

Type of Pipe	C Value
* Mortar lining cast iron pipe	110
* Lining steel pipe	110
* Asbestos cement pipe	110
* Rigid polyvinyle chloride pipe	110

Remark : Where bend loss and others are calculated separately, 130 of C Value can be used.

C Value can be adjusted according to the condition of pipeline.

3.5.5.7 Pipe Material

Pipe materials shall be selected from the following: ACP, CIP, DCIP, Steel Pipe and PVC.

In selecting pipe materials, the following shall be taken into consideration:

1) Maximum static pressure and water hammer impact,
2) Conditions of the road under which the pipeline is to be laid,
3) Corrosiveness of the soil in which the pipeline is to be burried.

3.5.5.8 Valves, Air Valves and Drain Pipe

Valves shall be installed at the following points:

Transmission pipelines: strategic operating points and at about 2 km intervals.

Distribution mains : all main crosses and branches and at about 500 m intervals.

Air valves shall be installed at the top of vertical curves of pipelines.

Drain pipes shall be installed at the bottom of vertical curves of pipelines, where draining from the pipeline is possible.

Pressure reducing valves shall be installed before standpipes, in case water pressure exceeds 4 kg/cm2.

Fire hydrants shall be installed at proper intervals.

3.5.5.9 Meters

All production of facilities and distribution shall be metered. For this purpose, meters shall be provided at appropriate and convenient places to measure.

House meters shall be installed at all service connections.

3.5.6 Cost Estimation

3.5.6.1 Construction Cost

Construction cost of water supply facilities for new construction and rehabilitation/replacement by year 2005 is shown below:

Table-3.5.6 Construction Costs

(1984 Prices)

Item		Construction Cost
1)	Emergency Works	LE 11.8 Million
2)	New Kafr Sagr Treatment Plant	LE 13.7 "
3)	New Northeast Treatment Plant	LE 18.2 "
4)	New Zagazig Treatment Plant	LE 35.5 "
5)	New Bilbeis Treatment Plant	LE 13.2 "
6)	New booster pumping stations	LE 2.3 "
7)	Transmission pipelines	LE 17.5 "
8)	Extension of distribution pipelines	LE 143.4 "
9)	New groundwater stations equipped with iron/maganese removal facility, 77 stations	LE 70.8 "
10)	- ditto - without above facility, 35 stations	LE 20.4 "
11)	Rehabilitation/replacement of existing groundwater stations, 140 stations	LE 60.9 "
12)	Rehabilitation/replacement of existing pipelines	LE 22.3 "
	Total Costs	LE 430.0 Million

Note : The above costs are estimated on the basis of Case B-5 plan.

3.5.6.2 Operation and Maintenance Cost

Costs for operation and maintenance per annum are estimated below:

Table-3.5.7 Operation and Maintenance Cost

(1984 Prices)

(Unit: Million Egyptian Pounds)

Year	1985	1990	1995	2000	2005
A) Personnel cost	1.23	2.83	3.17	3.33	3.54
B) Power cost	0.28	0.44	0.61	0.75	0.84
C) Chemical cost	0.20	0.42	0.65	0.86	0.89
D) Repair cost	-	0.52	1.24	1.81	2.13
Total	1.71	4.21	5.67	6.75	7.40

Note : The above costs are estimated on the basis of Case B-5 plan.

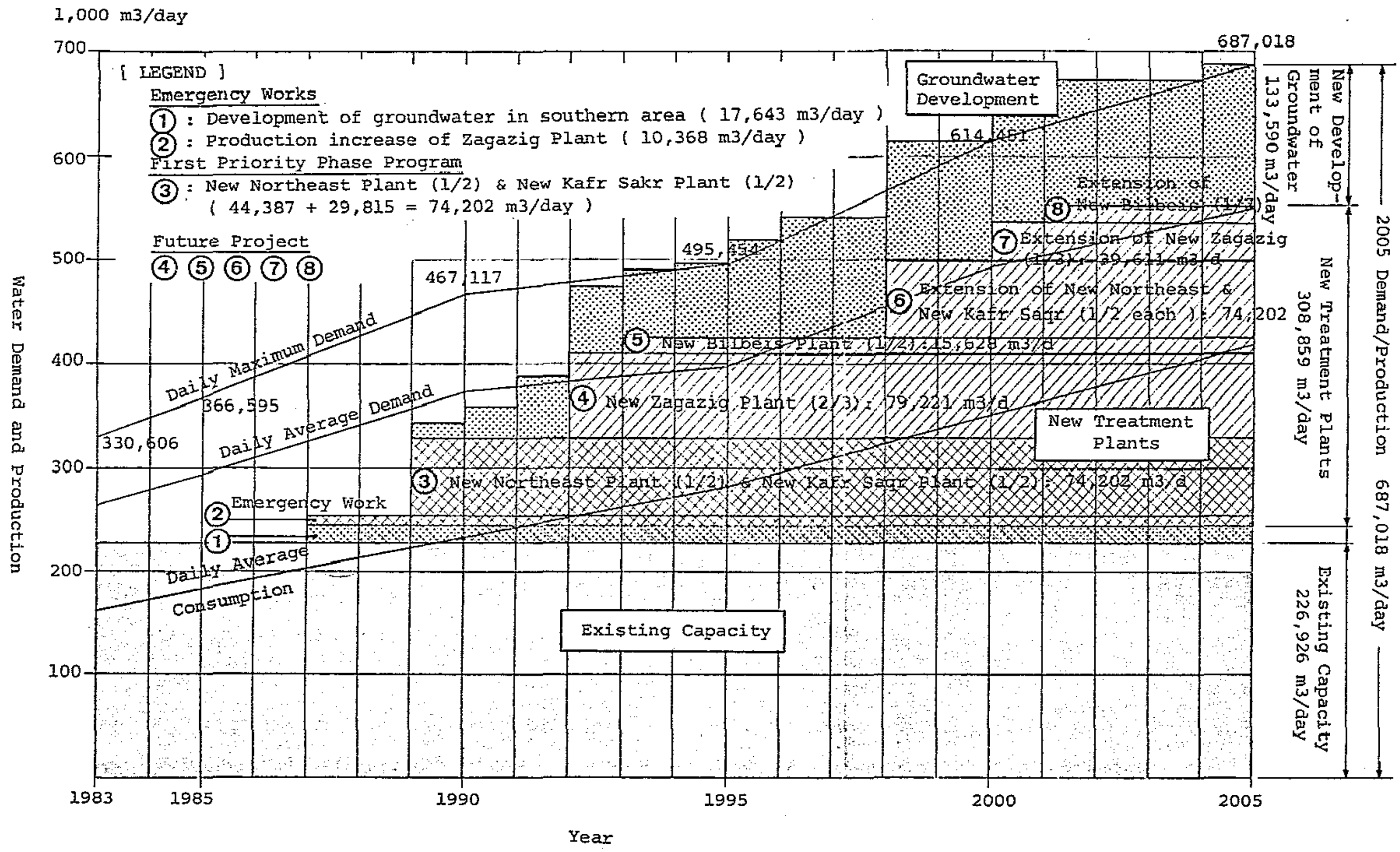
3.5.7 Implementation program

Implementation program for water supply development is shown in Table-3.5.8 and Fig-3.5.9. Construction of facilities to meet fully the daily maximum water demand is targeted at the year 1995.

Table-3.5.8 IMPLEMENTATION PROGRAM

Work Item \ Year	1985	86	87	88	89	1990	91	92	93	94	1995	96	97	98	99	2000	01	02	03	04	2005
1) Emergency Works		■																			
2) New Northeast Treatment Plant		■	■										■								
3) New Kafr Saqr Treatment Plant		■	■										■								
4) New Zagazig Treatment Plant						■	■								■						
5) New Bilbeis Treatment Plant									■							■					
6) Booster pumping station			■										■								
7) Transmission pipelines		■	■										■								
8) Extension of distribution pipelines/service mains		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
9) New groundwater stations equipped with iron/manganese removal facility; 77 stations				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
10) New groundwater stations without iron/manganese removal facility; 35 stations				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
11) Rehabilitation/replacement of existing groundwater stations; 140 stations				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
12) Rehabilitation/replacement of existing pipelines				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	

Fig-3.5.9 WATER SUPPLY DEVELOPMENT SCHEDULE



3.6 Institution and Management

3.6.1 Proposed Organizational Framework

The organizational setup has been studied to redress the present deficiencies as presented in the assessment of the existing organization and management in Section 2.6.2.

In this respect the in-depth study has already been completed in early 1981 by British consulting firm under the IDA's technical assistance program. The recommendation for the organization development presented in above study report has been agreed by the concerned authorities of Egyptian government to be implemented and their new organizational evolution has been progressed to the considerable extent.

Under such situation it has been considered adequate to streamline the institutional framework recommended in the previous study in comparison with the present status so that a practical proposal can be concluded.

1) Institutional Framework Recommended by Previous Study

The institutional framework recommended for the overall water supply works in the previous study is composed of four key entities as;

- a) Ministry of State for Utilities
- b) High Council for Utilities
- c) National Water Authority
- d) Public Water Companies (Local Water Undertakings)

The establishment of Ministry of State for Utilities was proposed to undertake the overall responsibility for utilities in the country including water utilities which are assigned in the present Ministry of Housing and local Governorates in order to meet the growing size and complexity of the utility sector and to facilitate the coordination between national policy making and planning and local initiatives.

The High Council for Utilities was proposed to support the Ministry of State for Utilities undertaking the responsibility mainly for policy making matter for water resources and utilities development and coordination between different utilities entities.

The National Water Authority is proposed to develop policies and regulatory frame work as a supervisory agency for all local water supply undertakings. This organization is proposed to maintain and observe the standard and technical and financial objectives of local water undertakings. The capital resources required for the local water undertakings are sought through this agency. This agency was proposed to replace the existing General Organization for Potable Water (GOPW) amplifying its original powers and increasing flexibility and freedom in dealing with organizational, financial and personnel system and practice. The close contacts and liaisons of this agency with local water undertakings were emphasized extending its specialist services including technical and training assistance until local undertakings become virtually self-sufficient.

The Public Water Companies were proposed to be instituted under each local governorate for respective local water undertakings unifying fragmented responsibilities between three entities of regional, municipal and village groundwater supply system. The Company was recommended as a semi-autonomus public water supply executing entities dealing with implementation of provincial water supply scheme and its day-to-day operation.

Prior to the recommendation of PWC, three other alternatives were evaluated as follows.

a) Functional amplification of NWA (present NOPWASD) to undertake the local water undertakings

b) Direct undertakings of the central Ministry

c) Establishment of private water supply company

The first and second alternatives had been discarded because they have a disadvantage of inconsistency in the momentous decentralization policy and have the restricted freedom for efficient operation of the system. The third alternative was considered having advantage of complete freedom from the central government but it was considered inadequate due mainly to the public nature of the water supply system.

2) Present Progress

The evolution of the institutional frame work has progressed since with the basic objectives proposed as above.

The proposed concept of National Water Authority has been embodied in the National Organization for Potable Water and Sanitary Drainage (NOPWASD) with added functions for sewerage merging previous GOPW (General Organization for Potable Water) and GOSSD (General Organization for Sewerage and Sanitary Drainage) under the new presidential Decree No. 197 issued in 1981.

The creations of Public Water Companies (PWCs) proposed have also been progressed for the provincial governorates where water supply schemes of significant scale are implemented. The Beheira Public Water Company was established under Beheira Governorate by Decree No.198 in 1981 for the provincial water supply operation. Further the establishment of another Public Water Company (PWC) for Kafr El Sheikh is presently under the process with same objectives of Beheira PWC.

3) Recommendation by Present Study

The present study will identify a most appropriate institutional framework for the Sharqiya water supply project, taking due account of the previous recommendations and the present progress of relevant reforms.

The previous concept to create Ministry of State for Utilities and High Council for Utilities has not been embodied but the concept to create NWA has been embodies by creation of NOPWASD. Such formation of NOPWASD as a single national agency to set up general guidelines and standards would result to more uniform nationwide policies, and at the same time, having sole agency dealing with international lending and aid agencies would facilitate loan and grant negotiations. Further problems and conflicts normally associated with creating new organizations could be minimized by withholding the setup of above two extra agencies.

The efforts and resources otherwise required should be directed to amplify and strengthen the functions of the existing Ministry of Housing so that responsibility for the water utilities and coordination with central policy making would fully be achieved.

The present structure of NOPWASD as indicated by Fig-2.1.1 and their functions described in Section 2.5.1 Existing Organization Framework are based on the organization criteria instituted for NOPWASD which are dictated mostly by the proposed organization structure in the previous study. This new structure is distinguished, however, by the added divisions specifically provided for the designing and implementation for the water supply projects all over the Egypt.

The existing status of NOPWASD is considered appropriate reflecting the current transitional decentralization period. The project control functions still retained by NOPWASD will be required until the decentralization of water undertaking authority are fully achieved and local water supply organization is capacitated to undertake the sizable water supply schemes.

The direct control and administration of the project should, however, be transfered to local water authority progrssively in future so that such authority can be afforded much greater managerial autonomy.

The establishment of Public Water Company for the local water undertaking at governorate level, as recommended after comparative evaluation among four alternatives in the previous study, is considered effective and reasonable proposition also for the Sharqiya water supply project.

In the present study, however, another alternative have been considered to set up a unified water supply division in Sharqiya Governorate combining existing separately operated three water supply systems on the ground that this would conform to the recent decentralization policy to empower local governorate and at the same time may avoid potential problems associated with the establishment of a new public company.

Although this alternative has a significant advantage as above, it is not necessarily considered an effective and recommendable solution because the present progress of the decentralization is too slow to expect the proposed water supply division in the Governorate to be free from the central government's restrictions.

After evaluation of above additional alternative the establishment of Sharqiya PWC is considered to be conclusive solution for the present project.

4) Proposed Sharqiya PWC

a) Objectives

The principal objectives of proposed Sharqiya PWC is to:

- Unify and consolidate the fragmented responsibilities dispersed in the existing separate water supply units and achieve control of water supply operation with well organized functions' distribution, defined responsibilities and efficient personnel management

- improve coordination between individual water supply schemes

- define the responsibilities for water supply undertaking between NOPWASD, Sharqiya Governorate and PWC

- provide more freedom for the management of water supply with their own accounting, budgeting and financial systems as well as personnel procedures

- permit to operate water supply undertakings in accordance with more commercially oriented objectives and practices with effective use of resources and ensure sound financial capability with new tariff system

- motivate productivity of the staff for the water supply services with adequate allowances and incentive payments

- ensure safe potable water supply throughout the Sharqiya Governorate

- establish efficient maintenance and operation system to reduce water leakage and loss

- let the water consumer to be well informed about the activities of Company especially for the necessity of new tariff system to be required in future

b) Powers and Functions:

The Company will be established by joint investments of initial foundation capital of NOPWASD and Sharqiya Governorate with allocation of shares to both parties in an appropriate proportion. The general assembly is to be provided comprising shareholders, representatives of other Ministries concerned, the Company employees and other nominated outside experts presided by the Governor to perform general supervisory duties for the Company's activities.

The chief executive power is vested with Chairman as the head of the Board of Director and responsible for management, control and external representation of the Company. The Board as the executive body of the Company comprises General Managers and selected employees of the Company and perform all tasks needed to fulfill the Company's objectives and policy makings. The main powers of the Company are:

- to develop, operate and maintain all public water supplies
- to prepare capital investment plan for the extension and improvement of the water supply in the service area
- to borrow funds from local and foreign financial institution in accordance with NOPWASD's guidelines
- to establish water supply charges for the revenue required to implement the project and maintain the water supply operation.

The functions of PWC to achieve required objectives largely fall in administration of financing, personnel and training, planning and design, operation and maintenance of the system and water quality control.

The organization structure of PWC is therefore recommended to be composed based on functions required to achieve principal objectives.

c) Management Structure

The followings are keynote of the proposed management structure dictated by the principal objectives.

(1) The company activities are to be performed based on three systemized leveles of headquarter, regional offices, and district offices.

Headquarter is to be located in Capital City of Zagazig and perform central control and supervision through several regional offices.

Regional Offices are to be located in some focal points strategically advantageous to control the region covering two or three Marakaz depending on magnitude of population and area, through district offices in Marakaz.

District Offices are to be located in every Marakaz and perform day to day operation of water supply and customer services.

(2) Financial and accounting functions are to be strengthened by well coordinated activities of headquarter for central finance control, and regional offices for accounting supervision of bill collection of district offices.

(3) The central laboratory is to be provided in the headquarter to perform monitoring and analysis of water quality sampled from all water sources in addition to water quality monitoring units to be provided at every treatment plants.

(4) The water leakage and loss reduction units are to be provided in every district offices to perform routine inspection and repair.

(5) The public relations unit is to be provided to enhance public awareness of the value and cost of safe water.

The organization charts of the proposed organization framework are indicated by Figs-3.6.1 and 3.6.2.

Some functions of respective organizational units are self-evident from the organization chart. The major roles of departments and distributed offices are summarized as follows:

d) Administrative & Finance

- develop and administer the internal personnel policies and procedure as approved by the Board

- review the company's organization and management structure and remodel the system if changes are required in compliance with the guidelines and policies set by the Board

- control the staff performance to consider incentive payments and promotions as well as career development maintaining personnel records and preparing reports for the Board

- prepare manpower planning and administer the recruitment and staff training program
- prepare annual company accounts and the regular financial reports for the Board and external authorities
- prepare the company's annual operating and capital expenditure budgets and medium term financial plan and provide the data base to seek for the funding resources
- perform financial adjudication of tenders for procurement and capital works

Technical Department:

This Department performs central control over technical aspects of water supply operation coordinating Sub-Divisions of (1) Plan & Design, Construction, (2) Central Laboratory and (3) Operation and Maintenance.

(1) Plan & Design, Construction

- prepare future estimation of the level of the service and demand for the potable water within the company's service area
- identify potential sources of water supply and appropriate means of extending distribution networks in coordination with operation and maintenance department
- develop medium term investment program showing the scale, timing and order of priority of new projects to meet future demand within the available investment resources in consultation with Finance and Administration Department
- develop the design of the project determined to be implemented
- prepare the tender documents, invitation and awards of the contracts
- supervise the implementation of the capital project

(2) Central Laboratory

- perform monitoring and analysis of water quality samples collected from treatment plants, distribution systems, wells and standpipes

- study acceptability of the water in conformance with water quality standard maintaining contacts with Ministry of Health

3) Operation and Maintenance

- supervise and coordinate the day-to-day water supply operations of the company in each Regional Office

- resolve disputes or conflicts of priority between Regional Offices

- advise Regional Offices on appropriate technical performance standards

- prepare reports on technical performance

Regional Office:

Under the Operation and Maintenance Sub-Division several core Regional Offices are recommended to be provided to control the grouped District Offices so that day-to-day operation and maintenance can be achieved locally in an efficient manner. The grouping of District Offices to be under each Regional Office should preferably reflect the geographical location and magnitude of population, water supply flow and the features of the water supply systems.

The Regional Offices will be responsible for:

- the operation and maintenance activities of Districts within the Division including major treatment plants and transmission mains

- the provision of specialist for electrical and mechanical services to District Offices and major treatment plants and buildings

- provision of divisional stores and procurement services, workshop facilities for the maintenance of the plant, vehicles and meters

- provision of engineering services such as designing for minor extensions and improvements throughout the District Offices

- routine accounting practices including billing, payments and payroll

- routine personnel administration including recruitment of junior staff

- ensuring that adequate training is provided by NOPWASD for the staff

District Office:

The District Offices are the basic day-to-day operational units to be under Regional Offices. The appropriate size of District Office will be dependent on the number of consumers and geographical extent. The administrative boundaries of existing Marakaz will provide a base to form the District Office providing sub-divided zones in the District Office where size of population and area is too large to administer.

The principal functions of District Office are:

- to maintain safe and continuous water supply in the District Office

- to lay, operate, and repair all distribution pipes other than trunk mains

- perform routine inspections and minor maintenance of trunk mains and reporting major faults to Regional Office

- to perform routine operation and maintenance of wells, public stand pipes and minor treatment plants

- to perform water leakage and loss detection and prevention, including routine reading and reporting of distribution meters

- to install customer connections after receiving their application and perform routine inspection and programmed meter maintenance and replacement thereafter

- to perform customer's meter reading and revenue collection

d) Coordination with Ministries of Central Government:

The coordination with Ministries related to the water supply operation is recommended to be embodied by the proposed general assembly of Sharqiya PWC which involves representative members of respective Ministries such as Ministry of Irrigation, Ministry of Health, Ministry of Finance and Ministry of Planning.

Ministry of Irrigation is responsible for the development and maintenance of national irrigation and drainage canals to provide source of water for irrigation purpose. The irrigation canals provide also source for surface water treatment plants to be utilized for potable water, and the approval from the Ministry is required for abstraction of water for such purpose. Therefore close liaison and communication between the Ministry and Sharqiya PWC would be required to ensure safe and sufficient water sources.

Ministry of Health is responsible to control water for various purposes by preparing guidelines and national standard for water quality as one of the political measures for the enhancement of national public health standard. The close coordination would be required between Ministry and Sharqiya PWC through the Company's Central Laboratory which is to be responsible for the monitoring and analysis of water quality throughout the Sharqiya Governorate.

The Ministry of Finance is largely responsible for overall budget administration including budget for capital investment and recurrent expenditure of the government agencies. The support of this Ministry would be required for the political decision on the funding of the central government for the water supply development and operation of proposed PWC.

The Ministry of Planning deals with national and regional plan and assessment of the priority of the various projects and sets the guideline for capital budget of the projects. The close coordination among this Ministry, Ministry of Finance and Sharqiya PWC would be required to formulate authoritative proposals to the decision-making body of the central government for the water supply development project.

3.6.1.1 Staffing and Training:

In accordance with the staged development of the water supply extensions projects the staffing of Sharqiya PWC should also be scheduled particularly for the qualified and skilled personnel. The roughly estimated staffing plan up to the year 2005 has been made as shown in Table-3.6.1 providing that more detailed schedule would be made in the subsequent feasibility study.

The existing staff in the Sharqiya governorate appears normal in terms of number. There is an acute shortage, however, of the professional staff especially for the skilled laborers such as welders, fitters, plumbers, mechanics and electricians and a serious misallocation of staff with some functions overmanned and others neglected resulting in a low labor productivity.

The level of staffing should aim to increase the efficiency of water operation represented by the increase of potential water output per employee which in turn requires reduction of overmanning and redundancy of unskilled laborers. The adequate staffing for routine works such as leak detection and preventive maintenance should be emphasized in order to maintain the volume of water available for consumption and achieve improvements in output per employee.

The shortage of skilled laborers and technical staff should progressively be reduced through vigorous training activities. The basic strategy for the training is considered primarily to meet the immediate need for the improvements of the existing level of water operation and maintenance and secondly to meet the future manpower requirements in the development of the systems and new Public Water company to be established.

The rapid introduction of training for the existing key staff using presently available training facilities are desirable for the initial stage of the training program concentrating on practical on-the-job training in the field and employment of highly experienced expertise or foreign professional consultants until the trained key staff can sufficiently be available to train and instruct their subordinate and build up future permanent training program.

Presently the regular training courses are provided in NOPWASD in coordination with Ministry of Housing to meet the ever increasing requirement for the professional staff for the water supply and sewerage operation. The intensification and amplification of such training activities will be required to motivate the early implementation of training program for the proposed Sharqiya water supply extension project.

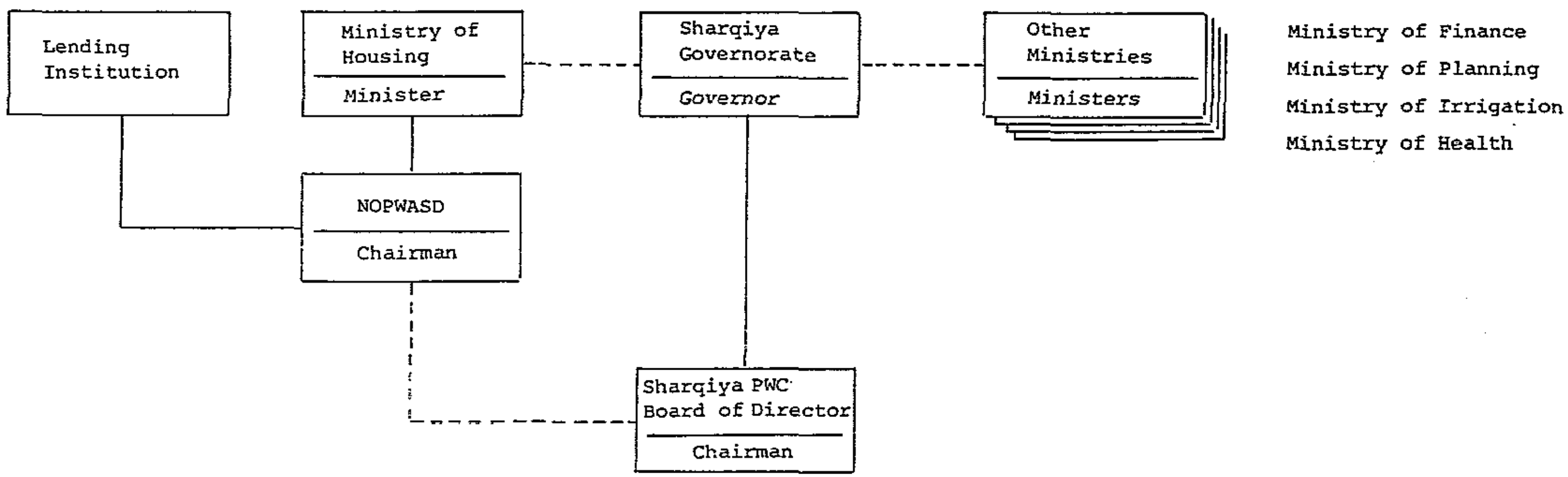


Fig - 3.6.1 PROPOSED ORGANIZATION FRAMEWORK (1)

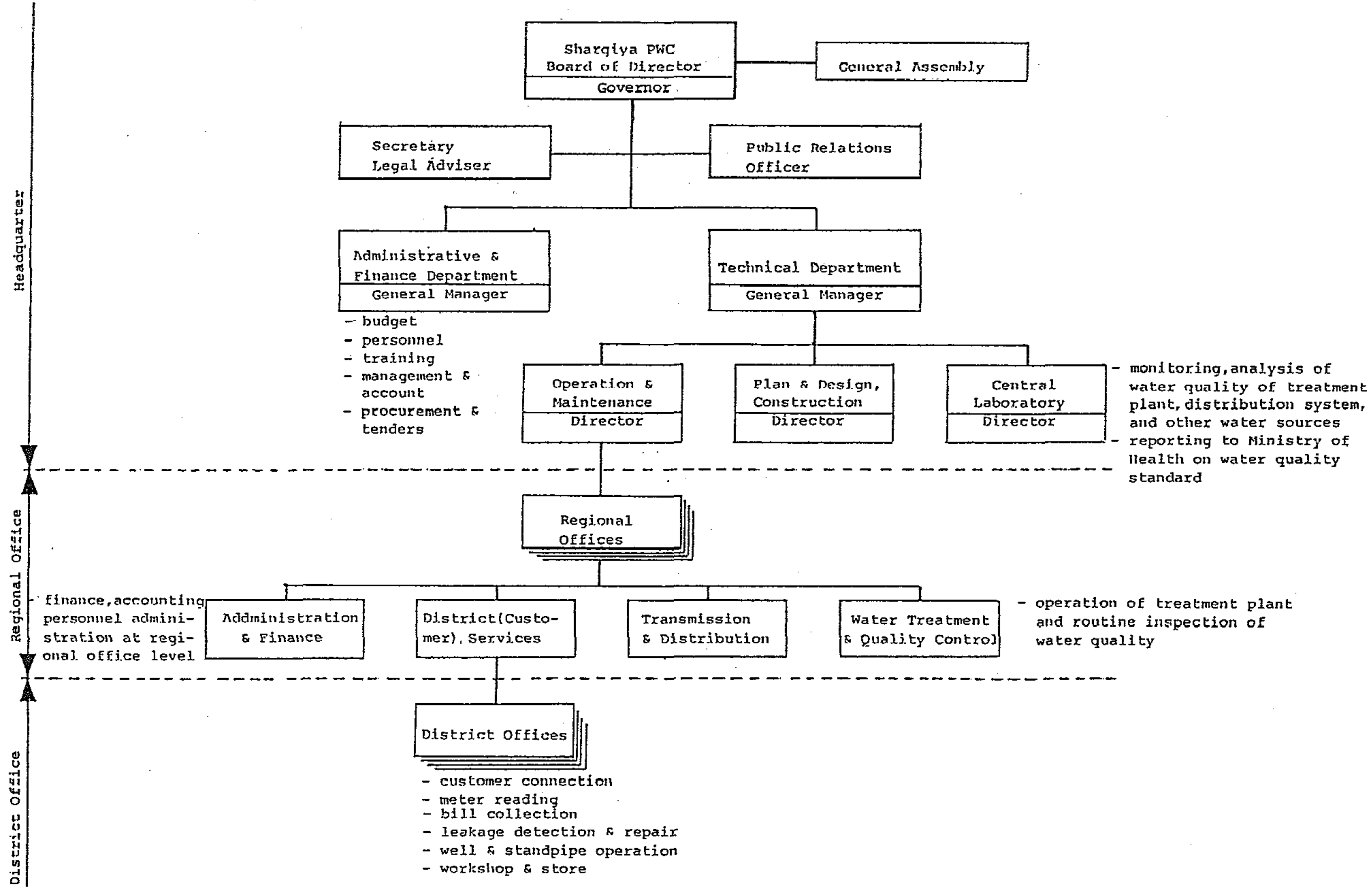


Fig - 3.6.2 PROPOSED ORGANIZATIONAL FRAMEWORK(2)

Table-3.6.1 Estimated Staffing Schedule 1985 - 2005, Sharqiya PWC

Job Title	1985	1990	1995	2000	2005
PWC Headquarter					
Top Management	8	8	8	8	8
Engineer	7	11	16	17	18
Chemist	7	10	12	12	13
Legal Officer	1	1	1	1	1
Personnel & Training Officer	5	5	6	6	6
Personnel Specialist	4	5	6	6	6
Financial Officer	3	4	5	5	5
Accountant	2	5	6	6	6
Administrative Officer	5	8	9	9	9
Procurement & Supply Officer	10	12	13	13	13
Clerk	18	35	43	48	51
Operation & Maintenance Divisions					
Engineer	18	28	33	35	44
Technician	24	31	43	46	60
Chemist	3	6	8	8	4
Superintendent	9	18	21	24	29
Water Operator	15	41	48	53	76
Craftman	20	43	51	55	38
Administrative Staff	25	28	31	35	39
Clerk	30	76	92	110	121
Laborer	80	210	225	236	235
Distribution District					
Superintendent	21	43	48	51	55
Inspector	45	93	104	112	121
Craftman	22	49	54	61	68
Water Operator	135	361	409	451	492
Skilled Laborer	80	194	203	215	221
Laborer	178	371	382	391	401
Administrative Staff	25	27	31	36	41
Clerk	23	159	163	168	173
Total	823	1882	2071	2218	2354

3.6.2 Long Term Financing

The water supply improvement and extension proejct in Sharqiya Governorate will require total investment of LE 430.0 million at 1984 price up to the year 2005 as estimated in previous section 3.5 and shown in Table-3.5.6 This investment is estimated based on the long term target to provide every household with satisfactory access to public water by the year 2005.

The investment program for such large scale construction scheme will be required to be implemented progressively by several stages in accordance with the available found resource and government policy for the water supply development. Such staged development should also be schemed in accordance with urgency of the water supply requirement.

In this context the initial stage of the construction from 1985 to 1989 has been identified, as described in subsequent Chapter 4 in order to facilitate the early implementation and satisfy the urgent requirement of water supply extension which will require approximately LE 100.1 million at 1984 price.

Capital Source:

The capitals for the construction composing the foreign currency, approximately 40 % of total costs and remaining local currency portions will be funded from the various sources. The international and bilateral funding agencies would provide the loan or even grant if such is available for the foreign currency portion and the central government agency is required to provide the loan, equity and subsidy for the local currency requirements if the local funds are not sufficiently available in the local water utilities.

Under the existing financial situation and practices of the water supply entities in Sharqiya Governorate where investment resources are scarce with low revenue-earning capacity mostly ascribable to the extremely low water tariff, a subsidiary funding such as soft loan with low interest and long term repayment and the government subvention will be required for the early stage of the development plan until the financial capability of water supply utilities are sufficiently strengthened.

Revenue Sources:

The substantial increase of the level of the water tariff and introduction of appropriate charge for the present free tap of public standpipe will be necessary to generate sufficient revenues to sustain a long term investment program which accounts for large utilities' current operating costs and debt-service obligation for the substantial external borrowings.

The introduction of the water tariff to raise sufficient revenue or at least break even for the operating costs of water supply will be required to reinforce the financial capability of proposed Sharqiya PWC, reducing its dependency on the scarce government subsidy. The water tariff reasonable imposed based on the economic cost of the water supply would make the water consumers aware that water is not costless and hence discourage the waste of water. Further the progressive increase of the water tariff will be necessary to ensure internal cash generation so that future heavy investment program can be sustained.

The new tariff systems, however, should be designed taking account of affordability of consumers to pay charges and implemented with support of authorized power of the Company to set their own water tariff accompanied by improved management, accounting system and effective billing and collection procedures.

3.6.3 Rough Economic Evaluation of Long Term Program

As mentioned in previous section the financial measurements of the prospective investment of proposed project is a key factor and it will be assessed in the subsequent financial feasibility study to provide means to determine investment. The evaluation of the water supply project depending on accounting measurement only sometimes gives rise to distorted conclusion since the water supply services normally intended to provide safe potable water which is the essential social requirement and not based on commercial profitability.

The evaluation including the socio-economic factors will therefore be necessary as a helpful tool to determine the desirability of the project. Although the most of the economic benefits derived from the water supply investment is difficult to quantify, the simplified benefit-cost analysis has been explored based on the following assumptions.

1) The incremental capital investment and maintenance and operation costs for the period of project life from 1985 to 2034 at constant price of 1984 have been assumed for the outputs of the project.

2) The inputs of the project have been assumed based on the incremental water consumptions derived from the implementation of long range water supply improvement and potential water tariff projection.

   The present water tariff under the government strict control is considered not representing real economic price of the water. The water tariff representing realistic value of water is normally assessed by the price which the potential consumers will pay for the safe potable water. The questionary surveys have been made to assess consumers' willingness to pay. It was found, however, difficult to obtain reliable results because they are presently provided with water of extremely low tariff under the government subvention which likely distorts their realistic evaluation of water.

In some rural areas where the safe water is in accutely short supply, the water is sold by private water vendors at approximately 20 pts/20 litres (equivalent to LE 10/m^3). This may be an extreme example which is not appropriate to apply for estimation of the realistic value of water but it provides a certain implication for the appreciation of the water. Such being the case, the amount of water charge which the potential consumers afford to pay has been considered representing value approximate to the realistic water price and it was estimated to be 30 pts/m^3 based on the incremental average income level and water consumption.

3) The discount rate of 6% has been assumed to reflect the real opportunity cost of capital because the economic rates of return in developing countries generally range 4% to 6% and the water supply project is socially-desirable public welfare project of the country.

Based on the assumptions outlined above a flow of incremental costs and benefits discounted at 6% has been projected as shown in Table-3.6.1 and the benefit-cost ratio has been computed to be 1.0006. The ratio of more than one indicates that long term benefits of the project outweigh its long term costs justifying the project which provides positive net benefits to the economy.

Further above ratio would increase if the unquantifiable socio-economic benefits are compounded. On notable benefits among others are to be derived from the health improvement. The provision of safe and clean potable water will contribute to the improvement of public health and hygene and reduction of water-borne diseases such as bilharzia, gastroenteritis, cholera, typhoid, stomach illness which are widely spread in the project area. In addition to above, other benefits can be expected such as better quality of life and amenities, employment increase during construction period of the project, and decrease of fire incidence by improved fire fighting capacities.

Table-3.6.2 Discounted Flow of Incremental Costs and Benefits

(UNIT: Million Egyptian Pounds)

Year	Investment Costs	Operation Costs	Total	Discount Factor at 6%	Present Worth	Incremental Consumption (Million m^3)	Incremental Revennes at 30 pts/m^3	Discount Factor at 6%	Present Worth
1985	1	-	1	0.943	0.94	-			
1986	17.8	-	17.8	0.890	15.84	-			
1987	30.6	-	30.6	0.840	25.70	-			
1988	26.0	-	26.0	0.792	20.59	-			
1989	12.9	-	12.9	0.747	9.64	36.50	10.95	0.747	8.18
1990	16.2	4.21	20.41	0.705	14.39	43.80	13.14	0.705	9.26
1991	32.7	4.58	37.28	0.665	24.79	49.28	14.78	0.665	9.83
1992	32.8	4.92	37.72	0.627	23.65	54.75	16.43	0.627	10.30
1993	32.6	5.24	37.84	0.592	22.40	60.23	18.07	0.592	10.70
1994	31.4	5.46	36.86	0.558	20.57	63.88	19.16	0.558	10.69
1995	14.3	5.67	19.97	0.527	10.52	67.53	20.26	0.527	10.68
1996	14.3	5.95	20.25	0.497	10.06	73.00	21.90	0.497	10.88
1997	14.3	6.07	20.37	0.469	9.55	76.65	23.00	0.469	10.79
1998	37.9	6.32	44.22	0.442	19.55	82.13	24.64	0.442	10.89
1999	34.8	6.56	41.36	0.417	17.25	87.60	26.28	0.417	10.96
2000	14.3	6.75	21.05	0.394	8.29	91.25	27.38	0.394	10.79
2001	20.1	6.97	27.07	0.371	10.04	96.73	29.02	0.371	10.77
2002	14.2	7.18	21.38	0.350	7.48	102.20	30.66	0.350	10.73
2003	14.1	7.25	21.35	0.331	7.07	105.85	31.76	0.331	10.51
2004	14.1	7.35	21.45	0.312	6.69	113.33	34.00	0.312	10.61
2005 ~ 2034	-	7.40 ~ 7.40	7.40 ~ 7.40	4.292	31.76	116.80 ~ 116.80	35.04 ~ 35.04	4.292	150.39
				Total	316.77				316.96

Benefits/Costs Ratio: $\frac{316.96}{316.77} = 1.0006$

4. Project Identification

In the preceding chapter, a long term program up to the year 2005 was studied. In this chapter, among a number of serial construction/ rehabilitation works to be involved in the long term program, the project which shall be implemented in the earlier stage as the First-Phase Project will be identified.

4.1 Selection of the Project to be Implemented

Considering urgent necessity of water supply and present situation of water shortage in the northern area of the Governorate, the priority of the project implementation will be placed on new construction of Northeast Treatment Plant and Kafr Saqr Treatment Plant; and their transmission/ distribution pipelines.

In addition to the above new construction works, the emergency works will be proposed in order to relieve present condition of water supply to a certain extent.

4.1.1 Construction of New Treatment Plants

Treatment plants to be newly constructed in the frame of the First-Phase Project will be located both at Kafr Saqr and Northeast. The two plants will have a final capacity of 150,000 m3/day in total by the year 2005. Supply area and capacity of the plants is summarized in Table 4.1.1.

In the First-Phase Project, the plants will aim to have supply capacity up to the year 1995. According to the water demand study, the capacity to be newly developed by 1995 is about a half of the 2005 capacity.

Therefore, capacity of each plant in the First-Phase will be:

- Northeast Plant : 90,000 m3/d x 1/2 = 45,000 m3/day
- Kafr Saqr Plant : 60,000 m3/d x 1/2 = 30,000 m3/day

Total : 150,000 m3/d x 1/2 = 75,000 m3/day

Table 4.1.1 New Treatment Plants and Supply Area

Plant	Supply Area and Capacity by 2005		
New Northeast	- Faqus City	: 14,086 m3/d	
	- Huseiniya City	: 7,391 "	Total = 88,775 m3/d
	- Villages in Huseiniya Markaz	: 31,568 "	Say, 90,000 m3/d
	- Villages in Faqus Markaz	: 35,730 "	
New Kafr Saqr	- Abu Kebir City	: 20,304 m3/d	
	- Kafr Saqr City	: 6,570 "	Total = 59,629 m3/d
	- Villages in Kafe Saqr Markaz	: 32,755 "	Say, 60,000 m3/d
		Grand Total =	150,000 m3/d

Simulteneously with construction of the two new plants, transmission pepelines to the above areas will be installed and booster pumping stations on the way of the transmission pipelines will be constructed. In addition, distibution pipelines and elevated tanks will be expanded/ supplemented to the existing distribution systems.

4.1.2 Emergency Works

1) Production Increase of Zagazig Treatment Plant

In order to relieve present poor water supply condition in Zagazig City, the existing treatment plant (200 l/sec = 17,280 m3/day) will be preferably expanded to possible extent.

Field survey revealed that production of the existing Zagazig plant would be increased by 120 l/sec (= 10,368 m3/day) with additional construction works. The work for production increase will be included in the emergency works.

2) Rehabilitation of Existing Treatment Plants

As studied in Working Paper No.4 "Existing Water Supply Systems", a number of mechanical equipment/devices such as pumps, flow meters, valves, chemical dosing equipment, etc, of the old existing treatment plants have been out of services or do not keep their original normal function, owing to deterioration by their age and lack of their spare parts.

All of the existing treatment plants will be rehabilitated by the emergency works, in order to recover the original design capacity.

They are:

i) Abbasa Treatment Plant
ii) Zagazig Treatment Plant
iii) Faqus Treatment Plant

3) Development of Groundwater in Southern Area

Water supply systems in the following cities/villages which are located in the southern area and will not be benefited by new treatment plants will be strengthened by new construction/reconstruction of groundwater stations to some extent in the frame of the emergency works.

They are:

- Bilbeis City .... Three groundwater stations
- Ibrahimiya City .... One "
- Hihiya City .... One "
- Diarb Nigm City .... One "
- Mashtul el Souk City .... One "
- Minyet el Qamh City .... One "
- Housing Department System ... Seven groundwater stations

4) Procurement of Machines/Vehicles/Spare Parts for Maintenance

At present machines and vehicles are insufficient. The following will be purchased in order to take prompt action for repair of existing facilities, and for regular maintenance work:

Four-wheel Drive Cars	:	3 cars
Trucks	:	4 cars
Backhoe (0.05 m3)	:	1 unit
Pumps (Engine 3.5 PS x 0.6 m3/min)	:	5 sets
Portable Chlorinator (50 g/hour)	:	2 sets
Leak Detector	:	3 sets
Overseas Training for Local Engineers	:	L.S.
Others	:	L.S.

4.2 Project Cost

Rough project cost is tabulated below:

Table 4.1.2 COST FOR FIRST PRIORITY-PHASE PROJECT

	Item	Cost
(A)	Construction of New Northeast Plant and New Kafr Saqr Plant; installation of transmission/distribution pipelines, booster stations and elevated tanks	LE 71.1 million
(B)	Emergency works	LE 11.8 million
(C)	Engineering services (Detail design and construction supervision)	LE 4.1 million
(D)	Physical contingency 1/	LE 8.7 million
(E)	Price contingency 2/	LE 30.3 million
	Total project cost =	LE 126.0 million

(Broken down into:
- Foreign currency portion : LE 54.3 million (or US$66.2 million), and
- Local currency portion : LE 71.7 million

Note: 1/ Physical contingency : 10% of (A+B+C)

2/ Price escalation rate per annum : 7 % for foreign currency portion, and 12 % for local currency portion

LE : Egyptian Pounds (LE 0.82 = US$ 1.00)
The cost described above is denoted in 1984 price.

4.3 Project Implementation Schedule

Implementation schedule for the First Priority-Phase Project will be :

1) Loan application : Early 1985 - Middle 1985 (1/2 year)
2) Detail design : Middle 1985 - Middle 1986 (one year)
3) Construction of New Northeast Plant and New Kafr Saqr Plant :
   Middle 1986 - Middle 1988 (two years)
4) Emergency works : Middle 1986 - Middle 1987 (one year)

FEASIBILITY STUDY ON

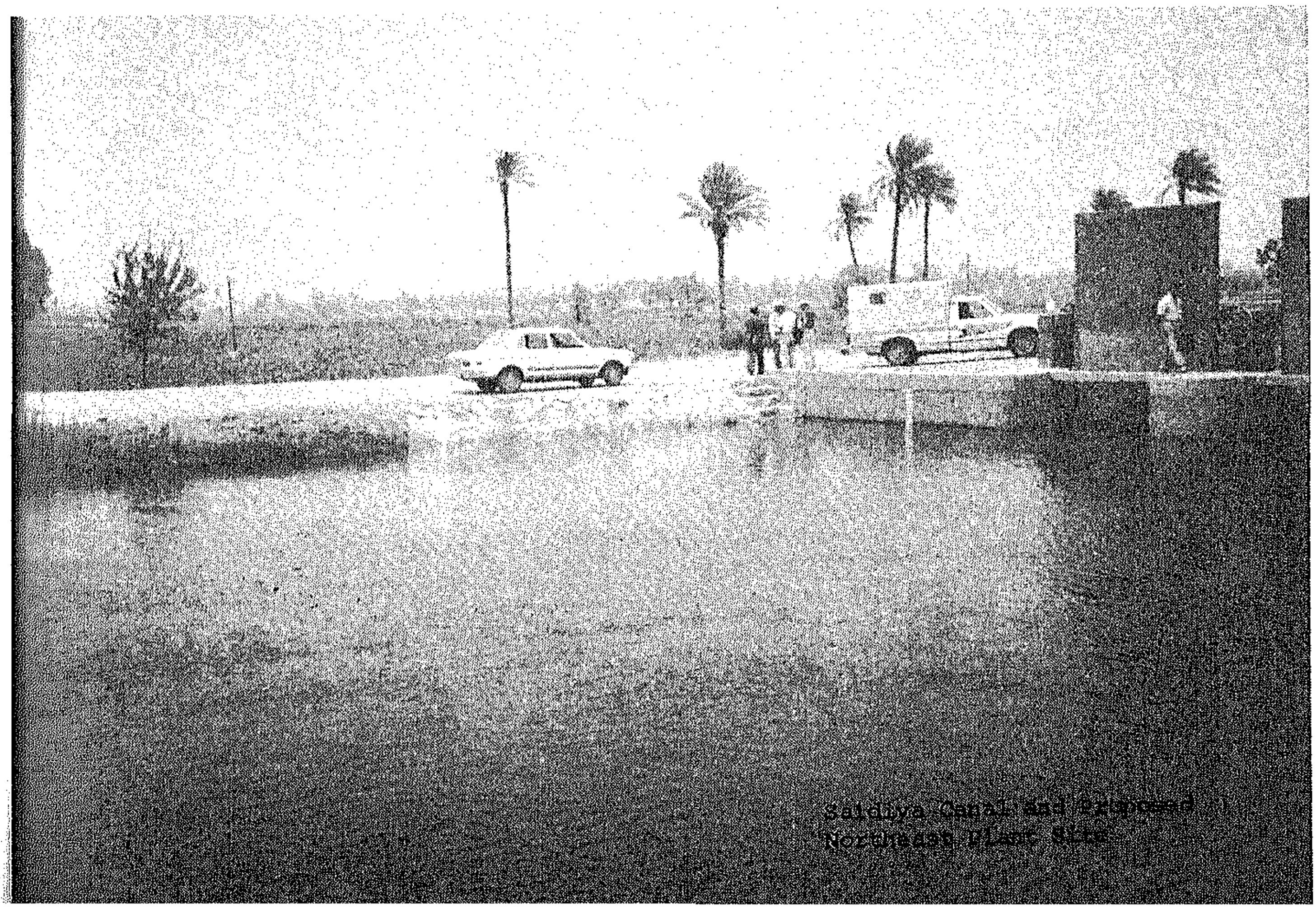
SHARQIYA WATER SUPPLY SYSTEM

IN

THE ARAB REPUBLIC OF EGYPT

PART THREE

FIRST PRIORITY-PHASE PROGRAM



Saidiya Canal and Proposed
Northeast Plant Site

FEASIBILITY STUDY ON
SHARQIYA WATER SUPPLY SYSTEM
IN
THE ARAB REPUBLIC OF EGYPT

CONTENTS

1. GENERAL

1.1 Scope of First Priority-Phase Program

The long term program which formulates a long range plan of Sharqiya Water Supply up to the year 2005 is studied in the preceding Part II. Consequently the most urgently necessitated project is identified as the First Priority-Phase Program in the last chapter of the Part II, from the technical and financial standpoints.

The selected project consists of a) New Northeast Plant and New Kafr Saqr Plant Systems which are to supply the northern part of the Governorate aiming at 1995, and b) imminent rehabilitation for existing plants and strengthening works for the southern area and densely populated Zagazig city which are called Emergency Works collectively.

1.2 Major Works of the Study

To cover the study for the scope stated above, the following works have been undertaken :

a) Preliminary Design
On the basis of the estimated population and water demand, two water supply systems supplying the northern Governorate are planned together with their distribution system and the emergency works. The construction cost for each of the stated above is estimated.

b) Implementation Program
The yearly disbursement schedule is planned from the planned implementation schedule, and the project cost is estimated on each of the local and foreign currency.

c) Institution, Organization and Financial Feasibility
Necessary setup of institutional and organizational matters for managing the Sharqiya Water Supply is proposed and a financial plan, involving the funding arrangement such as equity and water tariff is presented.

2. Preliminary Design

2.1 Distribution System

2.1.1 Design Criteria

Based on the estimated per capita consumption, quoted in 3.5.5, Part II, the design criteria for the distribution system are selected as follows :

i) Minimum residual pressure:

- 10 m for rural areas; and
- 20 m for urban areas.

ii) Distribution pipelines consist of:

- Trunk mains: Transmission/distribution mains; and
- Service mains: Distribution mains within cities and villages.

iii) Peak factors (Refer to 3.5.5, Part II) :

- Daily max. demands =
  1.25 x Daily average demands
- Peak hour demands =
  1.5 x Daily average demands; or
  1.2 x Daily max. demands

iv) Distribution method:

- Pumping system with elevated tanks

v) Capacity of pipeline:

The trunk mains for the present project will be one of the following:

- Existing mains meeting the 1995 demands;
- Existing plus proposed mains meeting the 2005 demands; or
- Proposed mains meeting the 2005 demands

vi) Elevated tanks:

- Capacity:	300 m3;
- Height:	25 m above ground;
- Effective depth:	4 m
- Purpose:	Backstopping supply at power failure to meet 1 hr equivalent of the daily maximum demands.

2.1.2 Service Area and Water Demands

Presently the whole Governorate is covered by the existing system, while the new assets are to serve the following areas :

i) New Northeast System:
- Huseiniya Markaz (City and rural area);
- Faqus City; and
- Part of Faqus Markaz (rural area).

ii) New Kafr Saqr System:
- Kafr Saqr Markaz (City and rural area);
- Part of Abukebir City; and
- One village of Faqus Markaz.

Water demands are summarized in Table 2.1.1. by each Markaz. Fig. 2.1.1 shows the proposed service areas of the project, and the schematic plan of the distribution systems is presented on Fig. 2.1.2.

The village level water demands are estimated from 1984 through 1995, 2000, and 2005 based on the study undertaken in 1983 by the team.

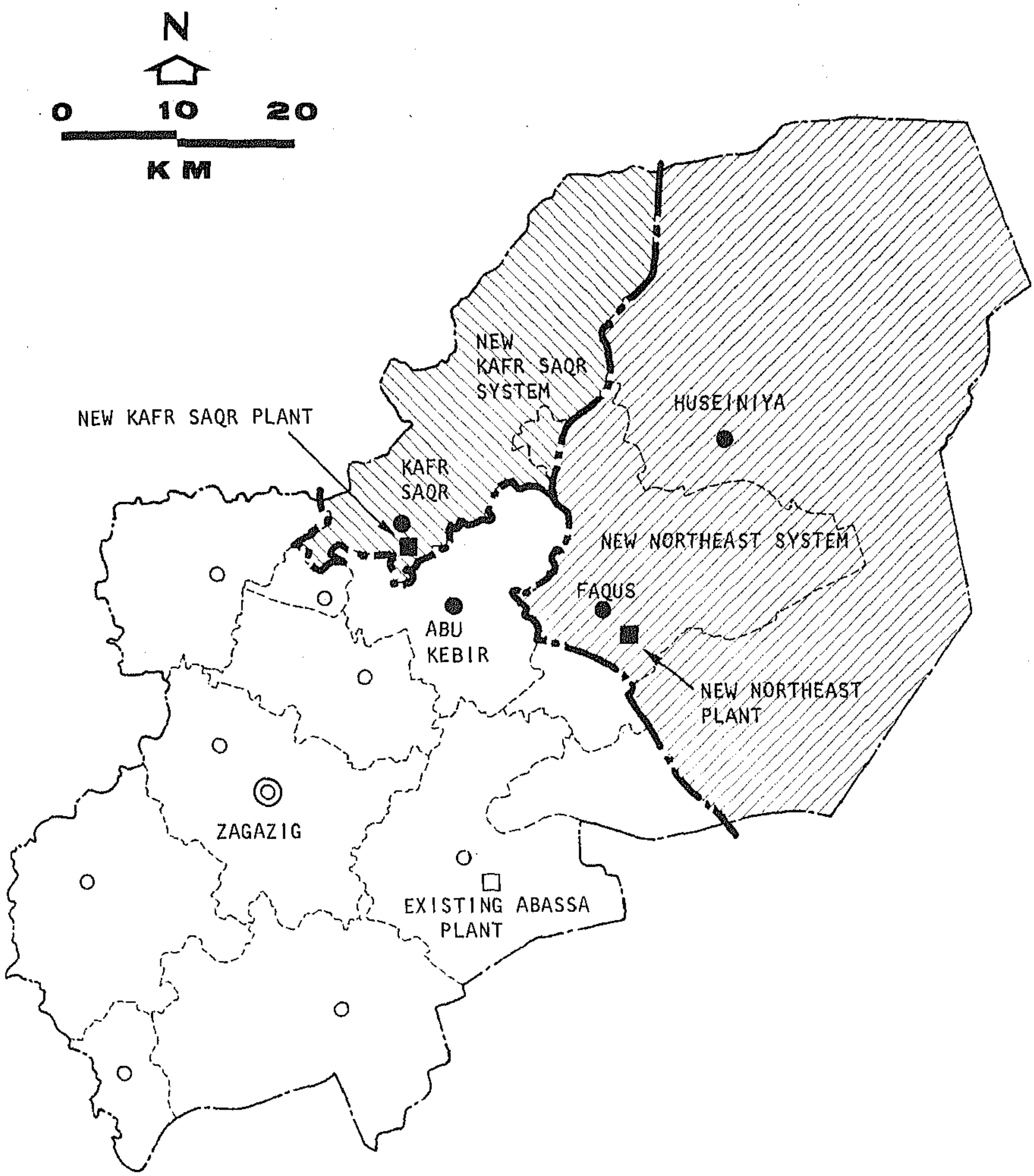
Table-2.1.1 Water Demands

(m3/day)

Area		FIRST PRIORITY-PHASE PROGRAM			LONG-TERM PROGRAM		
		AVG	MAX	PEAK	AVG	MAX	PEAK
New Northeast System							
Huseiniya	U	3,106	3,883	4,660	5,913	7,391	8,869
	R	14,022	17,527	21,032	25,292	31,616	37,939
	T	17,128	21,410	25,692	31,205	29,007	46,808
Faqus	U	9,142	11,428	13,714	19,269	24,086	28,903
	R *1	16,379	20,474	24,569	29,417	36,771	44,125
	T	25,521	31,902	38,283	48,686	60,857	73,028
Sub-Total		42,649	53,312	63,975	79,891	99,864	119,836
New Kafr Saqr System							
Kafr Saqr	U	2,790	3,487	4,184	5,256	6,570	7,884
	R	13,748	17,185	20,622	25,637	32,047	38,456
	T	16,538	20,672	24,806	30,893	38,617	46,340
Abu Kebir	U	11,850	14,813	17,776	24,243	30,304	36,365
Faqus	R *2	268	335	402	510	638	766
Sub-Total		28,656	35,820	42,984	55,646	69,559	83,471
Total		54,177	89,132	106,959	135,537	169,423	203,307
Existing Facilities							
Faqus City		9,504	9,504	9,504	10,000	10,000	10,000
Abu Kebir City		5,103	5,103	5,103	10,000	10,000	10,000

*1 (Faqus Rural Demands) x 87 % - (*2)

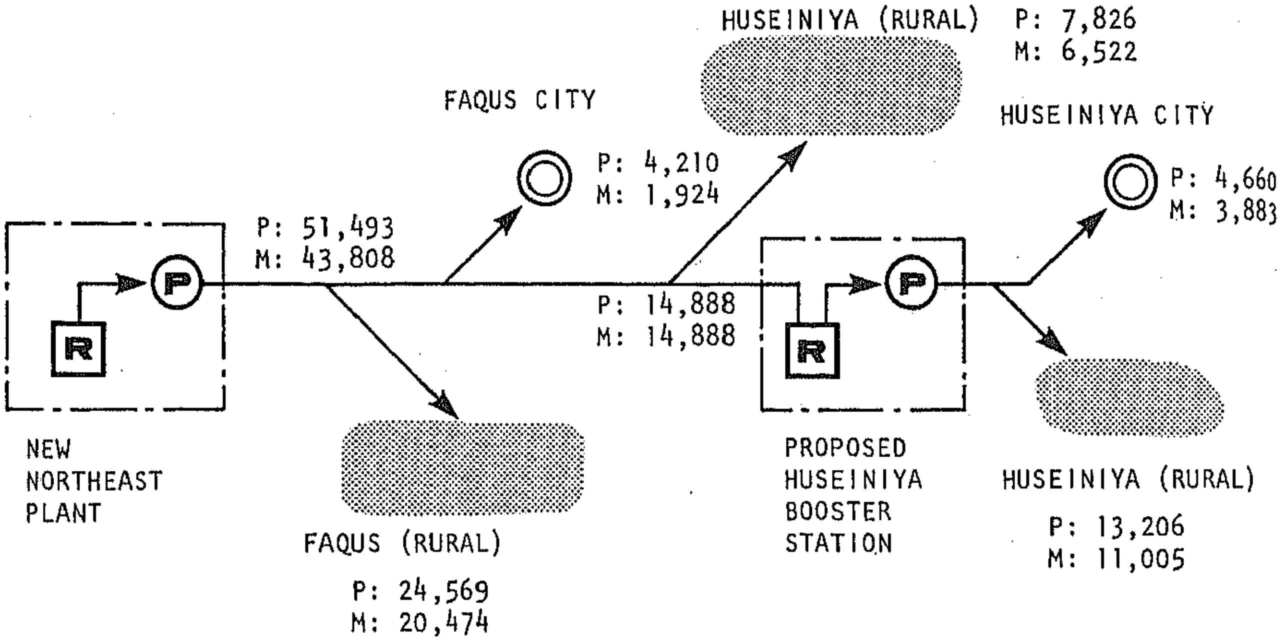
*2 Kafr El-Ashgam Village.



Fig－2.1.1　Proposed Service Areas

(UNIT: m3/day)

NEW NORTHEAST SYSTEM

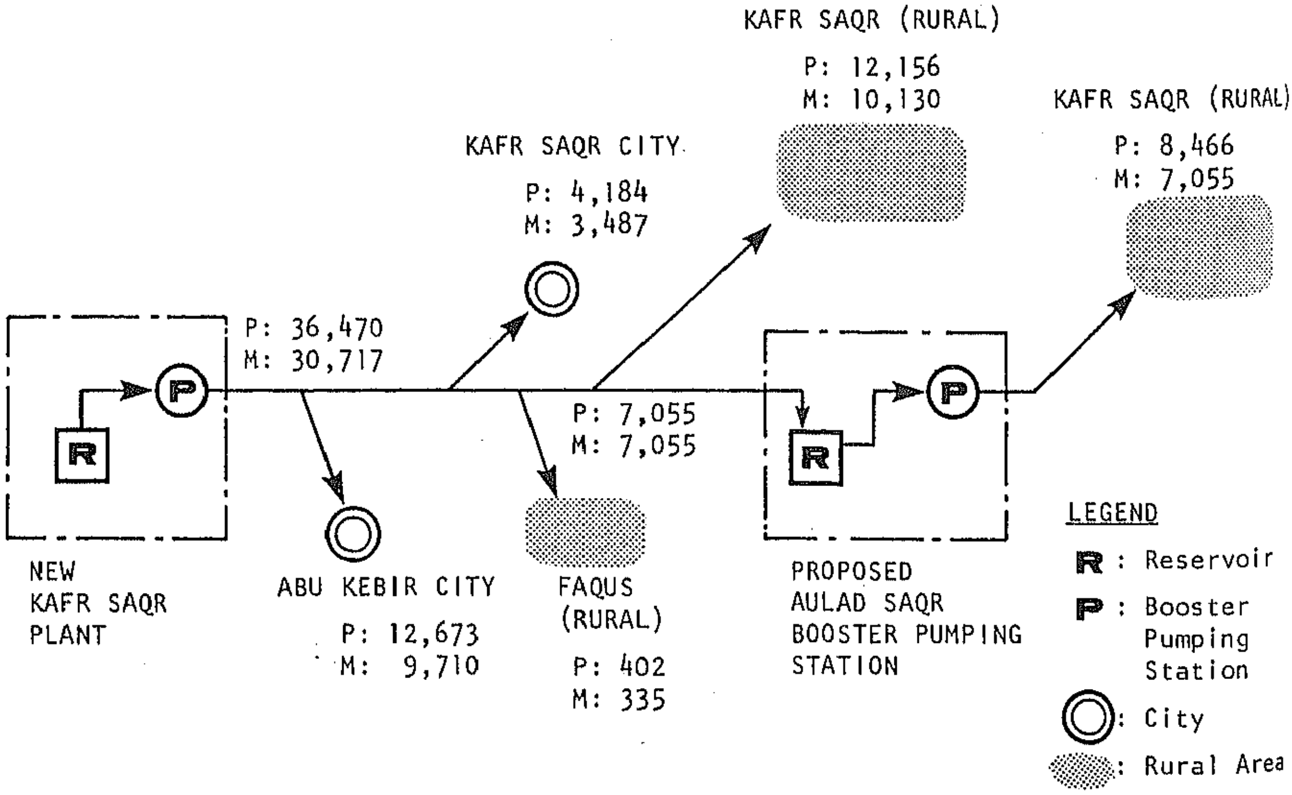


DEMANDS

P: PEAK HOUR

M: DAILY MAXIMUM

NEW KAFR SAQR SYSTEM



Fig—2.1.2 Schematic Plans of Distribution Systems

2.1.3 Trunk Mains

This section deals with the transmission and distribution pipelines in the service areas of the present project. Diameters of the proposed mains range from 1,100 mm to 100mm.

The existing transmission and distribution mains were initially installed with cast iron pipes in 1959 and since periodically expanded or reinforced with asbestos cement pipes. The existing mains are to be used for the project to full extent.

New Northeast System

Water from the proposed New Northeast Water Treatment Plant will be distributed to Faqus City, rural areas of Faqus Markaz, and part of Huseiniya Markaz. Water will be also conveyed to the proposed Huseiniya Booster Pumping Station. The trunk main from the proposed plant - Faqus City - Huseiniya will have capacity of 2005 peak hour demands.

New Kafr Saqr System

The trunk main, of which diameter ranges from 900 mm to 450 mm, functions as the distribution main to Kafr Saqr City and the southern rural area of Kafr Saqr Markaz, and at the same time, as a transmission main to the proposed booster pumping station to be located in Aulad Saqr Village. This station will serve the northern rural area of the Markaz.

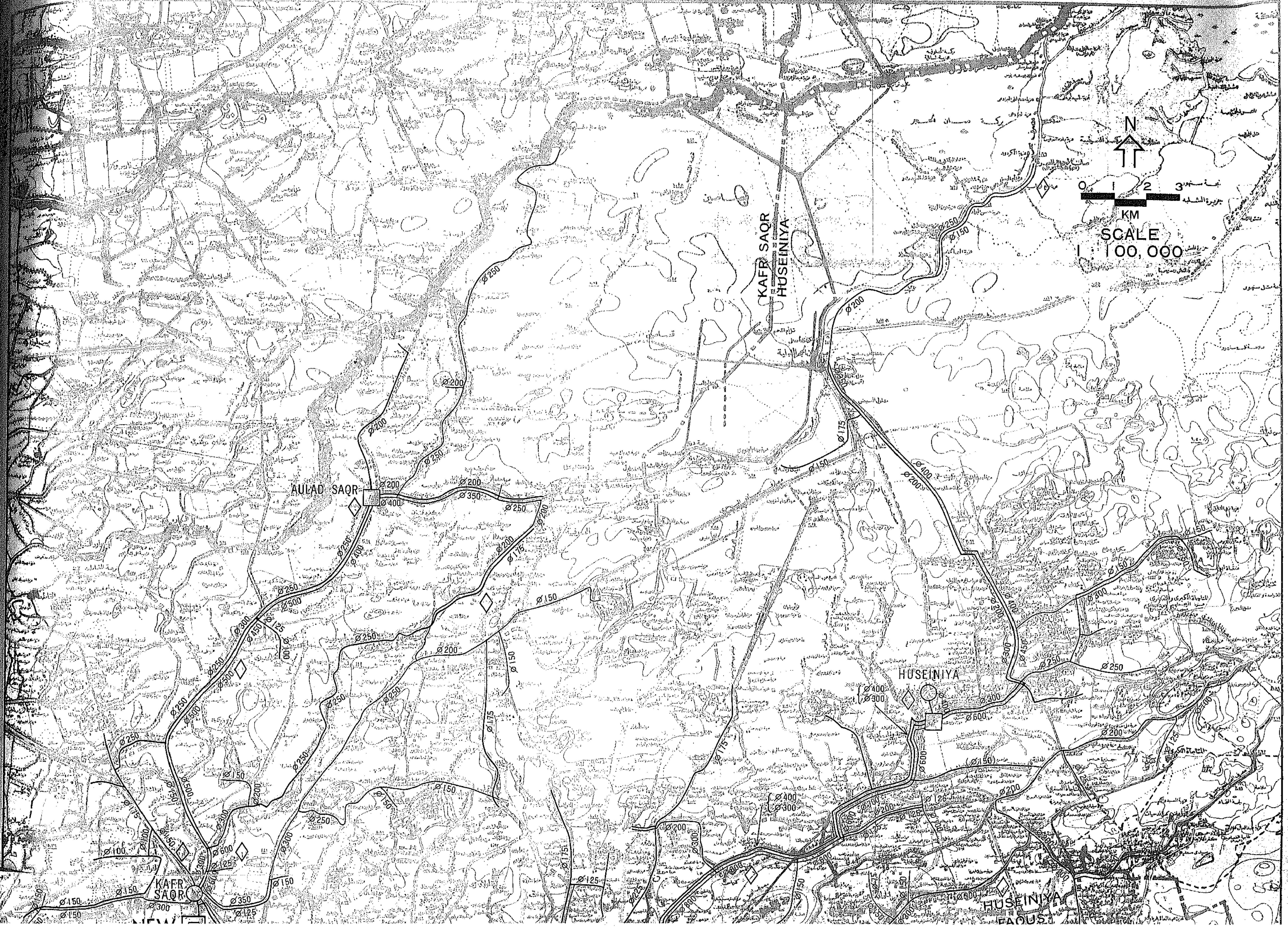
Another trunk main of 700 mm diameter branched from the abovementioned main at the railway crossing bounds south to supply Abu Kebir City.

Both proposed trunk mains will have capacities to meet the 2005 peak hour demands.

Table-2.1.2 summarizes the proposed trunk mains. The proposed trunk main plan is shown on Fig-2.1.3.

Table-2.1.2 Proposed Trunk Mains

DIAMETER (mm)	NEW NORTHEAST (km)	NEW KAFR SAQR (km)	TOTAL (km)
1,100	0.7	-	0.7
1,000	6.8	-	6.8
900	0.2	0.8	1.0
800	10.4	0.2	10.6
700	0.9	-	0.9
600	15.0	7.9	22.9
500	-	11.7	11.7
450	12.0	3.8	15.8
400	18.5	4.5	23.0
350	8.4	8.1	16.5
300	28.2	5.9	34.1
250	10.2	29.6	39.8
200	7.2	17.3	24.5
150	1.8	19.7	21.5
100	2.2	-	2.2
Total	122.5	109.5	232.0


N
0 1 2 3
KM
SCALE
1 : 100,000
KAFR SAQR
HUSEINIYA
AULAD SAQR
HUSEINIYA
KAFR SAQR
NEW
HUSEINIYA
FAQUS

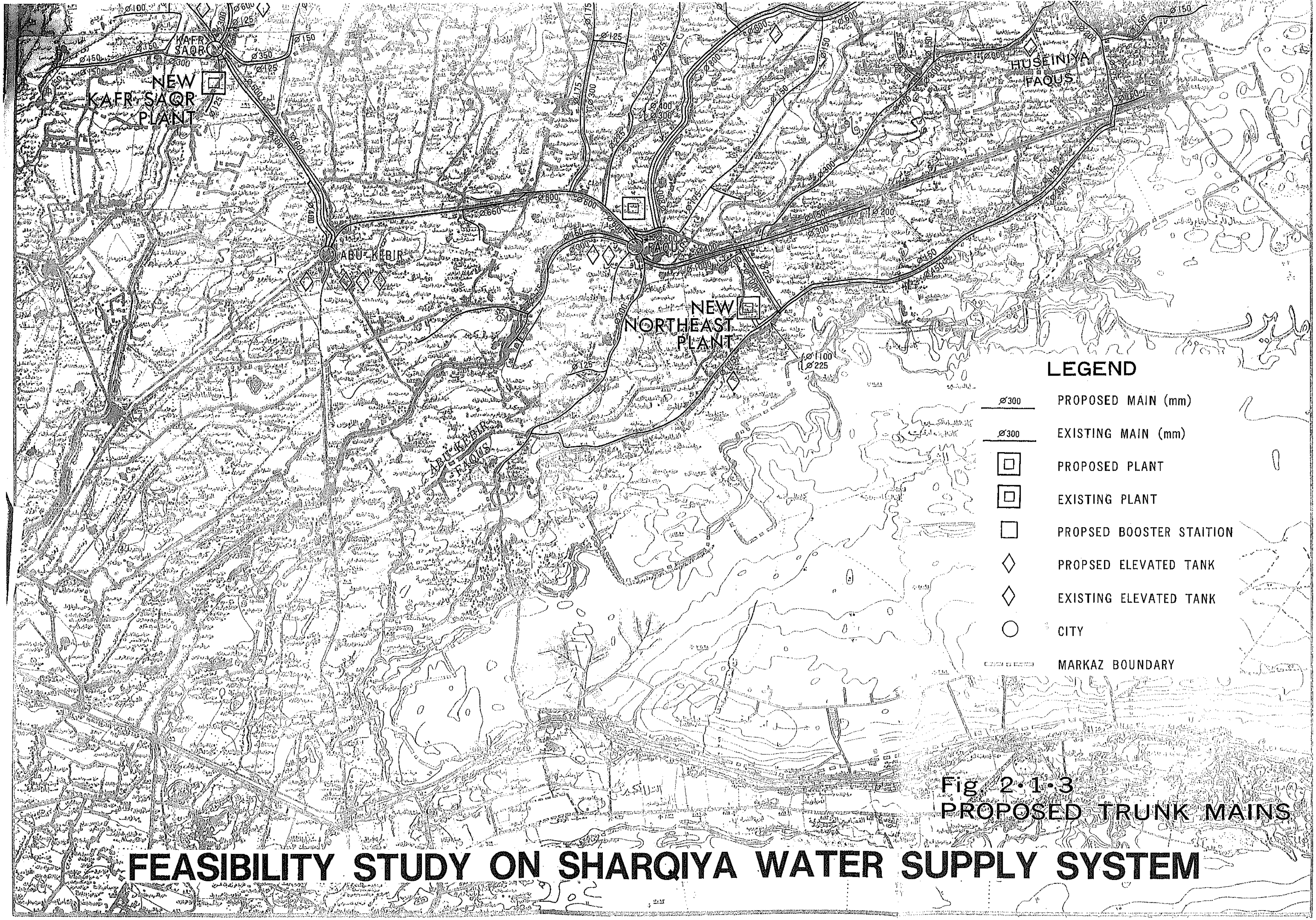


Fig. 2·1·3
PROPOSED TRUNK MAINS

FEASIBILITY STUDY ON SHARQIYA WATER SUPPLY SYSTEM

2.1.4 Booster Pumping Stations

The present project will include two booster pumping stations: the Huseiniya station and the Aulad Saqr station. (Refer to P. A-1)

The Huseiniya station will be constructed to meet the 1995 water demands of Huseiniya City and the northern rural area of Huseiniya Markaz. The facilities will include:

- 2 sets of 7.5 m3/min pumps;
- 2 sets of 4 m3/min pumps;
- 3,500 m3 storage reservoir; and
- 300 m2 pump house

The station will be augmented by 2 sets of 7,5 m3/min pumps and expansion of the reservoirs to 7,000 m3 by 2005.

Aulad Saqr station will be constructed to meet the 1995 water demands in the northern part of Kafr Saqr Markaz. The station will consist of:

- 2 sets of 4 m3/min pumps;
- 2 sets of 2 m3/min pumps;
- 1,800 m3 storage reservoir; and
- 200 m2 pump house

To furnish the long-term program's water demands, additional 2 sets of 4 m3/min pumps will be installed and storage capacity will be expanded to 3,600 m3 by 2005.

2.1.5 Elevated Tanks

There are 11 elevated tanks in the proposed service area of the project totalling to 4,550 m3 in storage capacity. (See Table 2.1.3). The analysis reveals that the existing tanks in the rural area suffice the demands up to 1995 but the urban area requires construction of five tanks; namely, one in Huseiniya City, one in Faqus City, and three in Abu Kebir City. (See Table 2.1.4). The location of the tanks will be studied and determined during the detailed design. Fig. 2.1.4 shows typical elevation of the tank.

Table-2.1.3 Existing Elevated Tanks

Location: City/Village	Location: Markaz	Volume	Height above gound
1) San El Hagar	Huseiniya	300 m3	25 m
2) Tell Rak	Kafr Saqr	300 m3	25 m
3) Kafr Saqr City*	"	400 m3	20 m
4) Natora	"	400 m3	20 m
5) Kahboona	Faqus	1,000 m3	25 m
6) Kanteer	"	500 m3	25 m
7) Faqus City	"	350 m3	**
8) El Roda	"	400 m3	32 m
9) Abu Kebir City	Abu Kebir	100 m3	**
10) Hanut	Kafr Saqr	400 m3	**
11) Aulad Saqr	"	400 m3	**
Total Capacity		4,550 m3	

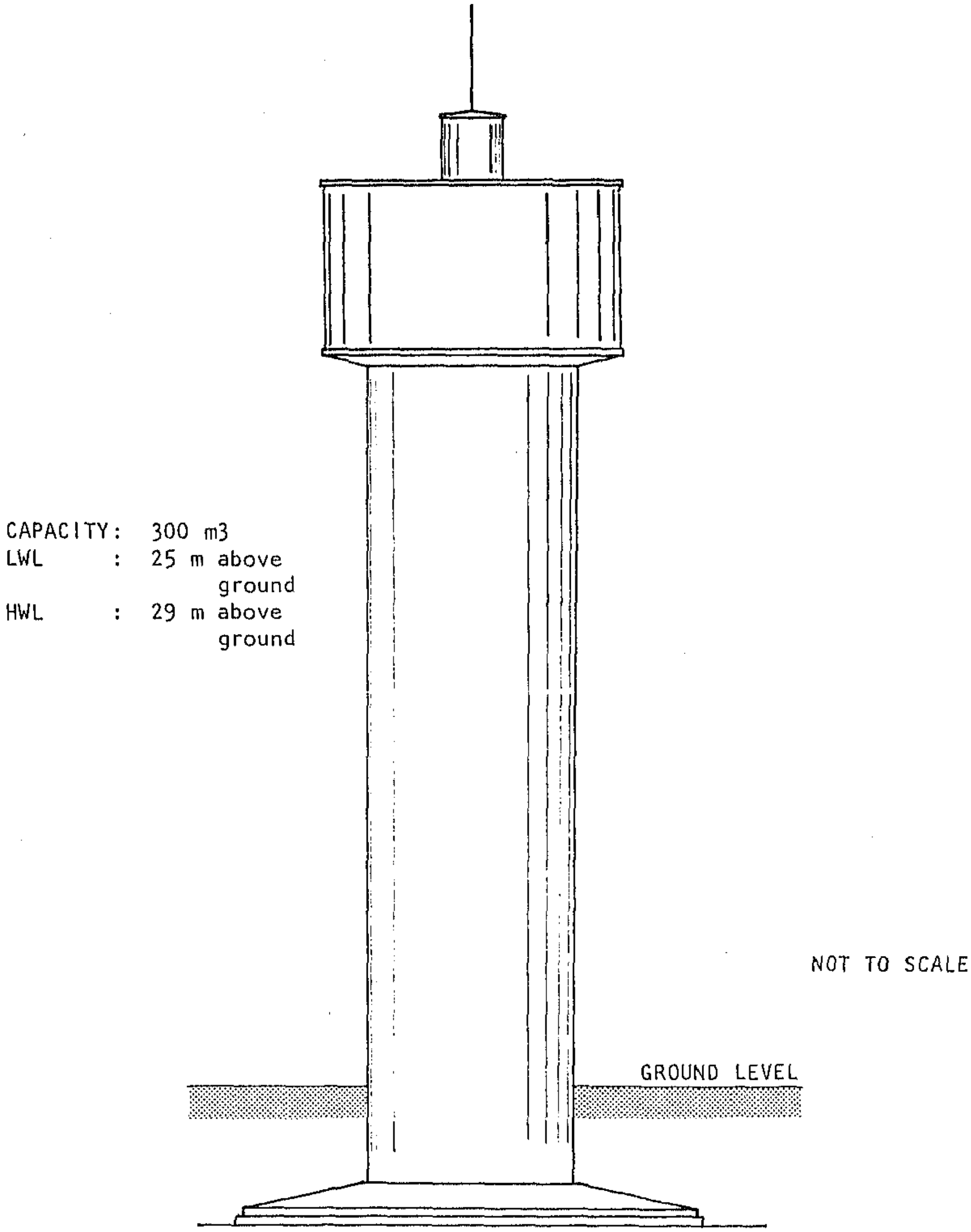
* Operated by the present Abbasa System

** Data unavailable

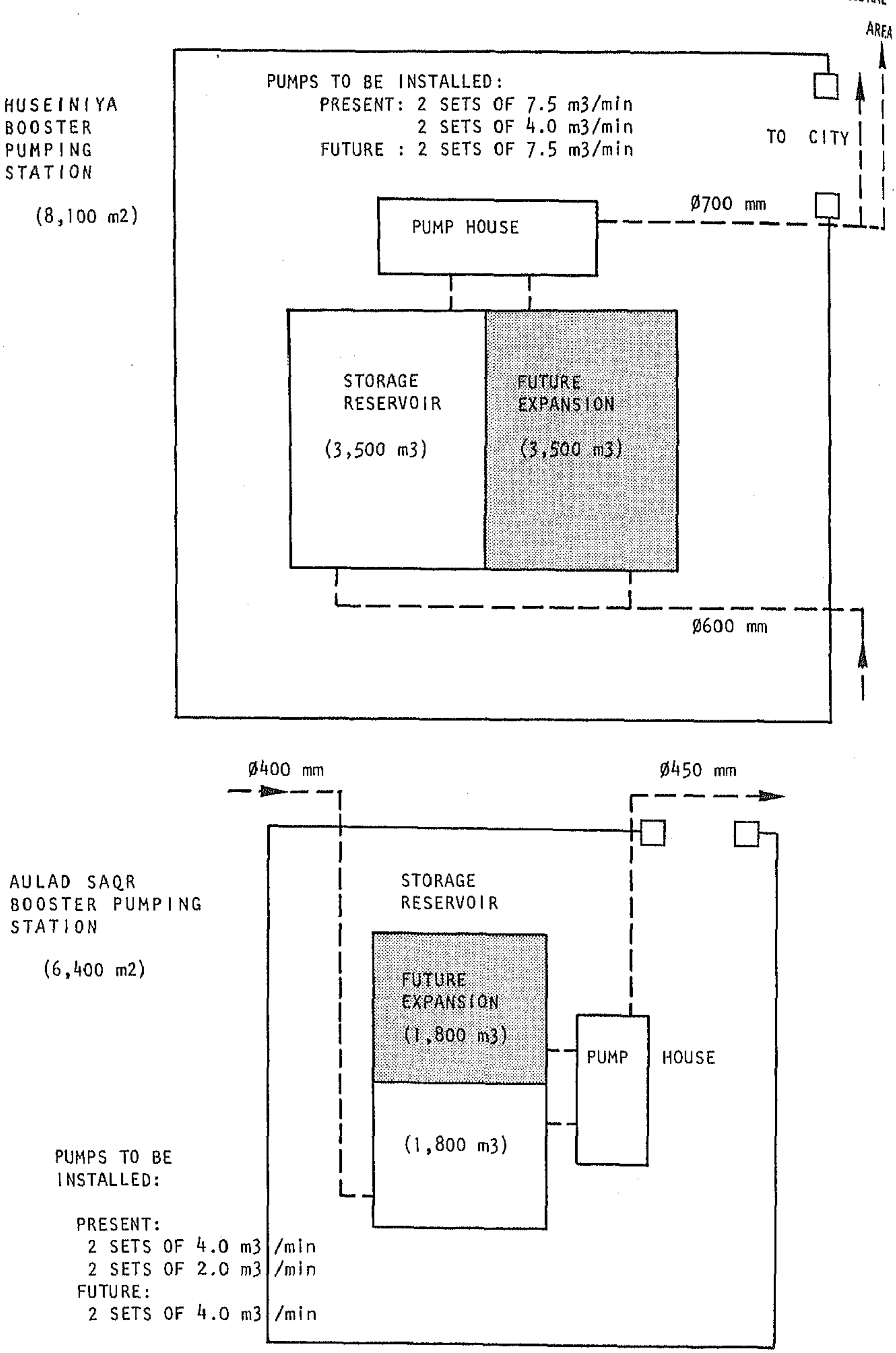
Table-2.1.4 Elevated Tanks Construction Program

Area	No. of tanks to be constructed By 1995	No. of tanks to be constructed By 2005	Present capacity (m3)
Huseiniya City	1	-	-
Kafr Saqr City	-	-	400 *
Faqus City	1	1	350
Abu Kebir City	3	3	100
Rural Area	-	3	3,700
Total	5	7	4,550

* Operated by the present Abbasa System



Fig－2.1.4 Typical Elevation of Proposed Elevated Tank



Fig－2.1.5 Schematic Layouts of Booster Pumping Stations

2.1.6 Service Mains

Service mains are defined for the present project as the distribution pipes within the cities or villages.

The project includes installation of the following service mains:

Table-2.1.5 Proposed Service Mains

Markaz	Proposed pipe length (km) City (ø250)	City (ø150)	City Sub-total	Rural (ø 150)	Total
New Northeast System					
Huseiniya	3.1	2.4	5.5	35.5	41.0
Faqus	4.2	3.1	7.3	48.0	55.3
Sub-total	7.3	5.5	12.8	83.5	96.3
New Kafr Saqr System					
Kafr Saqr	2.2	1.6	3.8	36.5	40.3
Aby Kebir	11.3	8.4	19.7	-	19.7
Sub-total	13.5	10.0	23.5	36.5	60.0
Total	20.8	15.5	36.3	120.0	156.3

2.2 Treatment Plants

2.2.1 General Concept

1) Design Capacity

Taking account of the water to be used for the plant operation, 110 % of the maximum day demand is employed as the design capacity for the new treatment plants.

- Northeast Plant (2005) : 90,000 m3/d x 1.1 = 99,000 m3/d (1.15 m3/s)
- Kafr Saqr Plant (2005) : 60,000 m3/d x 1.1 = 66,000 m3/d (0.76 m3/s)

In the First Priority-Phase Program, the plants will aim to have supply capacity up to the year 1995. According to the water demand study, the capacity to be newly developed by 1995 is about a half of the 2005 capacity. In the first stage, therefore, each plant will be constucted with half capacity.

2) Plant Site

Proposed sites for the treatment plants are shown in Fig-2.2.1. The sites were selected taking account of the quality and quantity of the canal water, the distance from the served area, and the convenience of the operation, maintenance and supply. Northeast Plant is proposed to be constructed on the left bank of Saidiya Canal, about one kilometer upstream far from the Abu Shalabi Gate. Kafr Saqr Plant is proposed to be constructed on the right bank of Muweis Canal, about one kilometer upstream of the core area of Kafr Saqr City.

3) Treatment Process

Canal is the sole available source for potable water in the northern half of the study area to meet the demand for the present project. Saidiya Canal for Northeast Plant and Muweis Canal for Kafr Saqr Plant are selected as water sources. For the canal water, the treatment method by rapid sand filtration is employed. The treatment process is schematically shown on Fig-2.2.2.

The treatment process and layout of the plants are planned in consideration of the following matters :

1) Grit Chamber and Junction Well

In the near future canals will be operated uninterruptedly all year round by means of dredging without stoppage of canals. Taking account of possibly increasing turbidity of the canal water due to the dredging, enough space for the Grit Chamber is arranged beside the Raw Water Pumping Well. The Junction Well is planned to install **valves/gates** of the Grit Chamber for the convenience of the future construction and operation.

2) Wastewater Treatment

Although the wastewater of the plant is to be directly discharged to the canal, it will become necessary in future to treat it because of pollution control. For the coming wastewater treatment as well, the space is considered in the plant site.

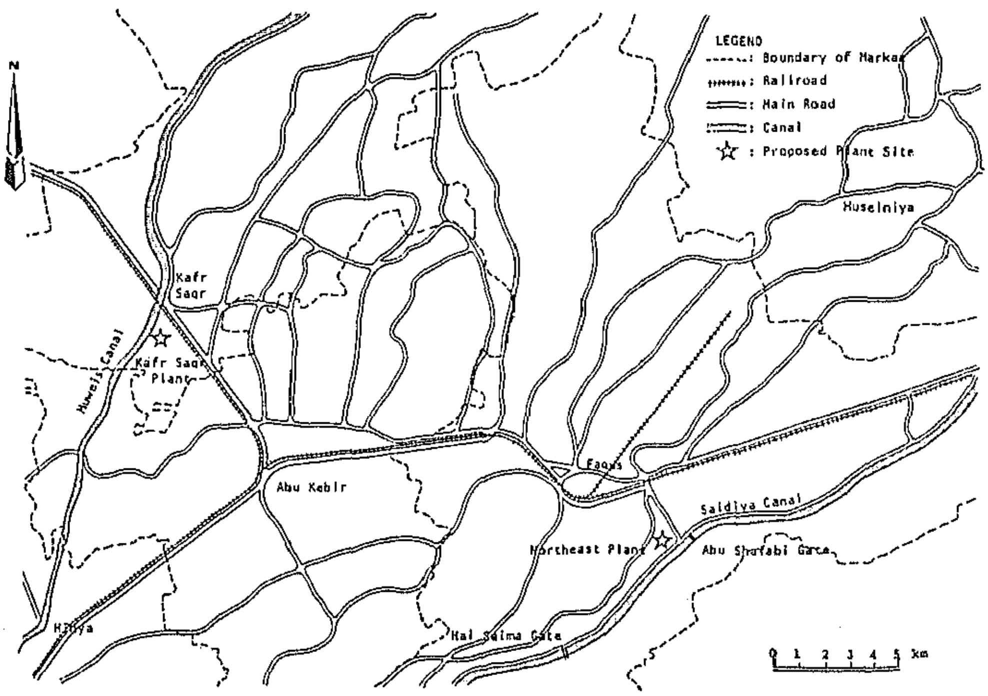


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Fig-2.2.1 LOCATION PLAN OF PROPOSED PLANT SITES

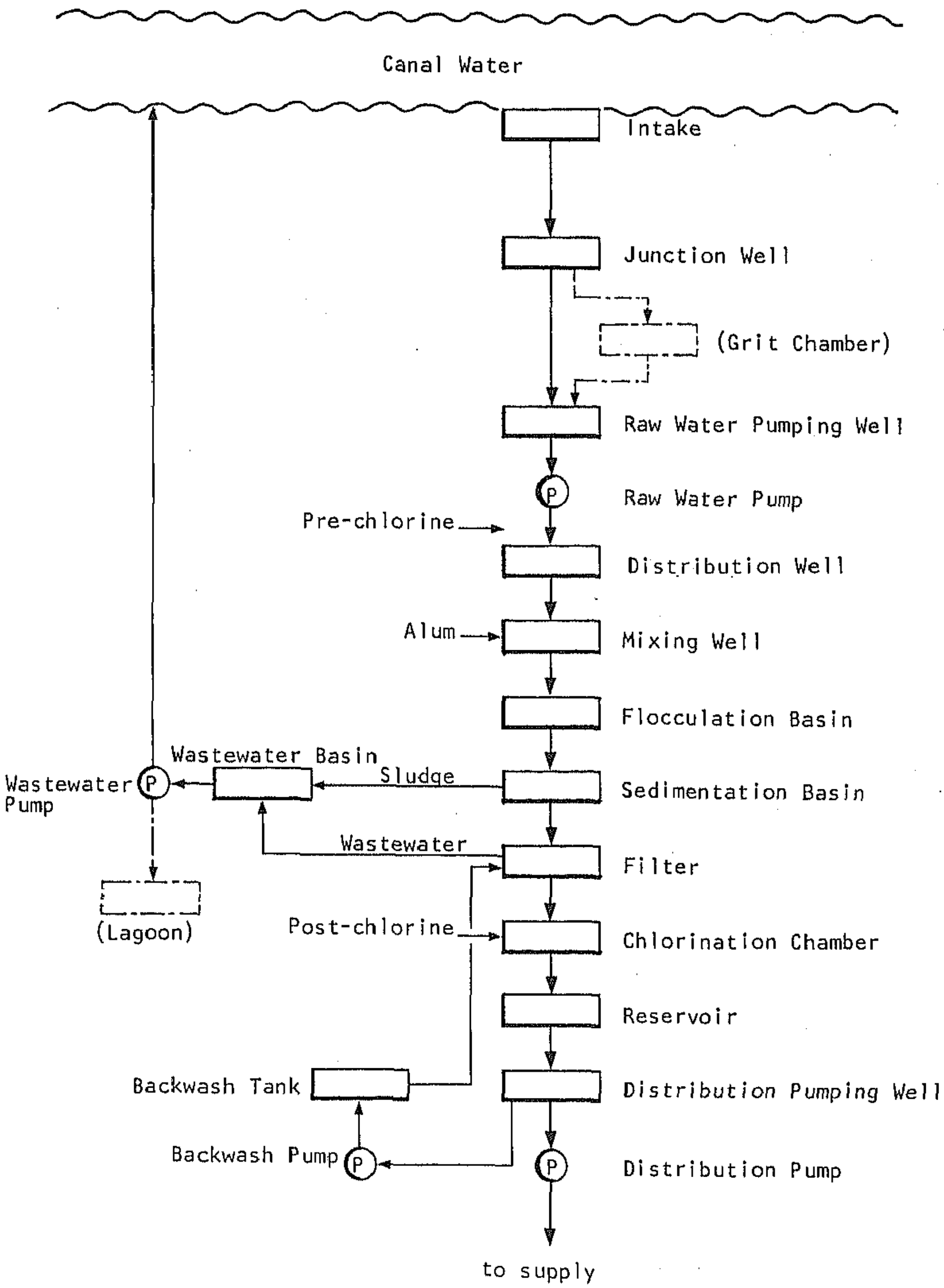


Fig-2.2.2 FLOW DIAGRAM OF TREATMENT PROCESS

2.2.2 Comparison of Facilities

1) Mixing Well

The widely employed rapid-mixing types for water treatment are as follows:

a) Hydraulic mixing by waterfall,
b) Hydraulic mixing by baffle plates/walls,
c) Mechanical mixing by rotary mixer(s), and
d) Mechanical mixing by pump (s)

Main features of them are listed in Table-2.2.1. The main feature of the mechanical system will be an adjustable intensity of mixing according to qualitative and/or quantitative fluctuation of raw water. As a matter of course, an adequate periodical and routine maintenance become indispensable for mounted machinery.

In case of hydraulic types which utilize water energy itself, any mechanical facilities are not necessary to get an appropriate mixing condition, while sludge is liable to be heaped up on a bottom of the mixing basin.

However, devices to adjust mixing intensity of mechanical type are scarcely operated everywhere in practice after mounting mixers, due to insensibility for mixing.

From the viewpoint of easy maintenance, hydraulic waterfall mixing type is employed as rapid mixing.

2) Flocculation Basin

Basic matters of slow mixing system in other words flocculation system are quite similar to rapid mixing's stated above in substance, and flocculation system as well can broadly be classified into two types; hydraulic type and mechanical. Although both types have a vertical and horizontal types respectively, there are no basic differences between them.

Table-2.2.2 shows a comparison for main matters of flocculation system. Hydraulic type generally necessitates rather high head loss comparing with mechanical system and desludging is rather difficult. In addition, as stated in the preceding section, hydraulic type is unable to carry out an adjustment by means of rotation of mixers accrding to changing conditions of water.

The most characteristic matter of mechanical system, adjustment, is not always utilized practically, and stepless variable speed reducers which are a type of devices are usually operated in a fixed speed.

Taking account of such practical condition and its easy maintenance, hydraulic type flocculation system is employed in spite of rather difficult desludging and much loss head.

3) Sedimentation Basin

In Table-2.2.3, the most popular types of sedimentation basis are compared in point of conspicuous features, that is,

a) Horizontal flow type,
b) Horizontal flow type with settling devices, and
c) Up-flow type

The type of the shortest detention time will generally be a horizontal flow type with settling devices as shown in the table. However, the construction cost does not always follows the order of their detention time in general because of the expensive devices' cost. The most costly one will be a horizontal flow type and then a horizontal flow type with settling devices, and the cheapest one an up-flow type. Their maintenance costs do not have much difference.

On the other hand, a size of sedimentation basin equipped with settling devices can be made small because of effective activity of devices. However, an appropriate attention for the devices have to be paid to the following:

a) Sludge lying on settling devices which may cause a serious damage of the devices, and
b) Deterioration of devices' material made of plastics due to mainly sunbeam.

Generally desludging becomes rather difficult because of the devices by which sludge space is covered.

The main feature of up-flow type of sedimentation basin is its compactness in size, and therefore the economization is derived. At the same time, it arises out of the compactness that the type is weak against fluctuation, qualitative and quantitative, of water, especially rapid fluctuation.

Horizontal flow type is most stable for fluctuation stated above, and operation and maintenance of this type are quite easy in general on account of big size. From the standpoint of stability for fluctuation, and easy operation and maintenance, horizontal flow type is employed for the project.

4) Wastewater Treatment

The wastewater treatment facilities are not constructed in the beginning of the First Priority-Phase Program stage for the time being, and only enough space for the facilities is maintained for the future necessity.

In Table-2.2.4, natural drying treatment and mechanical treatment systems are compared broadly. The necessary area is estimated based on the following precondition; wash water of filters is planned as drawing into canal directly, and drain water from sedimentation basins is treated by the treatment system.

For the preparation of the necessary area for treatment system, natural drying system is employed from the viewpoint of easy operation and maintenance, and little precipitation, although the system necessitates rather wide space.

Table-2.2.1 COMPARISON OF MIXING WELL

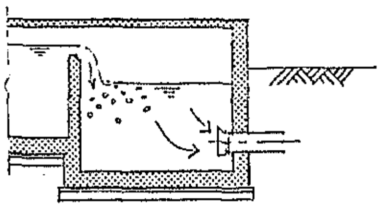
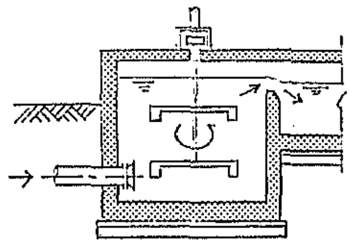
Type / Item	a. Hydraulic Type	b. Mechanical Type
		
	The above figures show represen	tative types.
1. Facilities	Basin Weir Chemical feeding equipment	Basin Mechanical mixer Chemical feeding equipment
2. Head loss	about 50 cm	Negligible
3. Reliability for mixing	Good	Good
4. Adjustability for water mixing	Unadjustable	Adjustable
5. Maintenance and repair	Not necessary	Necessary
6. Service life period	Long	Short
7. Economical aspects		
7-1 Construction cost	LE 39,200.-	LE 40,600.-
7-2 Operation cost	LE 0	LE 190/Year
8. Land area	40 m2 (First Stage)	30 m2 (First Stage)

Table-2.2.2 COMPARISON OF FLOCCULATION BASIN

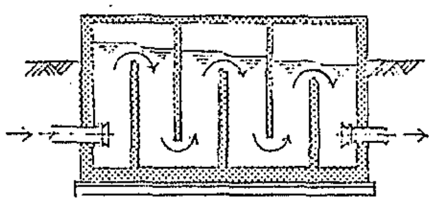
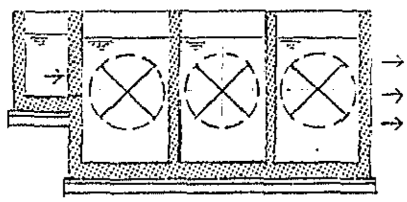
Type / Item	a. Hydraulic Type	b. Mechanical Type
		
	The above figures show representative types.	
1. Facilities	Basin Baffle walls	Basin Flocculators and motors Motor room/space Compartment walls
2. Head loss	About 40 cm	Negligible
3. Reliability for flocculation	Good	Good
4. Adjustability for water mixing	Unadjustable	Adjustable
5. Maintenance and repair	Not necessary	Necessary
6. Desludging	Difficult	Easy
7. Service life period	Long	Short
8. Economical aspects		
8-1 Construction cost	LE 150,000.-	LE 314,600.-
8-2 Operation cost	LE 0	LE 320/Year
9. Land area	300m2 (First Stage)	300 m2 (First Satge)

Table-2.2.3 COMPARISON OF SEDIMENTATION BASIN

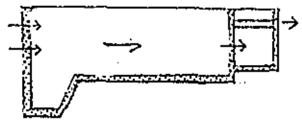
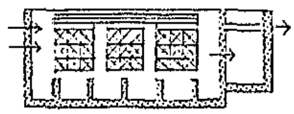
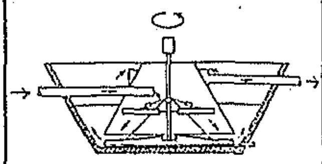
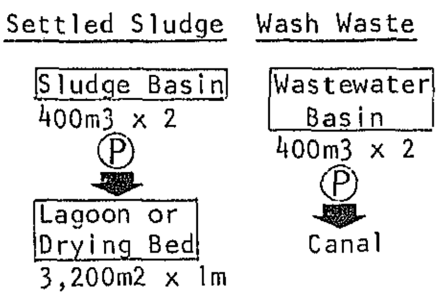
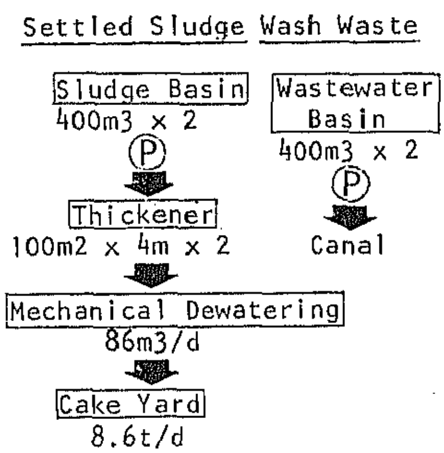
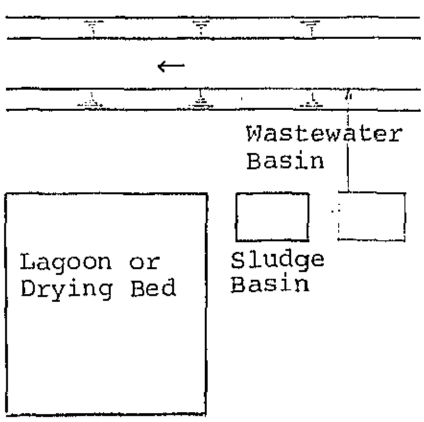
Type / Item	a. Horizontal Flow Type	b. Horizontal Flow Type with settling plates/tubes	C. Up-flow Type
			
	The above figures show representative types.		
1. Facilities	Basin Sludge scraper	Basin Settling plates/ tubes Sludge scraper	Basin Mechanical equipment Chemical feeding equipment
2. Detention time	3 - 5 hrs	0.5 - 1 hrs	1.5 - 2 hrs
3. Adaptability to fluctuation of water quality and quantity	Very good	Good	Good
4. Desludging	Easy	Rather difficult	Rather easy
5. Operacion	Easy	Easy	Rather difficult
6. Maintenance and repair	Easier	Easy	Rather difficult
7. Service life period	Long	Long	Short
8. Economical aspects			
8-1 Construction cost	LE 986,100.-	LE915,100.-	LE 630,900.-
8-2 Operation cost	LE 370/Year	LE 930/Year	LE 590/Year
9. Land area	2,800 m2 (First Stage)	700 m2 (First Stage)	1,100 m2 (First Stage)

Table-2.2.4 COMPARISON OF FUTURE TREATMENT FOR SETTLED SLUDGE AND WASH WASTE

Type / Item	Natural Treatment	Mechanical Treatment
1. Flow diagram		
2. Characteristics	Efficiency affected by precipitation. Easy operation and maintenance	A number of necessary equipments High technical level operation & maintenance
3. Economical aspects		
3-1 Construction cost	LE 750,700.-	LE 6,020,700.-
3-2 Operation cost	LE 3,300/Year	LE 1,600/Year
4. Land Area	6,000 m2 	3,200 m2