No.

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

WORKING REPORT

DECEMBER 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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WORKING REPORT NO.1

WATER RESOURCES SURVEY

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Introduction

Surveys have been carried out in order to study the conditions of both the surface water, mainly of canals, and the groundwater of wells.

1. Main Points of Survey

1.1 Surface Water of Canals

1.1.1 Canal Map (Fig. 1-1)

A canal map was made based on materials on the existing canals which had been collected at the Irrigation Department, as shown in Fig. 1.

1.1.2 Reconaissance of Canals

Referring geographical maps are on a 1:25,000 scale. The team reconnoitered the major canals of interest for the study and confirmed the validity of available maps.

1.1.3 Checking Water Quantity and Quality

Simultaneously with the reconaissance mentioned above, approximate measurement of the canals' dimentions, flow rate and water quality (mainly of conductivity and temperature) were taken at the major points of canals. The points, 19 in all, were also photographed for reference.

Those points are shown on Fig. 1-2 and the resulting data of water quality and quantity are listed in Table 1-1.

1.1.4 Observation at a Fixed Point

To study the daily change of a canal, the Muweis Canal was selected for observation. From 28 Aug. to 12 Sep., 1983, 14 days change were recorded at the fixed point, a bridge 150 m upstream from the Sharqiya Club where the team's office was located.

The observed and measured data were the flow section, flow rate and water quality (conductivity, pH, water temperature) as listed in table 2. Other data of quality were analyzed also by the Hydrochemist.

1.1.5 Reconaissance of New Canals

Two canals are now being constructed under the Irrigation Department's management. One is the Sulheiya Canal, branched from the Ismailiya Canal and running along the southeastern border of the governorate. Another is the Salam Canal, branched from the Nile mainstream and running along the northeastern tip of the governorate boundary.

The two canals, shown also in Fig. 1-1.

1.2 Groundwater

1.2.1 Groundwater Stations Map

The public water supplies in the governorate are composed either of treated surface water or of groundwater. A map showing the existing groundwater stations (wells with pumping stations) has been prepared. Fig. 1-3 shows the location of all groundwater stations and on it, the areas which are using groundwater are clearly recognized.

Table 1-3 classifies the groundwater stations of specific features.

1.2.2 Groundwater Quality

Thirty (30) wells of the above mentioned groundwater stations were investigated for the water level, water quality and other features. As all wells are installed underground, the water level of only a few wells was measurable. As for the water quality, however, it was found that conductivity, pH, RpH and water temperature could be measured on the spot, while the concetration of chlorine, iron, etc. were analyzed later in the field laboratory.

Fig. 1-4 shows the location of the 30 wells and the result of measurements are listed in Table 1-4.

1.2.3 Collection of Geological Informations

Limited information on the underground geological conditions are readily available. The wells used for water supply are mostly between 200 - 250 mm in diameter and 50 - 60 meters in depth. Based on an analysis of actually sampled soils at a well, a columnar section was pictured and it was compared with the available data obtained at the Ministry of Irrigation. As the comparison shows, the columnar section was more or less similar to the available data.

Fig. 1-5 shows the underground soil structure, existing generally in the study area.

1.2.4 Pumping Test

A pumping test should be made, usually before the start-up of a newly constructed well. This practice is not present here, however, and except for the result of a drawdown test, no information has been found available.

2. Summary of Findings

The facts found in the field study will be briefly summarized.

2.1 Surface Water (mainly of Canals)

The canals are mapped on Fig. 1-1.

All canals flowing in or through Sharqiya Governorate originate in the mainstream of the Nile River. Except for the Ismailiya Canal, which heads to the east, the major canals run northwards and discharge into Manzela Lake, and collect inflows of tributary canals on the way.

The major canals are divided into two groups according to their sources, one taking water from El Raiyah El Taufiqi Canal and another from Ismailiya Canal. Muwei Canal belongs to the former group while El Wadi and El Saidiya to the latter. Faqus Canal, though originating in El Raiyah El Taufiqi Canal, receives water of El Wadi Canal, a branch of Ismailiya Canal.

Muweis Canal is a branch of El Raiyah El Taufiqi Canal, Branched at Benha, and flows northwards through Minyet el Qamh, El Zagazig, Hihya and Kafr Saqr Markazes. The mainstream changes its name to El Hanut Canal between Hanut and Kasaby, and to El Dafan Canal from Kasaby downwards, through San el Hagar, to Manzala Lake. The water quality upstream of Hanut is kept well as it does not receive any wastewater discharge, but at Hanut, it receives a substantial amount of both domestic and agricultural waste-water, resulting in deterioration of water quality. Examination of the conductivity and chlorine concentration shows that they change from 600 μs/cm, 83 - 100 mg/l between El Zagazig and Kafr Saqr to 1500 s/cm, 246 mg/l at Hanut and 1600 μs/cm, 260 mg/l at Dafaun, indication an obvious increase of the values or notable decrease of the water quality.

Ismailiya Canal is branched from the Nile River at Cairo, flows to the northeast and runs about 50 km distance through Sharqiya Governorate, approximately one third of the 130 km total length from Cairo to Ismailiya.

It turns to the east after crossing the Governorate boundary near Abbasa and reaches Ismailiya.

El Wadi Canal is branched from Ismailiya Canal at Abbasa, flows through the city of Abu Hammad and discharges into Faqus Canal at Abu el Akhder. A pump station located on the way pumps wastewater to the canal. Another station is planned to be installed in the future. Deterioration of the water quality will be almost inevitable. El Saidiya Canal is also branched from Ismailiya Canal, at a point close to that of El Wadi Canal and then flows to the northwest, passing by the east of Faqus City. The canal does not receive wastewater. Faqus Canal is the downstream part of Bahr Abu el Akhder Canal, a branch of Muweis Canal, the name being changed on the way, and reaches Faqus City. It merges with El Wadi Canal which has received wastewater and further downwards it will receive more wastewater from a planned pumping station. Degradation of the quality will be forecast with certainty.

El Samana Canal, branched from Faqus Canal at Faqus City area, flows to the north to El Huseiniya City.

Beside the major canals as described heretofore, a number of minor canals branched from them run across the area like trees' branches and boughs.

Also, canal system which contain collecting wastewater from habitation and drainage from farmland run in a similar way as canal systems which contain supplying water.

Table 1-1 shows the qualitative and quantitative conditions at selected points, of the named major canals in the chapter.

The existing canals and canals under construction are studied in detail in Working Paper No.6, "Study on Canals and Wells as Water Sources". Water levels and discharges are tabulated for reference in Table-1-5, and study points of canal flow is shown in Fig. 1-6.

2.2 Groundwater

2.2.1 Utilization of Groundwater

As shown on Fig.1-3, the groundwater wells for water supply are overwhelmingly 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 l/s capacity range.

Table 1-3 explains each system's features.

2.2.2 Wells

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 area. As shown in Fig. 2-1, strainer covers a length of about 20 m long part 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 sand pit is provided at the bottom as the strainer part reaches there, it seems.

2.2.3 Aquifer

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

Collection of more data in the future is preferable.

2.2.4 Distribution of Groundwater

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 Noriher Diarb Nigm and Faqus City. The 3,000 to 2,000 μ s/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 μ s/cm water can be divided further into two, between 2,000 and 1,500μ s/cm, and below 1,500 μs/cm. For the area; however, the relation of conductivity and chloride concentration is not clarified. (See Fig.2-2 and 2-3)

As for the chloride (ion) concentration, the division line is 200 mg/l and the whole area is divided into the 300 - 200 part and below 200 part, the former approximately coinciding with below 2,000 s/cm conductivity area. It occupies the central part of Sharqiya Governorate and a localized portion of Mashful el Souk 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 Abbasa Markazes in the eastern zone of the Governorate. Also below 200 mg/l value is 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.

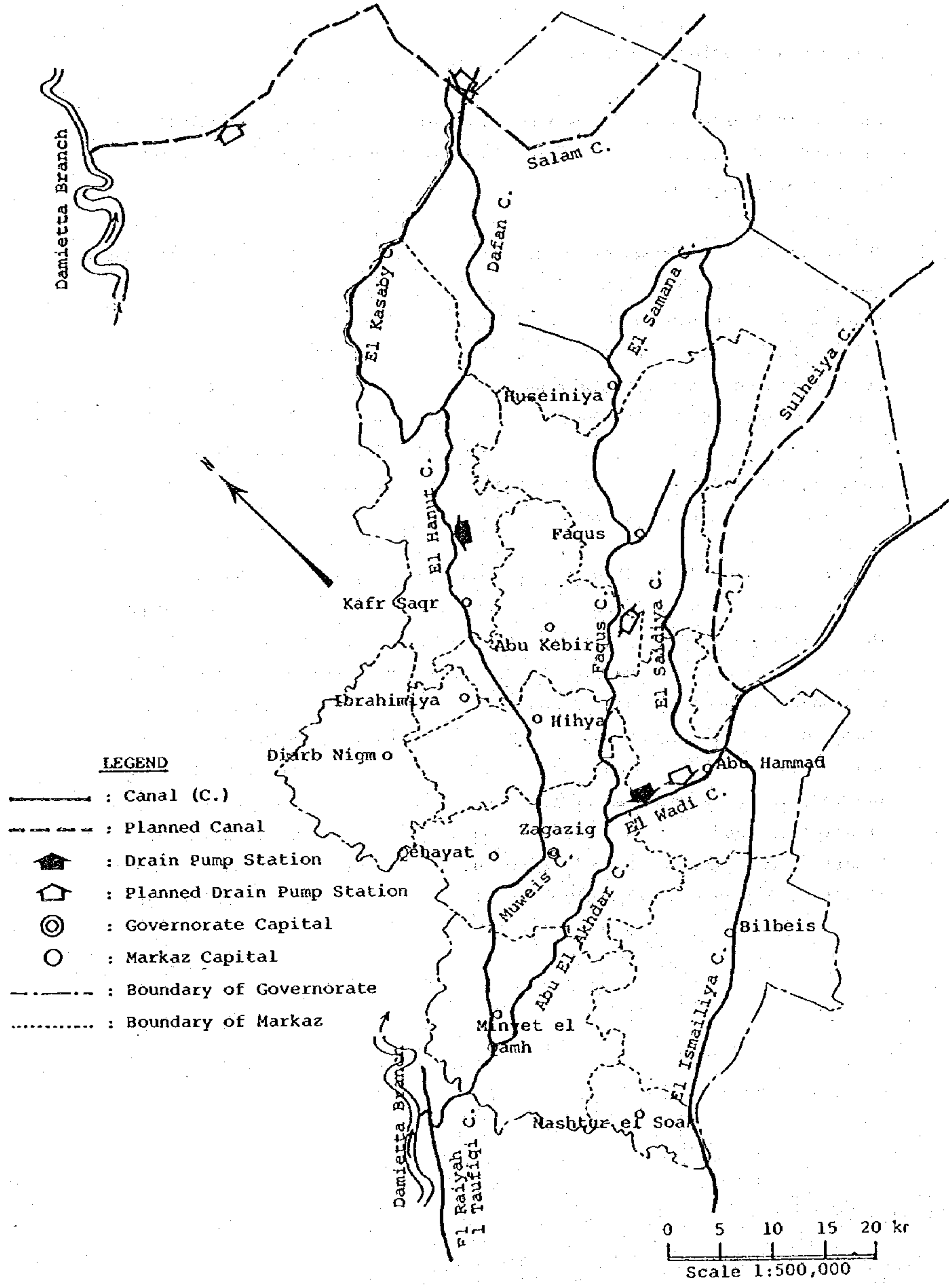

Fig.1-1 CANAL MAP

LIST OF SURFACE WATER CHECK POINTS

NO.	CANAL	LOCATION	
		Markaz	Point
1	Faqus	Zagazig	El Shabanat
2		Faqus	Faqus
3	El Samana	Faqus	Didamoon
4	Branchof El Samana	El Huseiniya	Amadd
5	Silien	El Huseiniya	Tannes
6	Saidiya	Abu Hammad	Saidiya
7	"	Faqus	Gez Abu Shalabi
8	El Wadi	Abu Hammad	Mabhasan
9	El Ismailiya	Abu Hammad	Abbasa
10	"	Abu Hammad	Sulheiya (new canal gate)
11	Muweis	Zagazig	Zagazig
12	"	Hihya	Hihya
13	"	Abu Kebir	Shaucayka
14	"	Kafr Saqr	Tileiga
15	"	Kafr Saqr	Kafr Saqr
16	El Mutarid	Kafr Saqr	Tell Rak
17	Hanut	Kafr Saqr	Aulad Saqr
18	Dafan	Kafr Saqr	Zur Abu el lil
19	Defan	Huseiniya	Sam el Hagar

From 28 Aug. to 12 Sept. 1983, measuring of flowrate and water quality test carried doen at the station of M-1 on Muweis as a fixed observatory station. (See Table 1-1)

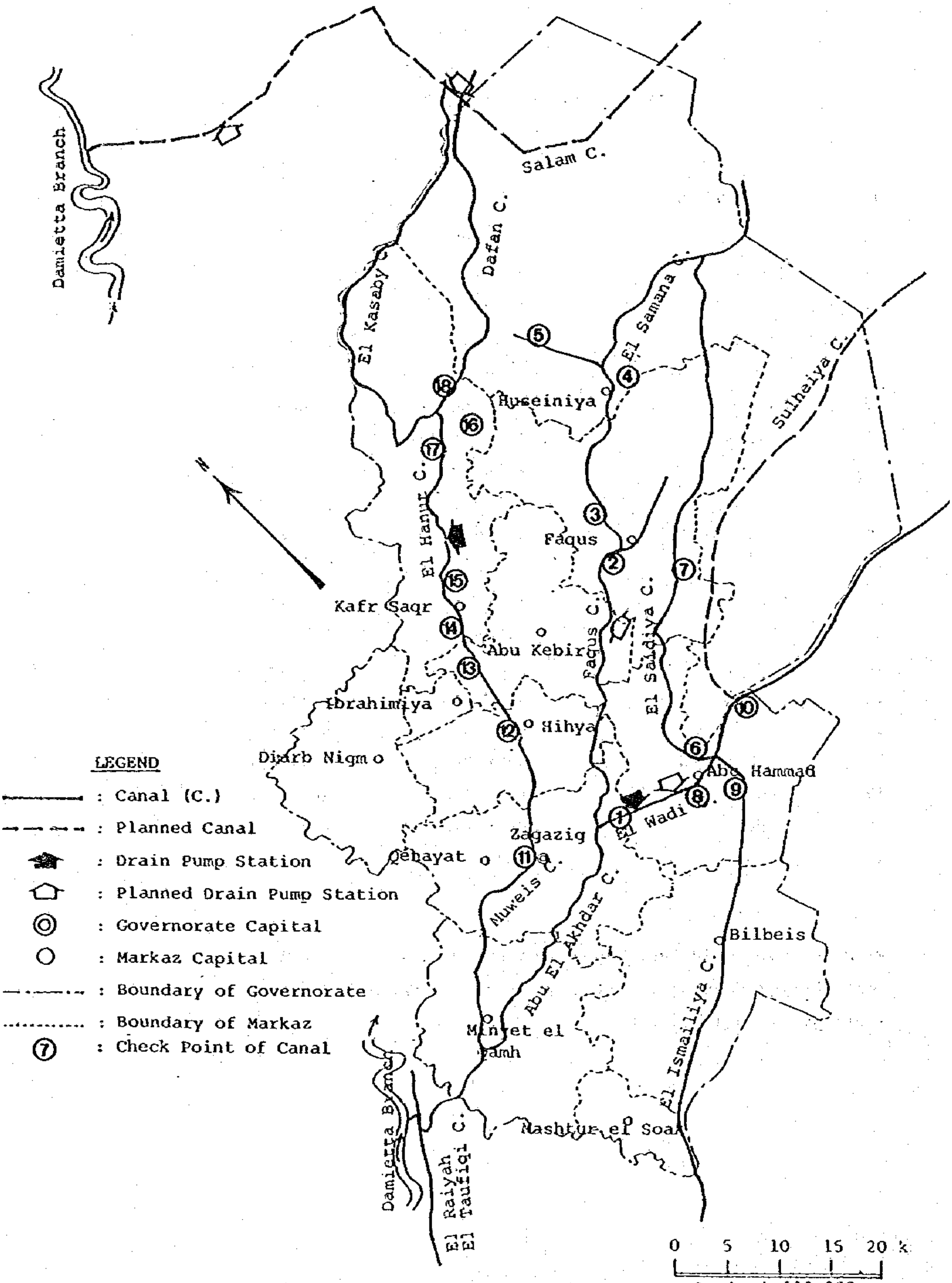

Fig.1-2 CHECK POINTS MAP OF WATER QUALITY

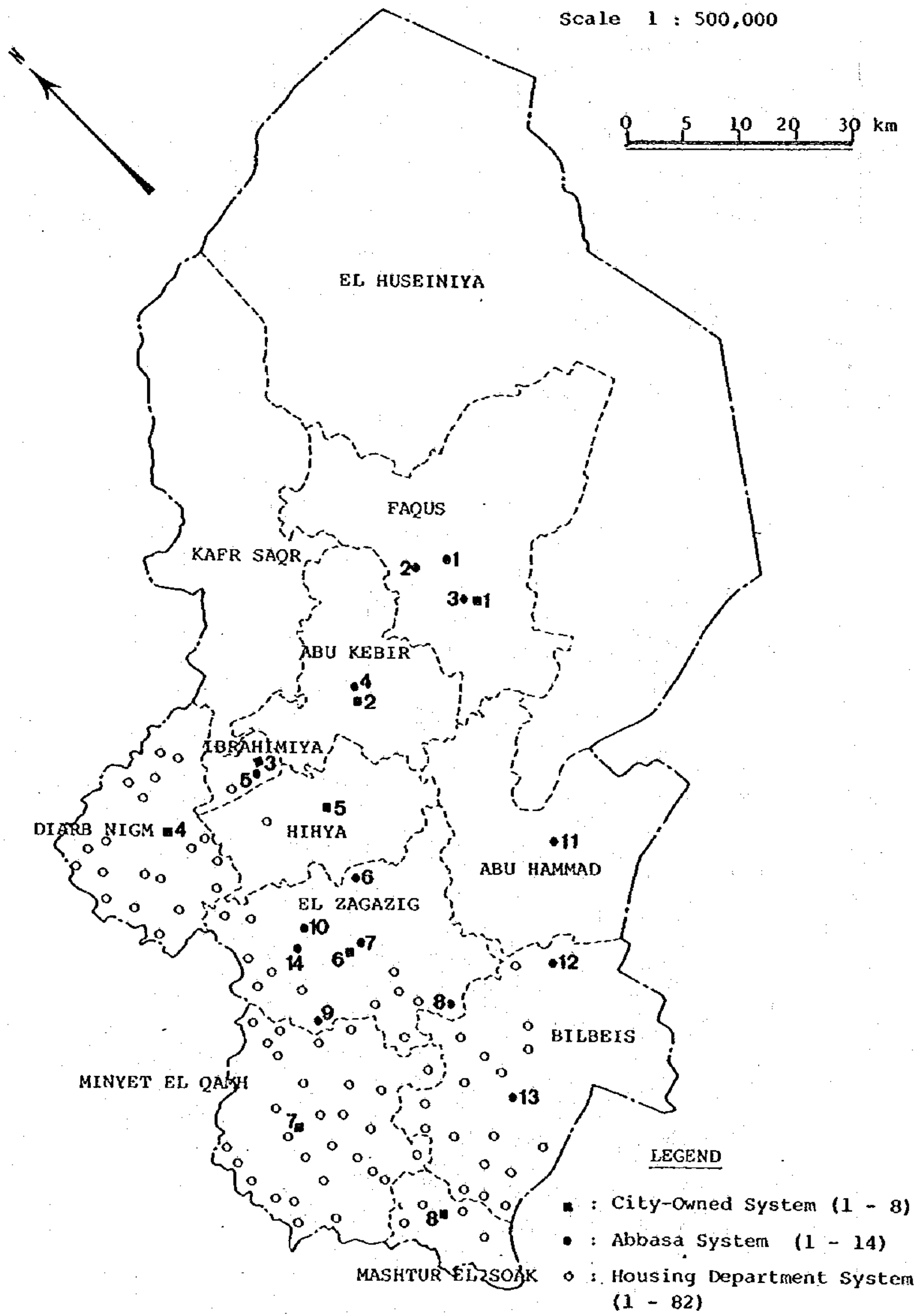

Fig.1-3 GROUNDWATER STATIONS MAP (a)

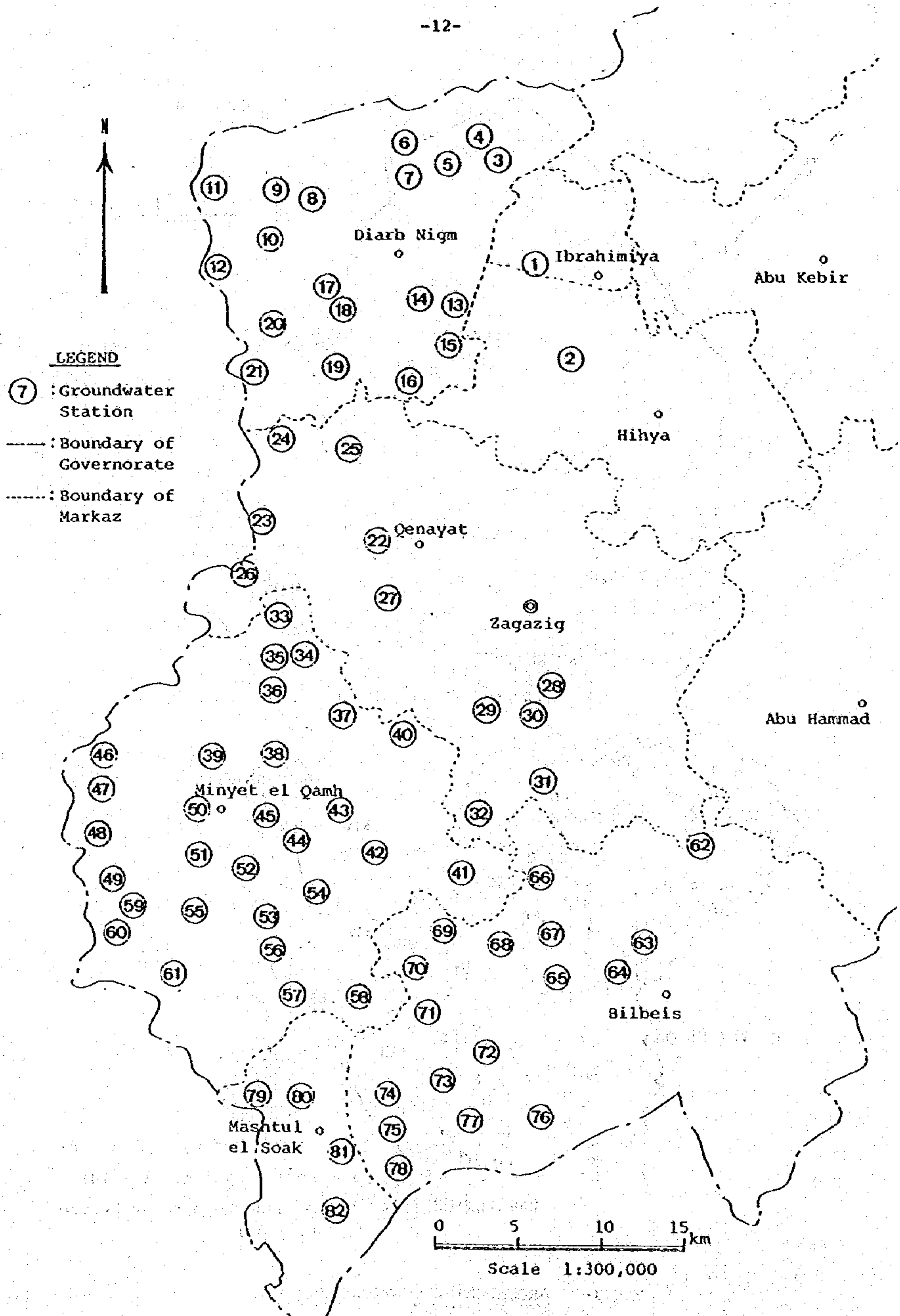

Fig.1-3 GROUNDWATER STATIONS MAP (b)

LIST OF GROUND WATER CHECK POINTS

FIG. NO.	LOCATION Markaz	Point
A - 1	Faqus	Didamoon
A - 4	Abu Kebir	Abu Kebir
C - 5	Hihya	Hihya
C - 3	El Ibrahimiya	El Ibrahimiya
H - 1	"	Mubashir
C - 4	Diarb Nigm	Diarb Nigm
H - 14	"	Saft Zireig
H - 3	"	Gimmeizeit Beni Ann
H - 9	"	Safur
C - 6	El Zagazig	El Zagazig
H - 22	"	El Nakh-khas
H - 23	"	El Baiyum
H - 24	"	Mit Abuarabi
H - 25	"	Duweida
H - 26	"	Shimbaret el-Mamuna
A - 14	El Qenyat	El Qenayat
A - 11	Abu Hammad	Abbasa
C - 7	Minyet el Qamh	Minyet el Qamh
H - 38	"	El Gudaiyida
H - 43	"	Mit Bash-shar
H - 36	"	El Tallein
H - 55	"	Sanhut el-Birak
H - 44	"	Shal Shalamon
H - 49	"	El-Aziziya
A - 13	Bilbeis	Ghita
H - 66	"	Sandanhur
H - 72	"	El Saidiya
H - 75	"	Salamant
C - 8	Mashtul el Soak	Mashtul el Soak
H - 80	"	Kafr Ibrash

Note: Managing Authorities

A ... Abbasa
C ... City
H ... Housing Dept.

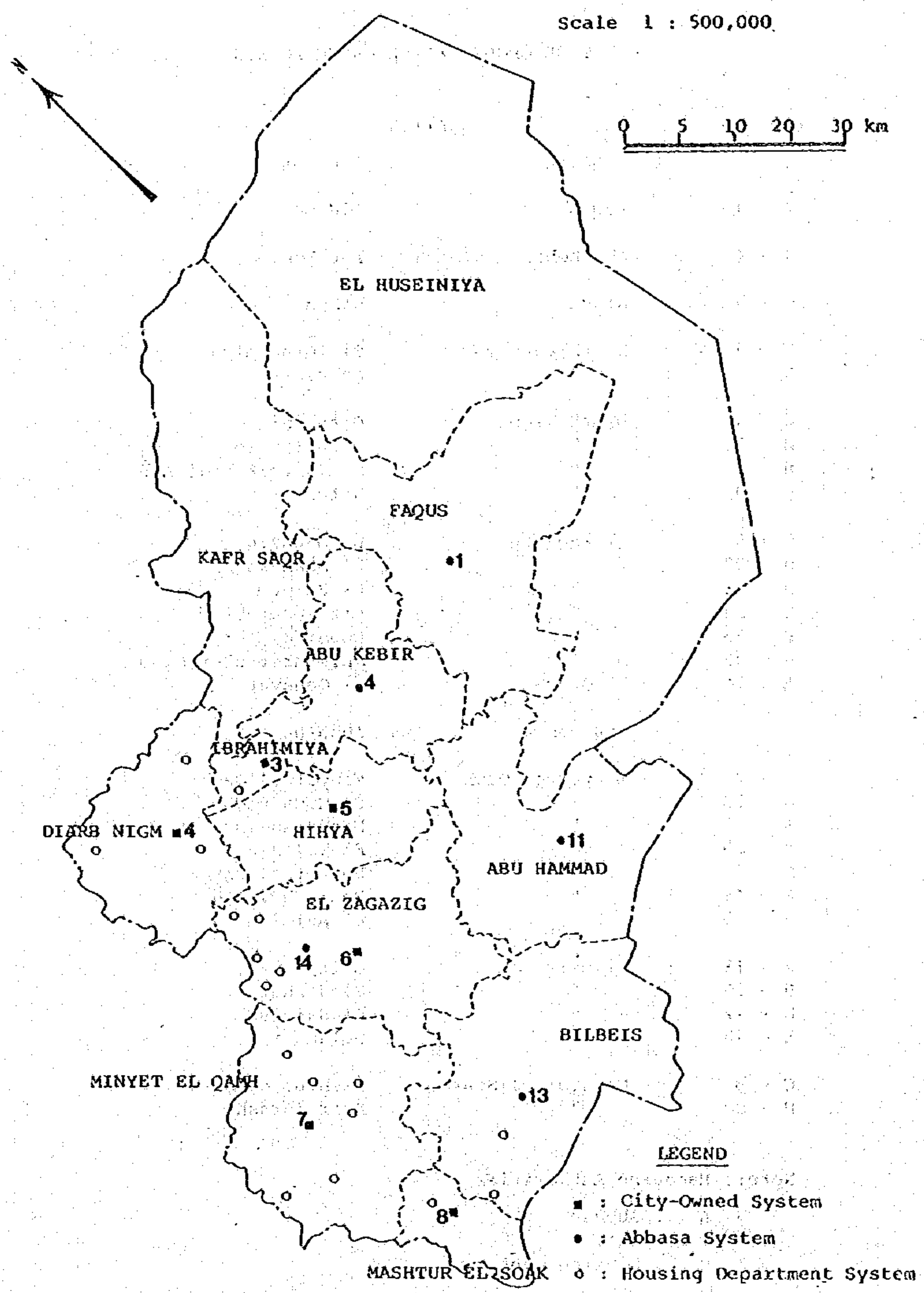

Fig.1-4 LOCATION OF GROUNDWATER QUALITY CHECK POINTS (a)

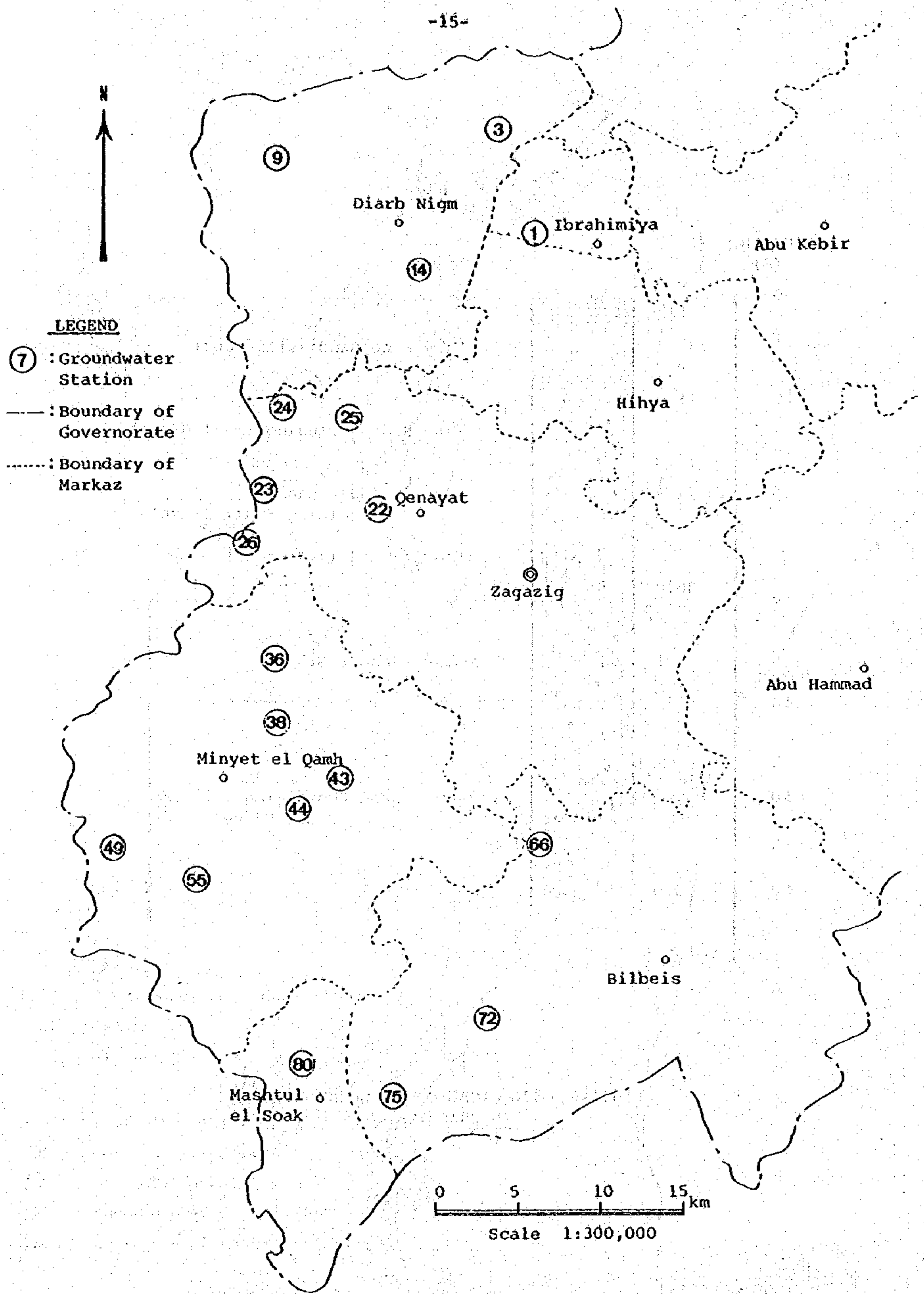

Fig.1-4 LOCATION OF GROUNDWATER QUALITY CHECK POINTS (b)

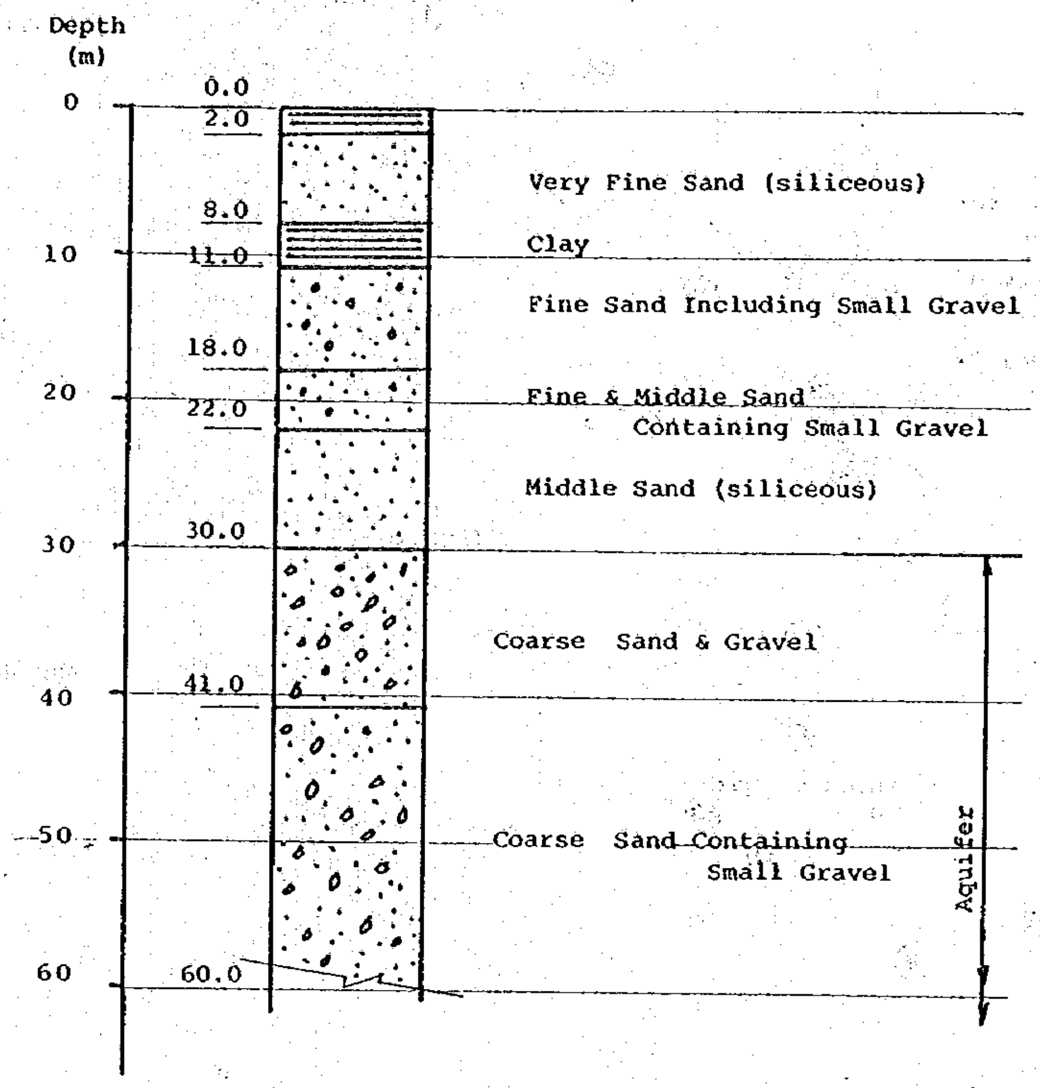

Fig.1-5 GEOLOGICAL COLUMNAR SECTION IN SHARQIYA

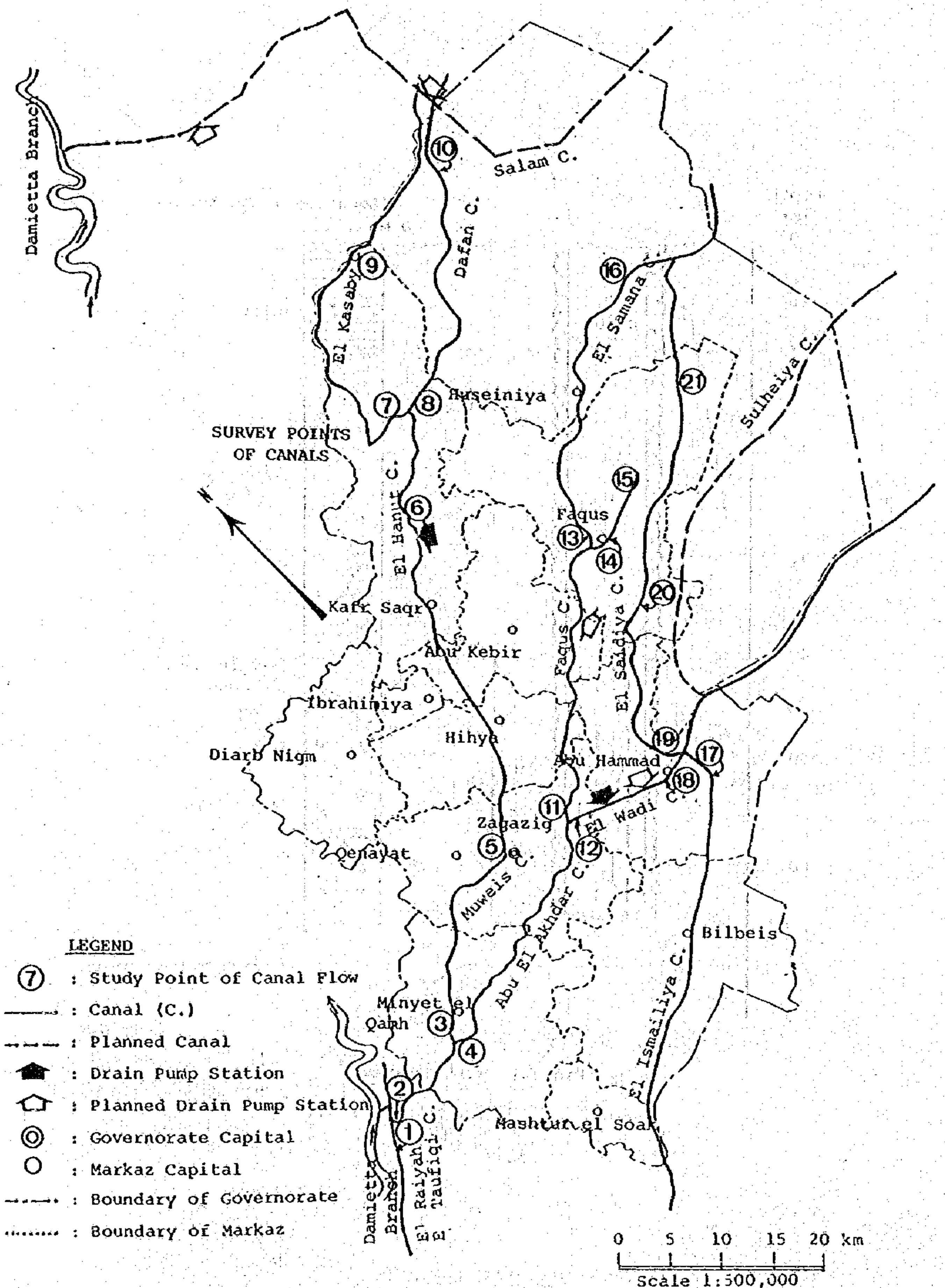

Fig.1-6 STUDY POINT OF CANAL FLOW

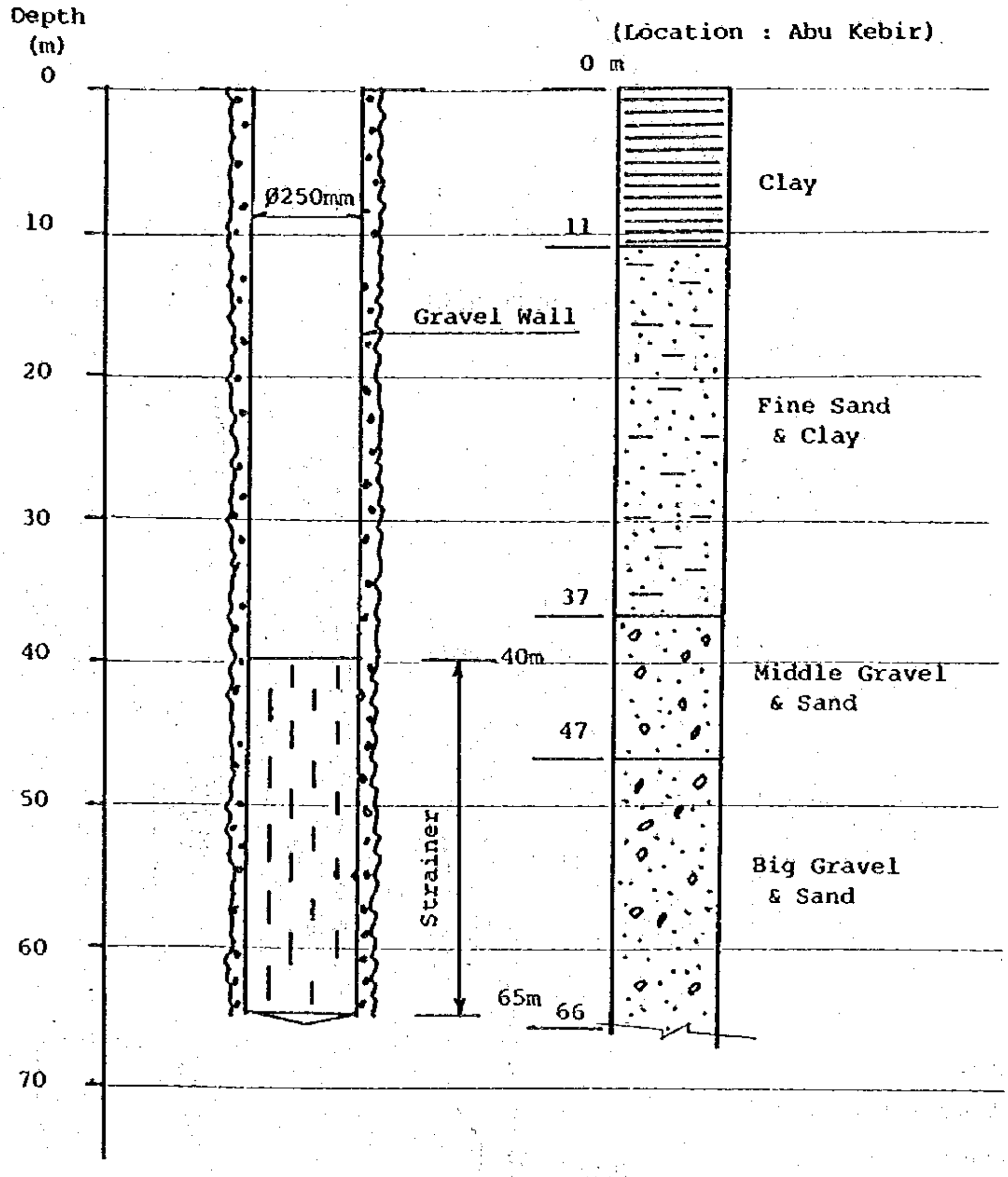

Fig.2-1 WELL STRUCTURE

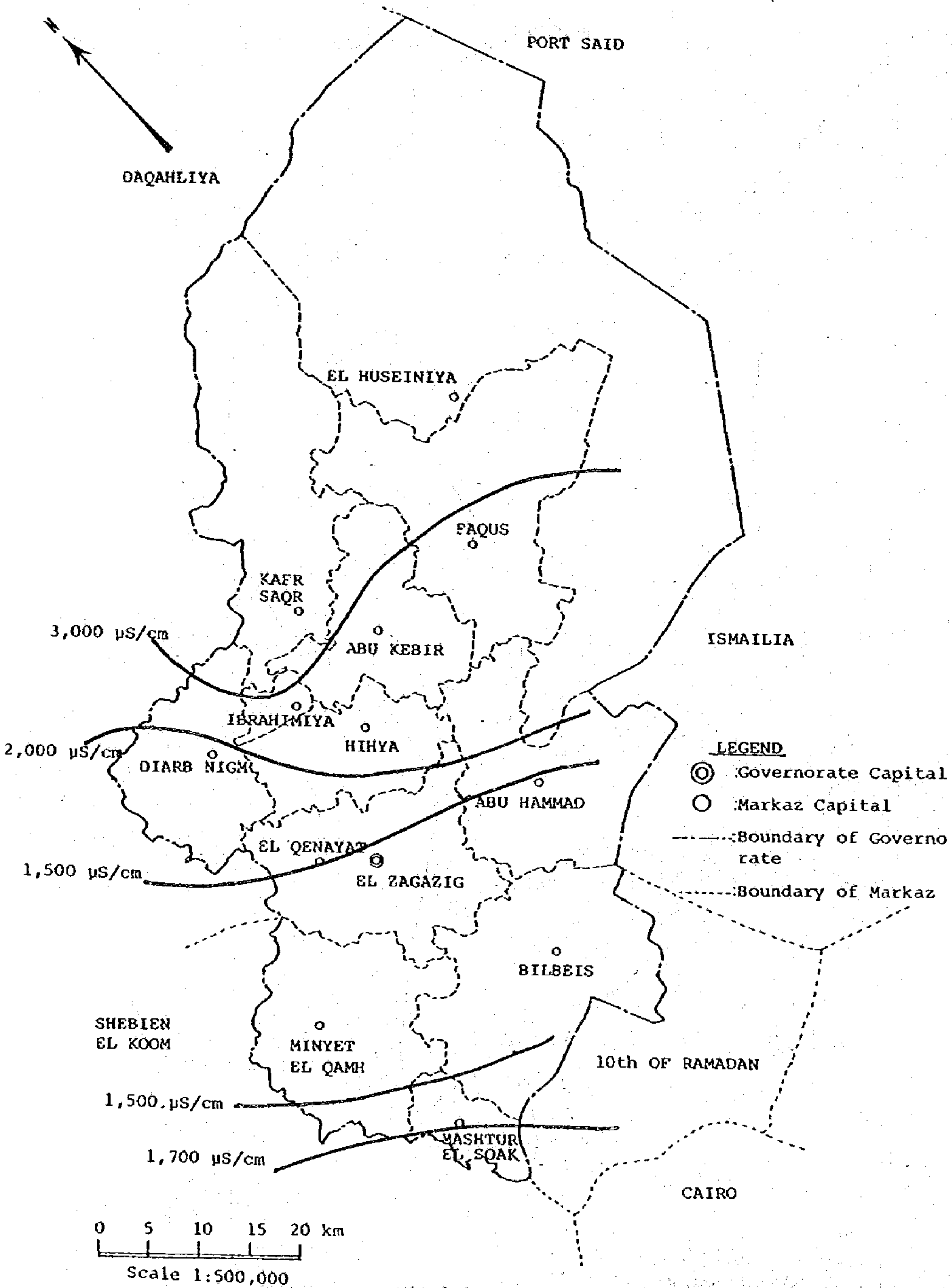

Fig.2-2 ELECTRIC CONDUCTIVITY DISTRIBUTION

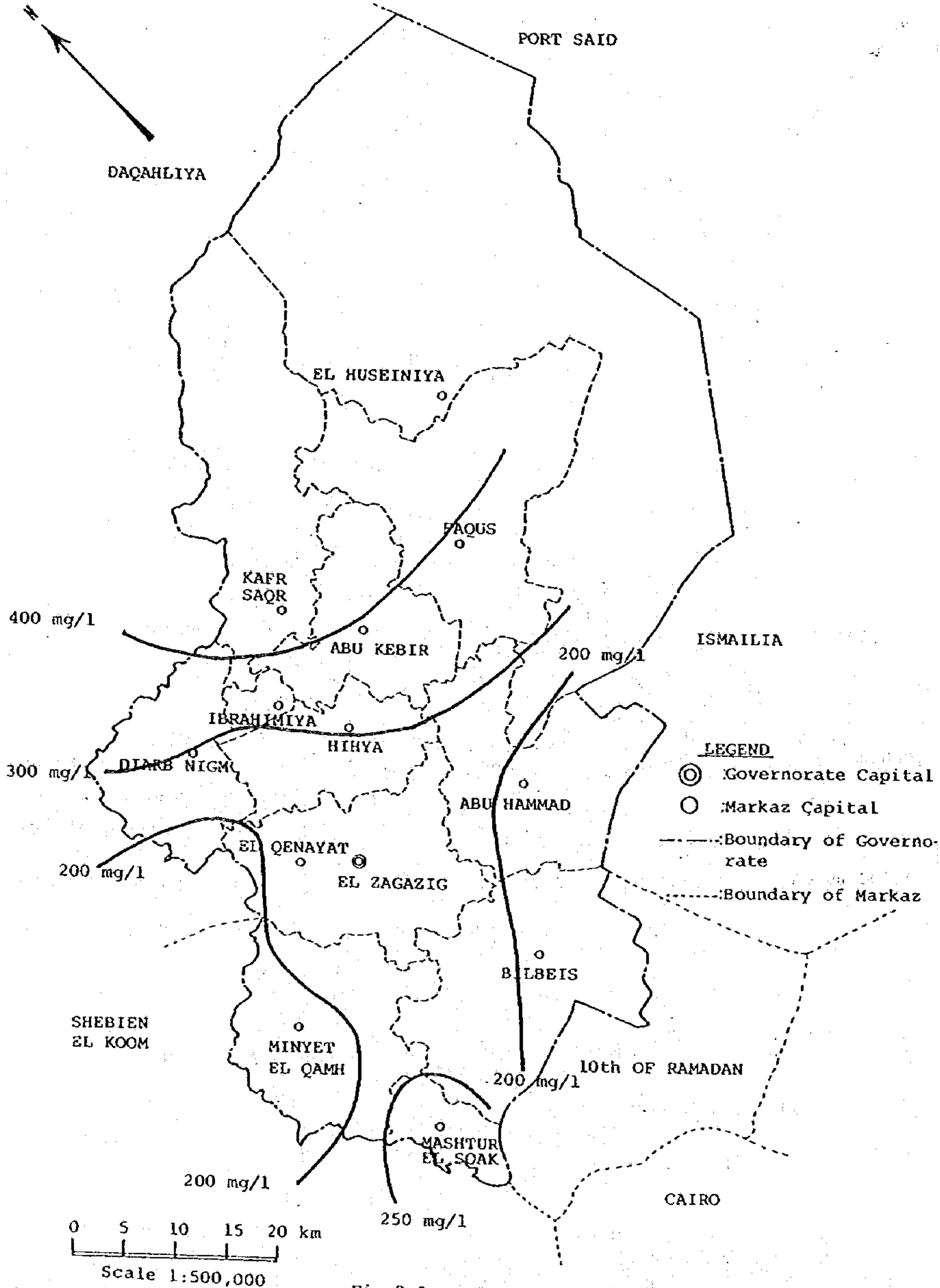

Fig.2-3 CHLORIDE ION CONCENTRATION DISTRIBUTION

Table 1-1 QUANTITY AND QUALITY OF CANAL WATER (a)

No.	Sampling Date (1983)	Canal	Location: Markaz	Location: Place	Conductivity (μs/cm)	pH	Temperature (°C)	Cℓ⁻ (ppm)	Turbidity (ppm)	T.Hardness (ppm)	Discharge (m^3/sec)	Remarks
1	30 Aug.	Faqus	Zagazig	Shabanat	610	7.50	27.6	90	22	106	35.62	
2	4 Sep.	"	Faqus	Faqus	900	7.50	27.7	146	40	143	23.38	
3	4 Sep.	Samana	"	Didamoon	940	7.40	28.8	166	80	374	14.54	from Faqus Canal
4	4 Sep.	Branch of Samana Canal	Huseiniya	Amadd	950	7.56	30.7	-	-	-	-	
5	4 Sep.	Siliem	"	Tannes	9000	7.69	29.9	-	-	-	-	
6	30 Aug.	Saidiya	Abu Hammad	Saidiya	630	7.82	28.7	89	16	104	28.12	from Ismailiya Canal
7	4 Sep.	"	Faqus	Gez Abu Shalabi	640	7.67	29.1	118	40	140	6.2	
8	30 Aug.	Wadi	Abu Hammad	Mabhasan	640	7.80	28.2	91	17	107	19.48	from Ismailiya Canal
9	30 Aug.	Ismailiya	"	Abbasa	630	7.70	28.8	84	8	106	111.79	
10	8 Sep.	"	"	Sulheiya New Canal Gate	700	8.02	28.3	-	-	-	-	
11	1 Sep.	Muweis	Zagazig	Zagazig	600	7.71	26.6	83	16	104	87.44	
12	1 Sep.	"	Hihya	Hihya	600	7.71	27.6	101	22	104	32.74	
13	1 Sep.	"	Abu Kebir	Shaucayka	600	7.30	27.3	-	-	-	-	
14	1 Sep.	"	Kafr Saqr	Tileiga	600	7.68	27.7	110	25	114	19.42	
15	1 Sep.	"	"	Kafr Saqr	600	7.62	27.7	-	-	-	24.85	

Table 1-1 QUANTITY AND QUALITY OF CANAL WATER (b)

No.	Sampling Date (1983)	Canal	Location		Conductivity (μs/cm)	pH	Temperature (°C)	Cℓ⁻ (ppm)	Turbidity (ppm)	T.Hardness (ppm)	Discharge (m^3/sec)	Remarks
			Markaz	Place								
16	1 Sep.	Mutarid	Kafr Saqr	Tell Rak	700	7.58	29.1	110	25	127	—	Branch of Mueis Canal
17	1 Sep.	Hanut	"	Aulad Saqr	1500	7.51	28.0	246	26	186	15.62	
18	1 Sep.	Dafan	"	Zur Abu El Lil	1600	7.55	29.4	260	10	127	-	Gate was Closed
19	4 Sep.	"	Huseiniya	San El Hagar	3500	7.53	28.8	-	-	-	-	

Table 1-2 DATA OF FIXED POINT OBSERVATION

No.	Sampling Date (1983)	Canal	Location		Conductivity (μs/cm)	pH	Temperature (°C)	Cl^- (ppm)	Turbidity (ppm)	T.Hardness (ppm)	Discharge (m^3/sec)	Remarks
			Markaz	Place								
1	28 Aug.	Muweis	Zagazig	Zagazig	660	7.78	28	-	-	-	86.8	
2	29 "	"	"	"	600	7.71	26.9	-	12	-	80.0	
3	30 "	"	"	"	610	7.64	26.7	87	22	106	86.4	
4	31 "	"	"	"	600	7.68	27.0	-	-	-	83.50	
5	1 Sep.	"	"	"	600	7.71	26.6	83	16	104	87.44	
6	3 "	"	"	"	570	7.50	26.7	83	20	101	75.98	
7	4 "	"	"	"	600	7.63	26.8	88	25	114	57.77	
8	5 "	"	"	"	660	7.75	26.8	96	20	108	90.62	
9	6 "		"	"	600	7.67	26.8	88	18	106	76.56	
10	7 "	"	"	"	600	7.70	27.3	91	7	107	81.84	
11	8 "	"	"	"	600	7.62	27.2	94	27	94	78.60	
12	10 "	"	"	"	670	7.51	27.0	91	15	106	74.27	
13	11 "	"	"	"	650	7.56	27.0	89	15	106	74.96	
14	12 "	"	"	"	650	7.50	26.7	77	16	106	86.48	

Table 1-3 <u>FEATURES OF GROUNDWATER STATIONS (a)</u>

System	No.	Location		Number of Well	Pump Capacity	Remarks	Check Point
		Markaz	Place				
City	C-1	Faqus	Faqus	8	8 x 25 l/s = 200 l/s	250m/m x 50 - 60 m	
	C-2	Abu Kebir	Abu Kebir	7	7 x 25 l/s = 175 l/s	250m/m x 50 - 60 m	
	C-3	Ibrahimiya	Ibrahimiya	3	3 x 25 l/s = 75 l/s	250m/m x 50 - 60 m	*
	C-4	Diarb Nigm	Diarb Nigm	3	3 x 20 l/s = 60 l/s	200m/m x 50 - 60 m	*
	C-5	Hihya	Hihya	4	4 x 25 l/s = 100 l/s	250m/m x 50 - 60 m	*
	C-6	Zagazig	Zagazig	21	21x 25 l/s = 525 l/s	250m/m x 50 - 60 m	*
	C-7	Minyet el Qamh	Minyet el Qamh	5	5 x 25 l/s = 125 l/s	250m/m x 65 - 70 m	*
	C-8	Mashtul el Soak	Mashtul el Soak	3	1 x 25 l/s = 25 l/s 2 x 20 l/s = 40 l/s	250m/m x 50 - 60 m 200m/m x 50 - 60 m	* *
	Total 8 Stations			54	1,325 l/s		
Abbasa	A-1	Faqus	Didamoom	8	8 x 25l/s x 16hrs = 133 l/s	250m/m x 60 m	*
	A-2	Faqus	Moallinien	1	1 x 25l/s x 16hrs = 17 l/s		
	A-3	Faqus	Faqus	7	7 x 25l/s x 16hrs = 117 l/s	Including 4 wells underconstruction	

Table 1-3 FEATURES OF GROUNDWATER STATIONS (b)

System	No.	Location		Number of Well	Pump Capacity	Remarks	Check Point
		Markaz	Place				
Abbasa	A-4	Abu Kebir	Abu Kebir	12	7 x 25l/s x 16hrs = 117 l/s 5 x 25l/s x 16hrs = 83 l/s	Booster pumping station	*
	A-5	Ibrahimiya	Ibrahimiya	2	2 x 25l/s x 16hrs = 33 l/s		
	A-6	Hihya	Bichet Kayed	1	1 x 25l/s x 16hrs = 17 l/s		
	A-7	Zagazig	Zagazig	3	3 x 25l/s x 16hrs = 50 l/s	Booster pumping station	
	A-8	Zagazig	Bourdien	2	2 x 25l/s x 16hrs = 33 l/s		
	A-9	Zagazig	Zanklon	1	1 x 25l/s x 16 hrs = 17 l/s		
	A-10	Zagazig	Bahnabai	1	1 x 25l/s x 16hrs = 17 l/s		
	A-11	Abu Hammad	Abbasa	6	6 x 25l/s x 16hrs = 100 l/s		*
	A-12	Bilbeis	Saadat	1	1 x 25l/s x 16hrs = 17 l/s	Booster pumping station	
	A-13	Bilbeis	Ghita	1	1 x 25l/s x 16hrs = 17 l/s		*

Table 1-3 FEATURES OF GROUNDWATER STATIONS (c)

System	No.	Location		Number of Well	Pump Capacity	Remarks	Check Point
		Markaz	Place				
Abbasa	A-14	Zagazig	Qinayat	2	2 x 25l/s x 6 hrs = 33 l/s		*
	Total 14 Stations			48	801 l/s		
Housing Department	Pleasa refer to Working Paper No.4 (Table 3-5)						
	Total 82 Stations						

Table 1-4 DATA OF GROUNDWATER CHECK POINTS (a)

A: Abbasa
C: City
H: Housing

No. Fig-No.	Sampling Date (1983)	Location		Well				Pump	Water Quality										Ground Elevation
		Markaz	Place	Dia. (mm)	Depth (m)	Water Level (m)		Capacity (ℓ/sec)	Conductivity (μs/cm)	pH	RpH	Temperature (°C)	Cℓ⁻ (ppm)	Fe (ppm)	Mn (ppm)	T.Hardness (ppm)	T.Alkalinity (ppm)	
						Static	Dynamic												
1 A-1	21,Aug.	Faqus	Didamoon	250	60	0.3		40	15,000	7.52	-	24.2	430	0.05	0.6	200	258.9	5.0
2 A-4	21,Aug.	Abu Kebir	Abu Kebir	250	60		4.330		2,180	7.55		24.1	367	ND	trace	334	262.2	6.0
3 C-5	21,Aug.	Hihya	Hihya	250	60	3.5	9.0	25	2,200	7.44		24.1	380	0.15	trace	191	281.1	7.0
4 C-3	25,Aug.	Ibrahimiya	Ibrahimiya	250	50			25	2,980	7.36	7.58	23.8	390	trace	0.5	278	255.5	6.5
5 H-1	12,Sept.	"	Mubashir	200	60			motor 20 diesel 6	2,050	7.34	7.37	23.5	280	0.1	0.3	220	220.4	6.0
6 C-4	25,Aug.	Diarb Nigm	Diarb Nigm	200	65			20	810	7.84	7.97	25.4	110	ND	ND	44	161.1	6.0
7 H-14	12.Sept.	"	Saft Zireig	100 200	59 59			motor 20	1,300	7.49	7.60	24.8	130	ND	trace	126	168.9	
8 H-3	"	"	Gimmeizeit Beni Amr	150 200	58 58			motor 20 diesel 6	3,600	7.60	7.78	24.9	360	0.4	trace	200	237.8	5.0
9 H-9	12,Sept.	"	Safur	200	60			motor 30 diesel 6	1,700	7.63	7.80	28.2	220	0.3	trace	132	271.1	6.0
10 C-6	27,Aug.	Zagazig	Zagazig	250	66			25	1,120	7.94	8.12	24.2	155	0.06	ND	31.6	228.9	8.5
11 H-22	03,Sept.	"	Nakh-Khas	200	50-60			6	2,180	7.26	7.33	25.5	230	ND	2.0	114.4	346	8.0
12 H-23	"	"	Baiyum	200	50-60			motor 20 diesel 12	1,000	7.33	-	24.2	160	0.15	0.5	251.1	196	8.0

Table 1-4 DATA OF GROUNDWATER CHECK POINTS (b)

A: Abbasa
C: City
H: Housing

No. Fig-No.	Sampling Date (1983)	Location		Well				Pump Capacity (ℓ/sec)	Water Quality										Ground Elevation
		Markaz	Place	Dia. (mm)	Depth (m)	Water Level (m) Static	Dynamic		Conductivity (μs/cm)	pH	RpH	Temperature (°C)	Cℓ⁻ (ppm)	Fe (ppm)	Mn (ppm)	T.Hardness (ppm)	T.Alkalinity (ppm)	
13 H-24	06,Sept.	Zagazig	Abu Arabi	200	58			motor 15 diesel 6	1,550	7.30	7.62	27.5	200	ND	0.02	292	271.1	6.0
14 H-25	"	"	Duweida	200	60			motor 20	1,100	7.52	7.77	26.3	190	ND	0.03	206	317.8	6.0
15 H-26	"	"	Shimbaret Maimuna	200 250	61 61			20	5,000	7.34	7.58	26.7	450	ND	ND	212	269.9	8.5
16 A-14	25,Aug.	"	Qenayat					20	1,600	7.43	7.62	23.7	268	0.1	0.5	297	307.7	8.0
17 A-11	08,Sept.	Abu Hammad	Abbasa	250	60				1,300	7.09		23.9	120	0.25	0.6	167	224.4	6.0
18 C-7	27,Aug.	Minyet el Qamh	Minyet el Qamh	250	65-70			20	1,200	7.47	7.52	23.9	220	0.12	0.6	258.4	271.1	10
19 H-38	"	"	Gudaiyida	200	65			20	1,700	7.71	7.74	23.5	-	-	-	-	-	9.5
20 H-43	10,Sept.	"	Mit Bash-shar	200	60			motor 20 diesel 30	900	7.67	7.83	25.2	180	ND	ND	140.8	206.7	9.6
21 H-36	"	"	Tallein	200	55				1,050	7.62	7.78	23.4	150	ND	0.6	220	285.5	9.5
22 H-55	"	"	Sanhut el-Birak	250	60			motor 30 diesel 25	900	7.40	7.54	26.2	100	ND	ND	178	173.3	10
23 H-44	"	"	Shal Shalamon	200	-			motor 440 12	1,300	7.69	7.72	25.5	110	0.1	trace	224	228.9	10.0

Table 1-4 DATA OF GROUNDWATER CHECK POINTS (c)

A: Abbasa
C: City
H: Housing

No. Fig-No.	Sampling Date (1983)	Location		Well				Pump Capacity (ℓ/sec)	Water Quality									Ground Elevation
		Markaz	Place	Dia. (mm)	Depth (m)	Water Level (m) Static	Water Level (m) Dynamic		Conductivity (μs/cm)	pH	RpH	Temperature (°C)	Cℓ⁻ (ppm)	Fe (ppm)	Mn (ppm)	T.Hardness (ppm)	T.Alkalinity (ppm)	
24 H-49	10.Sept.	Minyet el Qamh	Aziziya	250	58			motor 30 diesel 25	1,400	7.23	-	27.9	120	0.1	1.5	218	291.5	10.5
25 A-13	27.Aug.	Bilbeis	Ghita	250	75	1.0	4.0	25	900	7.55	7.66	25.0	100	ND	ND	179	217.8	9.5
26 H-66	12.Sept.	"	Sandanhur	100 200	60 60			motor 12 diesel 6	1,300	7.27	7.41	23.9	170	trace	0.3	144.8	242.2	9.0
27 H-72	"	"	Saidiya	100 200	61 61			motor 15	1,300	7.34	7.52	24	190	trace	ND	194	187.8	10.0
28 H-75	"	"	Salamant	150 200	52 59			15	1,900	7.26	7.47	24.4	290	trace	trace	300	237.8	11.0
29 C-8	27.Aug.	Mashtul el soak	Mashtul el Soak					2,160 m^3/day	1,780	7.25	7.28	29.3	240	0.05	trace	336	261.1	11.5
30 H-80	12.Sept.	"	Kafr Ibrash	200	61			motor 25 diesel 25	1,600	7.15	7.43	28.3	220	trace	trace	226	235.5	11.5

Table 1-5 WATER LEVEL, DISCHARGE AND SECTION OF CANALS (a)

No.	Name of Canal and Location	Water Level High (m)	Water Level Low (m)	Discharge Max. (m3/sec)	Discharge Min. (m3/sec)	Cross Section Width of Canal Bed (m)	Cross Section Elevation of Canal Bed (m)	Cross Section Side Slope	Note
1	El Raiyah El Taufiqi (Before Muweis branch)	+12.47	+12.00			40	+7.50	1:2	1/
2	Muweis Canal (After branch)	+12.40	+10.50	144.7	34.7	46	+8.60	1:2	1/
3	Muweis Canal (Before Abu El Akhdar branch)	+11.30	+9.75	137.1	31.8	46	+7.75	1:2	1/
4	Abu El Akhadar Canal (After branch)	+10.60	+8.80	46.3	13.8	20	+7.50	1:2	2/
5	Muweis Canal (In Zagazig City)	+ 9.40	+8.75	111.1	23.1	26	+5.15	1:2	1/
6	Muweis Canal (After Kawasienr)	+ 4.00	+2.70	21.8	6.5	13	+1.43	2:3	2/ 3/
7	El Kasaby Canal (After branch)	+ 2.40	+1.80	14.2	4.3	8	+0.15	2:3	2/ 3/
8	Dafan Canal (After branch)	+ 2.40	+1.80	13.9	4.2	9	+0.15	1:2	2/ 3/
9	End of Kasaby Canal	+ 0.70	+0.45	zero	zero	5	-0.20	2:3	2/ 3/
10	End of Dafan Canal	+ 0.20	-0.65	zero	zero	1	-1.46	1:2	2/ 3/
11	Faqus Canal (After branch)	+ 7.60	+6.60	64.35	19.3	25	+4.40	2:3	1/ 4/
12	East Wadi Canal (supplying to Faqus Canal)	+ 8.00	+7.00	24	7.2	13	+5.05	2:3	1/ 4/
13	El Samana Canal (After branch)	+ 5.40	+4.50	32.1	4.6	15	+2.40	2:3	2/ 4/

Table 1-5 WATER LEVEL, DISCHARGE AND SECTION OF CANAL (b)

No.	Name of Canal and Location	Water Level High (m)	Water Level Low (m)	Discharge Max. (m3/sec)	Discharge Min. (m3/sec)	Cross Section Width of Canal Bed (m)	Cross Section Elevator of Canal Bed (m)	Cross Section Side Slope	Note
14	Faqus Canal (After Samana Canal branch)	+5.42	+5.10	5.13	1.5	14	+2.65	2:3	2/ 4/
15	End of Faqus Canal	+5.35	+4.50	10.3	7.4	8	+3.05	2:3	2/
16	End of El Samana Canal	+2.40	+2.10	zero	zero	8	+1.13	2:3	2/ 4/
17	Ismailia Canal (Before East Wadi branch)	+9.45	+8.90	332		54	+5.46	1:2	
18	East Wadi Canal (After branch)	+8.70	+7.90	19.8	6	15	+5.80	2:3	1/
19	El Saidiya Canal (After Canal)	+8.20	+7.75	42	12.6	19	+5.10	1:2	2/
20	El Saidiya Canal	+6.30	+5.50	35	10.5	16	+3.31	1:2	2/
21	El Saidiya Canal (Afterbranch of Brttigh)	+4.20	+3.50	21.4	6.4	14	+1.90	1:2	2/

Note :

1/ No water flow during period end of December to around 20th January.

2/ In addition to above condition, water level is not constant through out the year.

3/ Hanut Drain water is mixed.

4/ Kaliadria Drain water is mixed.

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

WORKING REPORT NO.2

WATER QUALITY STUDY

JAPAN INTERNATIONAL COOPERATION AGENCY

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Introduction

The study of water quality in Egypt was mostly concentrated on the following three major works:

- water quality survey at sites
- study on treatment methods
- collection of available data

With findings made in other relevant fields, it will lead to:

- Planning alternatives on water quality related treatment processes and selecting the most appropriate ones

1. Water Quality Survey at Sites

1.1 Objective and Outline of Survey

Though substantial information on the water quality of both surface water and groundwater are already available, surveying the study area and collecting first-hand information, necessary for judging the suitability as public water supply sources, are essential. The surveys were made from 12 Aug., 1983 to 25 Sept.,1983 and samples of both surface water and groundwater were collected and analyzed.

Surface water samples were taken from the major canals including the Ismailiya, Muweis and Faqus, while groundwater samples were drawn from 30 wells which are now used for public water supply.

The results of the survey, together with other undertakings mentioned previously, will be utilized in selecting water sources and treatment processes.

1.2 Method of Survey

The public water supply systems in the surveyed area are classified into the systems belonging to the Governorate Housing Department, Abbasa Regional Supply System and the Markazs' capital cities. Their sources are surface water of canals and groundwater taken from wells. Fig.1-1 and 1-2 show the major canals map and locations of wells distributed in the Governorate.

Under the said circumstance, the sampling points for water analysis were selected. As for the surface water, they are mostly on the Muweis and Ismailiya Canals and their branches, as shown in Fig.1-3. Fig.1-4 shows the sampling points of groundwater.

The equipment used for analysis was a portable water checker, product of Kyoritsu Co., Ltd. of Japan.

1.3 Findings on Survey

1.3.1 Groundwater (Tables 1-1)

The water supply wells investigated for the study are distributed mostly in the southern and central parts of Sharqiya Governorate. The depth is usually 50 - 60 m.

Although the concentration of dissolved substances differs, possibly owing to underground geological conditions from one well location to another, the water quality of wells, on the whole, conforms to the standards of the General Organization for Greater Cairo Water Supply (GOGCWS). However, some of the wells' water containing iron and manganese will show a red and/or black color when they are chlorinated.

In case of such a water quality, making it safe for drinking contradicts making it pleasant. Some processes shall be studied to solve it. Often observed are live stocks of neighboring farmers straying in and grazing around the compounds of groundwater stations and people using the standpipes of water supply where trash and garbage are scattered about on muddy ground. Protection of water sources and supply facilities from garbage and sewage is to be enforced as well as chlorination of treated water.

Wherever 50 - 60 m deep wells are in use in the before mentioned area, the water quality has been proved satisfactory for public water supply and in the future, the wells will last to be the most prospective source. However, some studies of shallow and middle depth wells will be worthwhile for the near and far future water shortage. The idea is that while good quality wells will be utilized for public supply, lower quality wells be used for other purposes.

1.3.2 Surface Water (Tables 1-2)

All of the surface water originate in the Nile. The quantity is, needless to say, abundant and the quality is, as 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 a point north of Cairo, the Muweis and Faqus Canals are used as surface water sources of the public systems.

Qualitative characteristics of the Nile water are found in 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 throughout 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 designed for agricultural uses and therefore, the water quality is affected sustantially by the conditions like the seasonal fluctuation of irrigational water demand and periodical (usually winter) dredging of the canals. The Abbasa Treatment Plant, for instance, has experienced difficulties in operating the sedimentation and filtration processes as it has faced remarkable algal growth in mid-January to mid-March and high turbidity in the beginning February to end-March periodically every year.

Survey has been carried out for each of the Ismailiya and Muweis Canal Systems. Fig.1-3 shows the sampling points of investigation. The water quality at Zagazig Treatment Plant on the Muweis Canal and at Abbasa Treatment Plant on the Ismailiya Canal has been found good, containing low dissolved solids and low nutrient salts, even though the relatively fast (60 - 80 cm/sec in the center of flow) flow is suspending fine and easily settleable turbid matters.

These canals are polluted heavily when they flow through city areas. Two typical cases are Witnessed at the downstream parts of Zagazig City on the Muweis Canal and Faqus City on the Faqus Canal. Canals in the Governorate tend to be polluted gradually as they flow downwards as the dissolved matters concentration increase. However, organic matters do not increase much, possibly owing to the self purification that is preserved under a relatively high (4 mg/l) level of the dissolved oxygen and fast flow velocities. In the northern area of the Governorate such as Kafr Saqr and Huseiniya Markazs, the dissolved matters content tends to increase rapidly as the canals receive agricultural drainage water.

The study team went upstream along the Ismailiya canal to the Nile River mainstream near Cairo where a number of factories were located. Although no direct discharge of wastewater was detected, industrial wastes were scattered around on the beach and bank along the river. The wastes will cause pollution of water and more attention will be needed for conserving the water quality.

With the canals in the Governorate, illegally dumped garbage is markedly polluting water and not infrequently waste oil is floating. The canals which were developed and maintained for supplying water to the land have been polluted, not only by organic wastes of habitation but also by industrial wastewater and agricultural drainage water. The pollution problem will be a major issue that needs watchful attention in the future.

The survey has resulted in findings that:

- in the northern area of the Governorate, no other alternative source than the canals will be available for the public water supply systems,

- all conceivable means to check the water quality deterioration shall be employed and enforced, and

- water treatment processes which can meet the algal overgrowth under eutrophication and the increasing pollution caused by all kinds of waste water shall be studied.

1.3.3 Biological Examination of Surface Water

For the biological examination of water, eight samples were taken at the spots listed below:

Sample Number	Source	Location of Sampling
No.1	Ismailiya Canal	Intake of Abbasa Filtr. Plant
2	"	"
3	"	"
4	"	Branch point from Nile River in Cairo
5	Nile Mainstream	Luxor
6	"	Aswan, downstream of the Dam
7	" (downstream)	El Zarqa
8	Faqus Canal	Intake of Faqus Filtr. Plant

The location of sampling is shown on Fig. 1-5.

As for the number of algae, the group of No.1 to No.4 shows far higher figures than in a second group of No.5 to No.8. Each of No.2 and No.4 shows nearly 1,000 number per milliliter level, figures which can be seen as extraordinary for the surface running water or rather like a pond or reservoir.

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

A few of blue-green algae (Cyanophyceae), Microcystis sp., Anabena sp., and Oscellatoria sp., are found in the canal water.

These species are known as a kinds of taste and odor producing organisms. Such level of amount, less than 200 of each species, is not so hazardous, actual operation of Abbasa water treatment plant is producing good quality water by strengthen of pre-chlorination and coagulation when algae is aboundant.

2. Study on Treatment Methods

2.1 Removal of Iron and Manganess (Preliminary Test)

2.1.1. Objective and Principle

In the south and central area of the Governorate, groundwater is widely used as the public supply source, owing to its abundance and palatability. It is drawn from an aquifer, underlying 50 - 60 m below the ground level. The dissolved matters contents differ on locations being affected by the geological conditions, and iron and manganese are often contained.

Iron and Manganese cause tastes in drinking water and stains on laundry.

At present, chlorination is not practiced for the groundwater supply and no trouble of "red water"*has been experienced. For sanitary consideration, chlorination should be given priority to the problem of "red water".

In naturally existing iron-obtaining groundwater and soils, a species of special bacteria called "iron bacteria" is living. It is capable of oxidizing bi-valent iron and manganese dissolved in the water and changing them to insoluable iron and manganese compounds which are precipitated on, and/or in the bacterial body.

The biochemical reaction can be used in removing iron and manganese in the water. Filtering the bacteria-containing water by sand will help growth of the the bacteria on the surface and the inside of the filter-sand layer. The layer, thus matured, will effectively absorb and separate iron and manganese from water, contacting inflow of water.

An experiment, aimed to estimate the effectiveness of iron and manganese removal through a continuous filtration process, was made at Abbasa Treatment Plant.

*Note: "red water" is caused by finely dispersed oxidized iron particles, which is a result of oxidation-precipitation (a chemical reaction)of the dissolved iron and chlorine.

2.1.2 Test Apparatus and Method

Well known is a fact that 30 m/day has been proved effective in removing iron and manganese by sand filtration under the activity of iron bacteria and it has been seen as a criterion. On the test apparatus, the performance was 100 cm^3/6 min. or 23.8 l/day, equivalent to about 25 m/day filtration rate.

The test apparatus is shown on Fig. 2-1.

2.1.3 Test Results

During the test period from 30 Aug. to 14 Sep. 1983, filtration was made without interruption and reddish brown substances were found to be attached on the sand surface. The substances were collected and later in Japan they will be inspected by microscope for bacterial growth levels.
The removal efficiency was about 90% of the total iron, from 0.25 to 0.03 mg/l and about 67% of manganese, from 0.6 to 0.2 mg/l, each on the pre- and post-filtration sample.
A titration test of sodium hypochloride in the raw and filtered water showed that the former and latters color was 90 and 40 degree respectively. At 3 hours after the titration the test result was 0.9 ppm residual chlorine.

The effectiveness of the test will be applicable to filtration plants of practicable size. When the iron bacteria is not found existing in a location, transplanting it from iron bacteria-containing groundwater is feasible. The removal efficiency will differ according to conditions like the raw water quality, species of bacteria and filter conditions including the filtration rate. Generally a substantial and stable efficiency will be guaranteed once the operation is started.

Clogging of the surface sand layer by continued filtration shall be cleaned by backwashing or periodical scraping off of the sand, especially in case of a small sized filter media.

2.2 Coagulation and Sedimentation

At the laboratory in Abbasa Filtration Plant, daily water quality test of the samples taken at points of the treatment process and the supply system's service taps, are carried out by two chemists and an assistant. They also jar-test to find the optimum dosage of chemicals for the plant operation. The results are reported to the Deputy Chief Engineer and he gives specific instructions on the matter to the plant operators. Now, as the jar tester is partly defective, no rapid mixing test is made and only a gentle mixing test of 20 - 25 minutes duration is practiced.

Tests under the study showed that 20 - 30 ppm alum dosage had given satisfactory results with the Ismailiya Canal raw water. With other canals' water, the results were similar in this test. But, as algal growth is supposed to be more active in the northern areas' canals, joint uses of alum and coagulation aids such as various polyelectrolytes, might be effective and worth studying.

3. Existing Data on Water Quality (Table 3-1)

Attached herewith are the records of water sources' quality which are being managed by the Abbassa Regional System and the Housing Department of the Governorate.

I-1 is an analysis made at Abbassa, of the water samples taken from canals. As the canals being planned by the Irrigation Department may become prospective water sources for the northern part of Shargiya Governorate, the analysis was made for future reference. Even though a part of agricultural drainage water flows into the canals at Sroui Drain, the canal water, through coagulation-sedimentation-filtration-sterilization, will become potable with less difficulty.

II-1 and II-2 are the summarized record showing the past fluctuation of surface water quality at the Abbassa Plant. II-1 lists the data from January to March 1983 when the water quality, in the operator's opinion, was said to be worse, and the data in August and September 1983 when the study team stayed and studied the water quality. While II-1 shows the weekly average of turbidity, transparency and algal number, II-2 is the monthly average of various items, drawn from the same background data as II-1's.

Reveiwing the data, it is found that the turbidity is in the 25 to 30 degree range, the alkalinity is 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. Other features such as a low concentration of nitrogen and nutrient salts like phosphorus 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 selecting the treatment processes and in operating the plant.

III-1 to III-16 are data of water sources managed by the Housing Department of the Governorate. Area-wise, they cover the Markazes of Zagazing, Diarb Nigm, Faqus, Hihya, Minyet el Qamh, Bilbeis, Mashtul el Soak, and Ibrahimiya.

Generally, iron and manganese are detected in almost all locations. Iron ranged from 0.1 to 0.3 ppm with the maximum of 0.6 ppm, while manganese's maximum was 0.5 ppm. Chloride ion was in 50 to 300 ppm, an ordinary range, except in the cases in Ibrahimiya where 500 to 840 ppm was detected. As nitrogen was barely detected, the water seems to be free from organic pollution.

4. Findings on Water Treatment Process

Comments on the treatment process of both surface- and groundwater are presented here, based on the findings during the field survey and analysis of water quality data collected so far.

4.1 Surface Water

Water in the irrigation canals is flowing at a rate of 60 to 80 cm/sec. Silt contained in it will settle partly, but algae is kept in floatation, thus making the water slightly turbid. Though blue algae are detectable, they seem to have caused no problems of odor. In the future however, outbreak of odor may occur as eutrophication of water proceed.

Besides the treatment process practiced here as described previously, another process is conceivable which is discussed herein.

The process will consist of sand settling, promary filtration through a layer of 3 to 5 mm size gravel, slow sand filtration and chlorination. The primary filtration through gravel layer may be replaced by the micro-strainer filtration when conditions are suitable.
The advantageous points of the process are that it does not include chemical coagulation and sedimentation, and the slow sand filtration can cope with the possible odor problems in the future.

The disadvantages are that a plant using the process will need a wide land area and in operating the sand filters, periodical scrapping of the sand surface, as it is made manually, will result in continuous employment of a substantial number of labourers.

The process, practiced at several locations in Japan, has been proved effective and some know-how will be worth explaining.

The aim of the primary filtration is to make the filtrated turbidity to less than 10 degrees, under an approximately 100 m/day filtration rate through the gravel layer. Usually, 70 to 80% of algae and 50 to 60% of turbidity is to be removed by the operation. The primary filter, a gravel bed a micro-strainer, shall be backwashed periodically.

The period of scrapping the slow sand filters is supposedly about 20 days for below 10 degree filtrated turbidity of the primary filter. When the filtrated turbidity rises, due to higher turbidity of the raw water and/or lower removal efficiency of the filter, to 15 to 20 degrees, the period will be shortened to about 10 days which is the approximate limit of the process's practicability. Micro-straining is effective for removing diatoms but not much can be expected for removing blue algae and inorganic turbidity contents.

4.2 Groundwater

The groundwater in the study area has been found to contain iron and manganese mostly. When chlorine is dosed into such water, oxidized iron and/or manganese will color the water, to the annoyance of users. To avoid it, iron and manganese shall be removed to a certain degree, prior to chlorination.

Effectiveness of a treatment method is actually influenced by the forms of iron and manganese in the solution, together with the existence of other substances in the water. Generally however, iron and manganese can be removed by chemical coagulation-sedimentation (followed by filtration sometimes) after being dosed with such an agent like pottasium permanganate or being aerated.

Recently, a biological process making use of iron-manganese bacteria, as they are so called, which live in natural water has been applied in practice a several locations in Japan. A simple experiment of sand filtration at the Abbassa Plant was proved effective, as more than 90% of the iron was removed. The sand was then examined micro-scopically, and Gallionells sp. and Siderocapsa sp., both of iron-manganese bacteria, were detected.

From the result, the iron-manganese bacteria method for treatment seems to be a prospective process. Usually, a filtration rate of 30 to 40 m/day through a sand bed is recommended.

<u>NOTE</u> Available Organization for Water Quality Analysis

The two organizations listed below can conduct water quality analysis on request, according to an information from NOPWASD.

1. National Central Research, Dr. Fathma El-Gohry
   Ministry of Scientific Research,
   El Taarer Street, El Dokki Square, Cairo

2. Central Laboratory of the Ministry of Health
   Nageeb El Rehany Street,
   El Tahrer Square, Cairo
   Mr. Ahmed Mohyeldeen Zaki

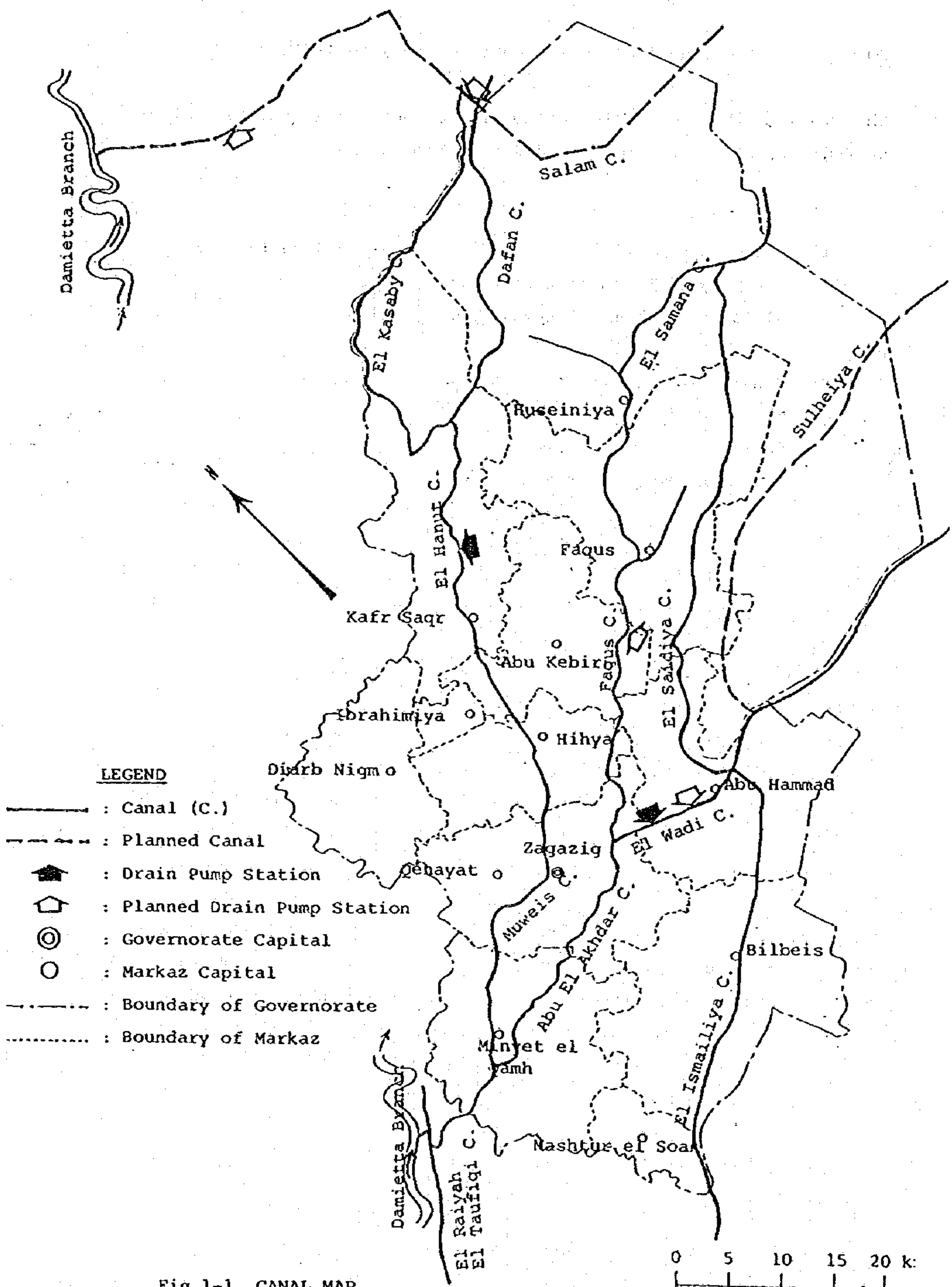


Fig.1-1 CANAL MAP

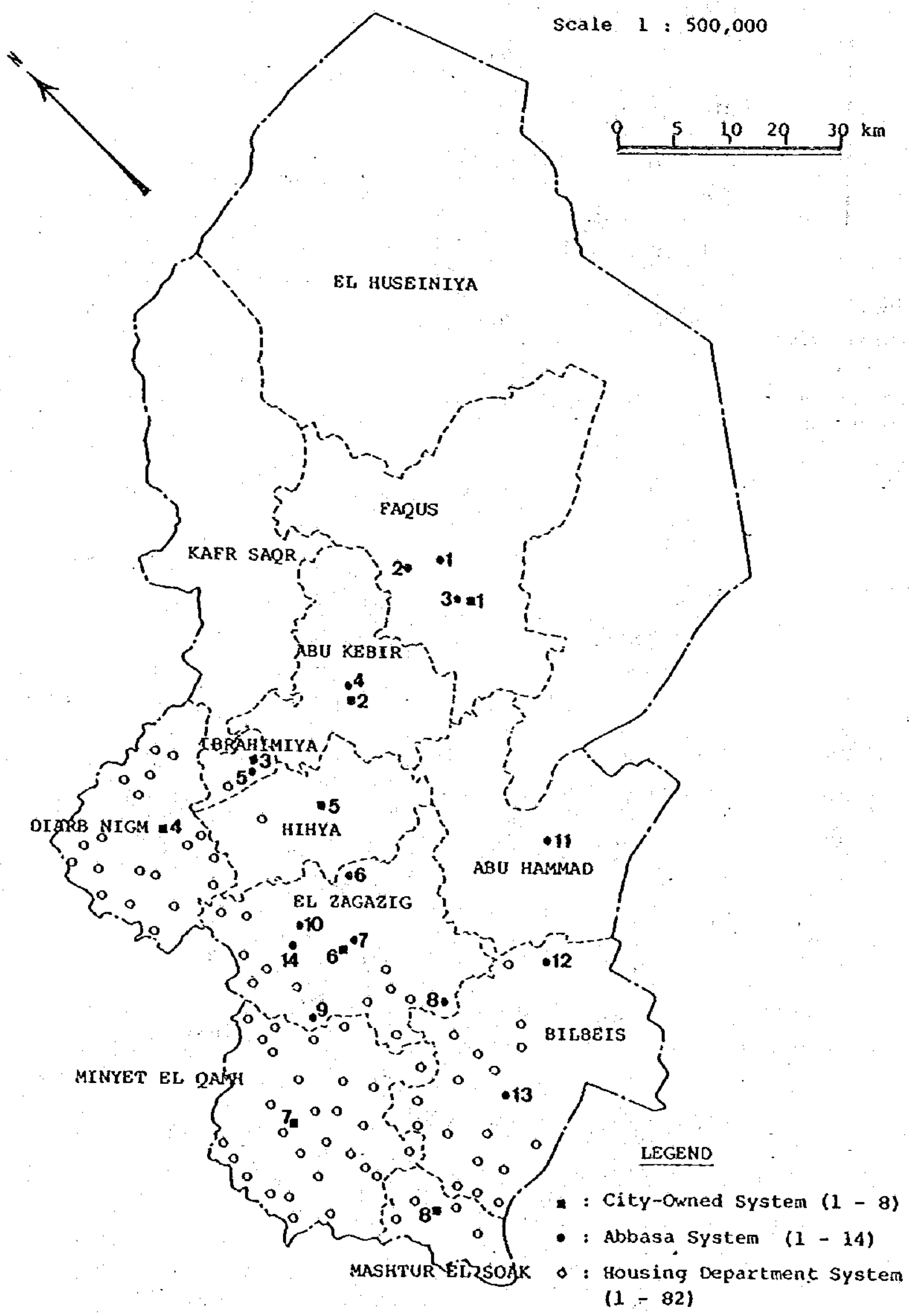


Fig.1-2 GROUNDWATER STATIONS MAP (a)

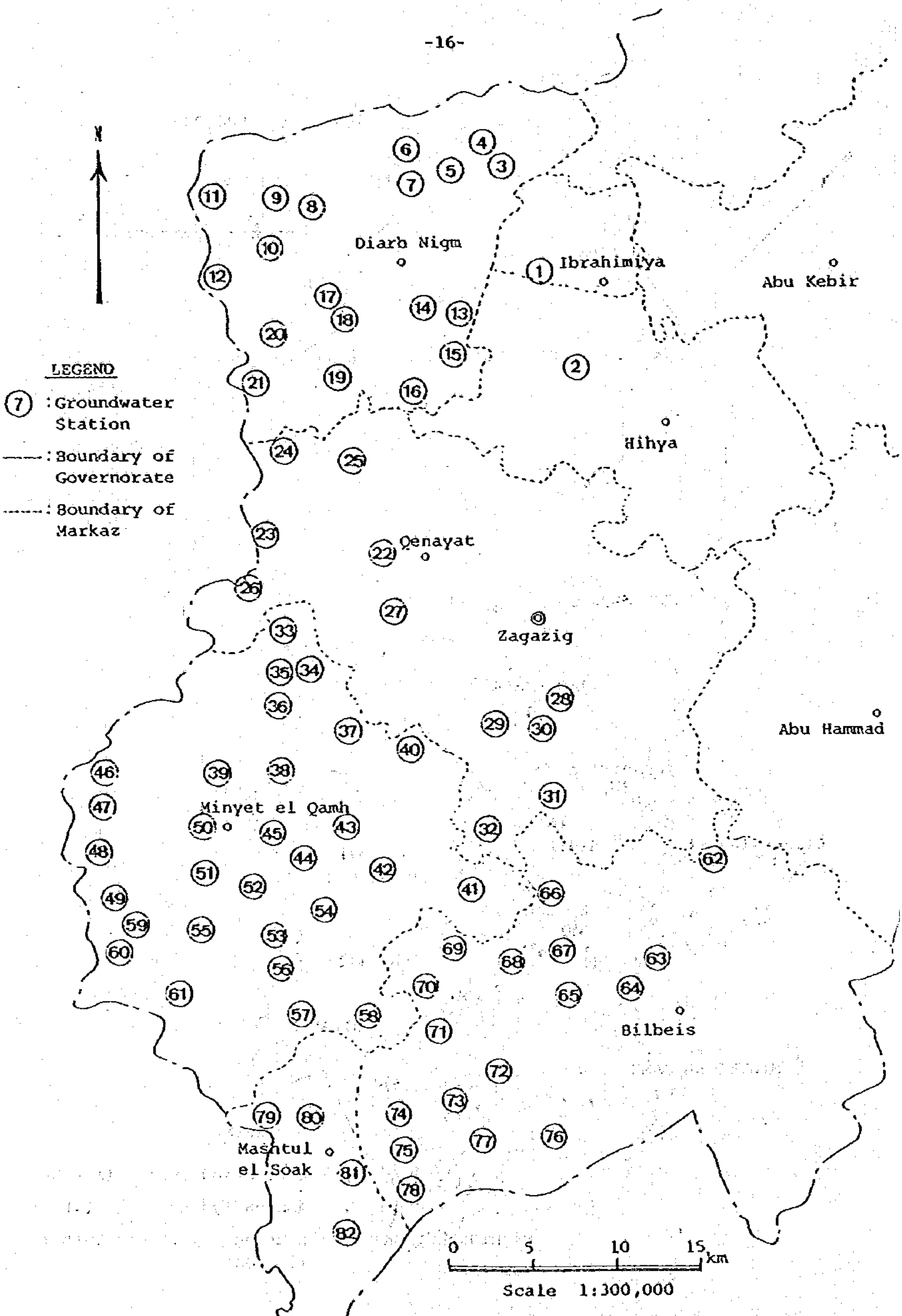


Fig.1-2 GROUNDWATER STATIONS MAP (b)

LIST OF SURFACE WATER CHECK POINTS

NO.	CANAL	LOCATION Markaz	Point
1	Faqus	Zagazig	El Shabanat
2		Faqus	Faqus
3	El Samana	Faqus	Didamoon
4	Branchof El Samana	El Huseiniya	Amadd
5	Silien	El Huseiniya	Tannes
6	Saidiya	Abu Hammad	Saidiya
7	"	Faqus	Gez Abu Shalabi
8	El Wadi	Abu Hammad	Mabhasan
9	El Ismailiya	Abu Hammad	Abbasa
10	"	Abu Hammad	Sulheiya (new canal gate)
11	Muweis	Zagazig	Zagazig
12	"	Hihya	Hihya
13	"	Abu Kebir	Shaucayka
14	"	Kafr Saqr	Tileiga
15	"	Kafr Saqr	Kafr Saqr
16	El Mutarid	Kafr Saqr	Tell Rak
17	Hanut	Kafr Saqr	Aulad Saqr
18	Dafan	Kafr Saqr	Zur Abu el lil
19	Defan	Huseiniya	Sam el Hagar

From 28 Aug. to 12 Sept. 1983, measuring of flowrate and water quality test carried doen at the station of M-1 on Muweis as a fixed observatory station. (See Table 1-2)

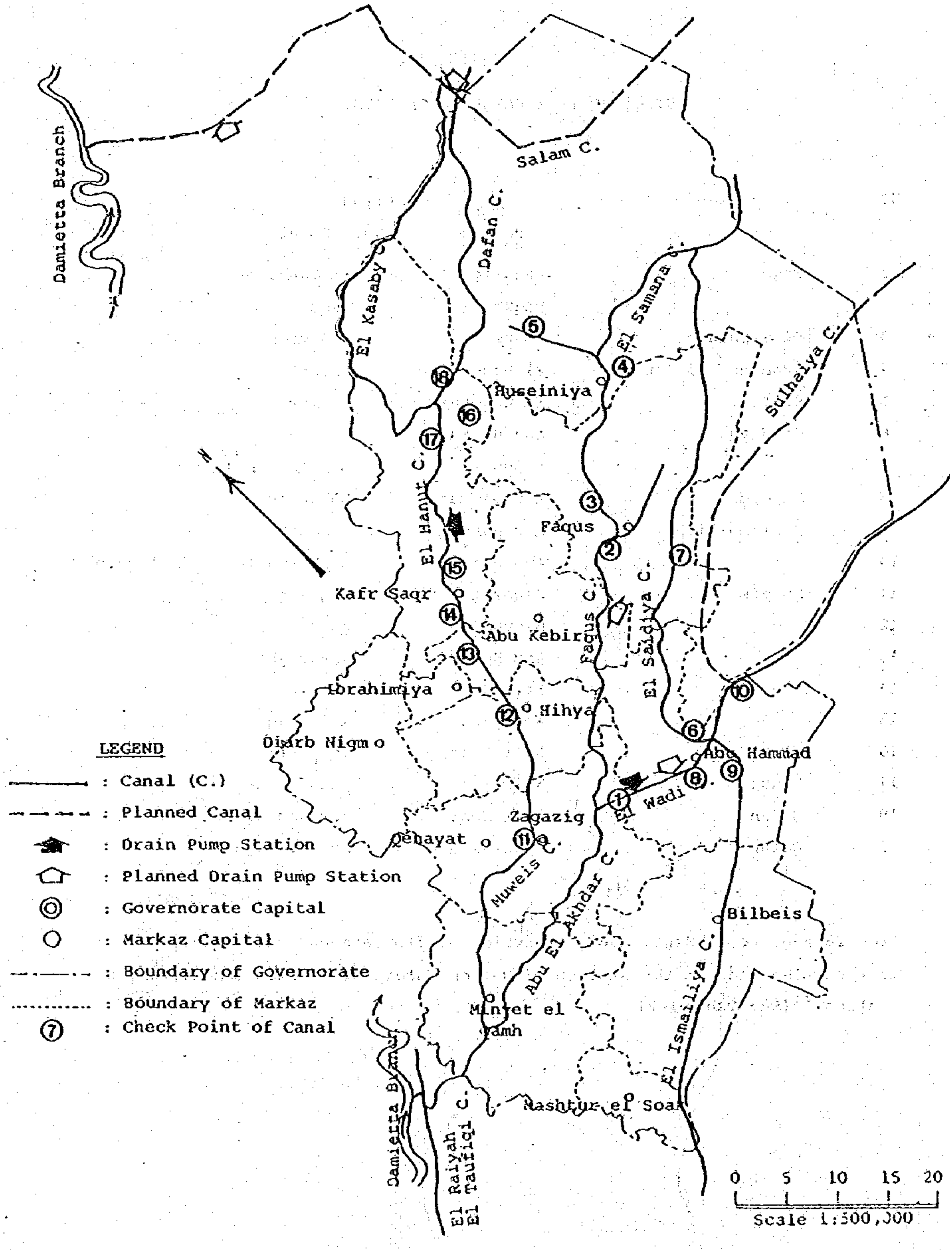


Fig.1- 3 LOCATION OF SURFACE WATER QUALITY CHECK POINT

LIST OF GROUND WATER CHECK POINTS

FIG. NO.	LOCATION Markaz	Point
A - 1	Faqus	Didamoon
A - 4	Abu Kebir	Abu Kebir
C - 5	Hihya	Hihya
C - 3	El Ibrahimiya	El Ibrahimiya
H - 1	"	Mubashir
C - 4	Diarb Nigm	Diarb Nigm
H - 14	"	Saft Zireig
H - 3	"	Gimmeizeit Beni Ann
H - 9	"	Safur
C - 6	El Zagazig	El Zagazig
H - 22	"	El Nakh-khas
H - 23	"	El Baiyum
H - 24	"	Mit Abuarabi
H - 25	"	Duweida
H - 26	"	Shimbaret el-Mamuna
A - 14	El Qenyat	El Qenayat
A - 11	Abu Hammad	Abbasa
C - 7	Minyet el Qamh	Minyet el Qamh
H - 38	"	El Gudaiyida
H - 43	"	Mit Bash-shar
H - 36	"	El Tallein
H - 55	"	Sanhut el-Birak
H - 44	"	Shal Shalamon
H - 49	"	El-Aziziya
A - 13	Bilbeis	Ghita
H - 66	"	Sandanhur
H - 72	"	El Saidiya
H - 75	"	Salamant
C - 8	Mashtul el Soak	Mashtul el Soak
H - 80	"	Kafr Ibrash

Note: Managing Authorities

A ... Abbasa
C ... City
H ... Housing Dept.

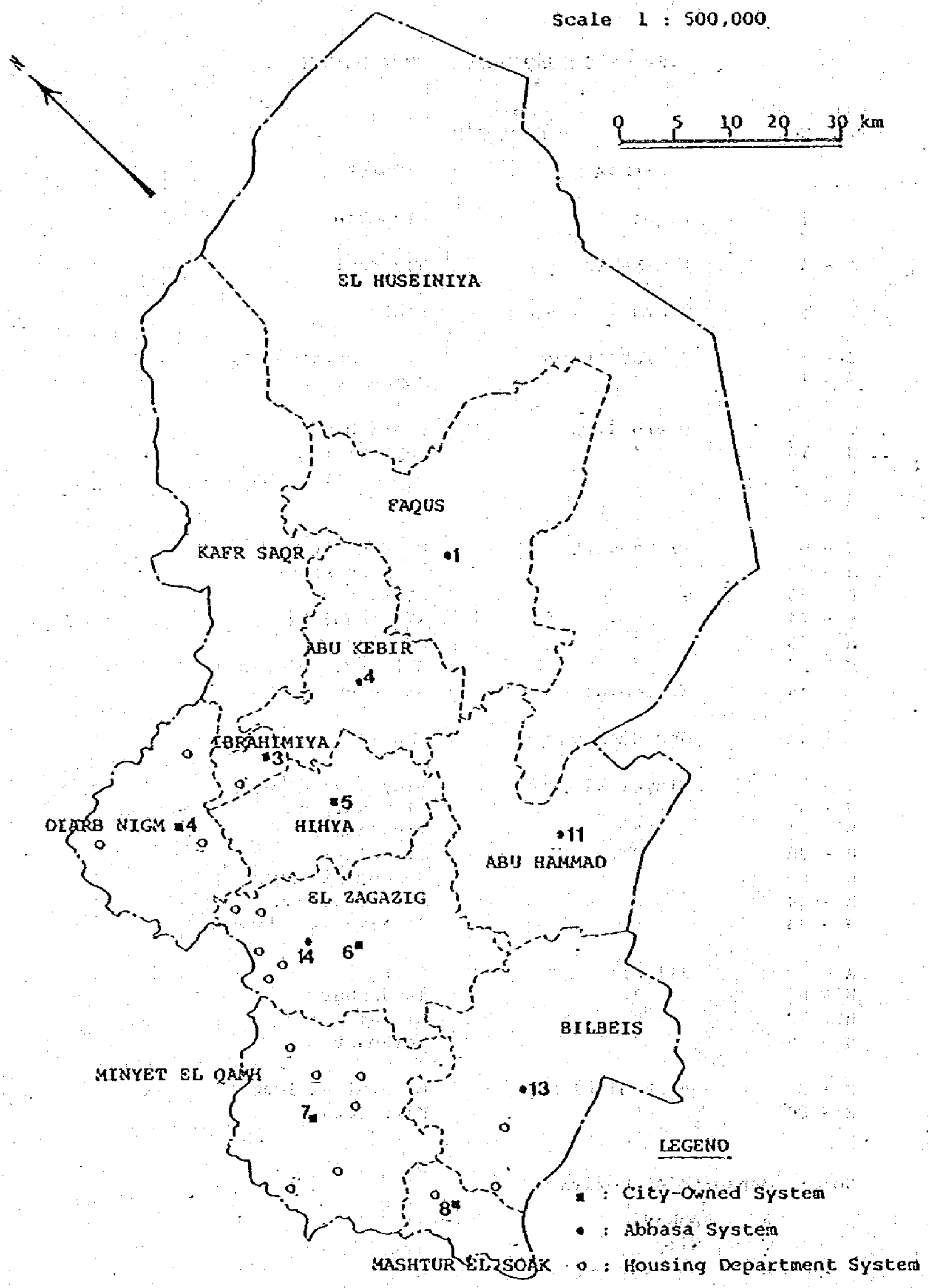


Fig.1-4 LOCATION OF GROUNDWATER QUALITY CHECK POINTS (a)

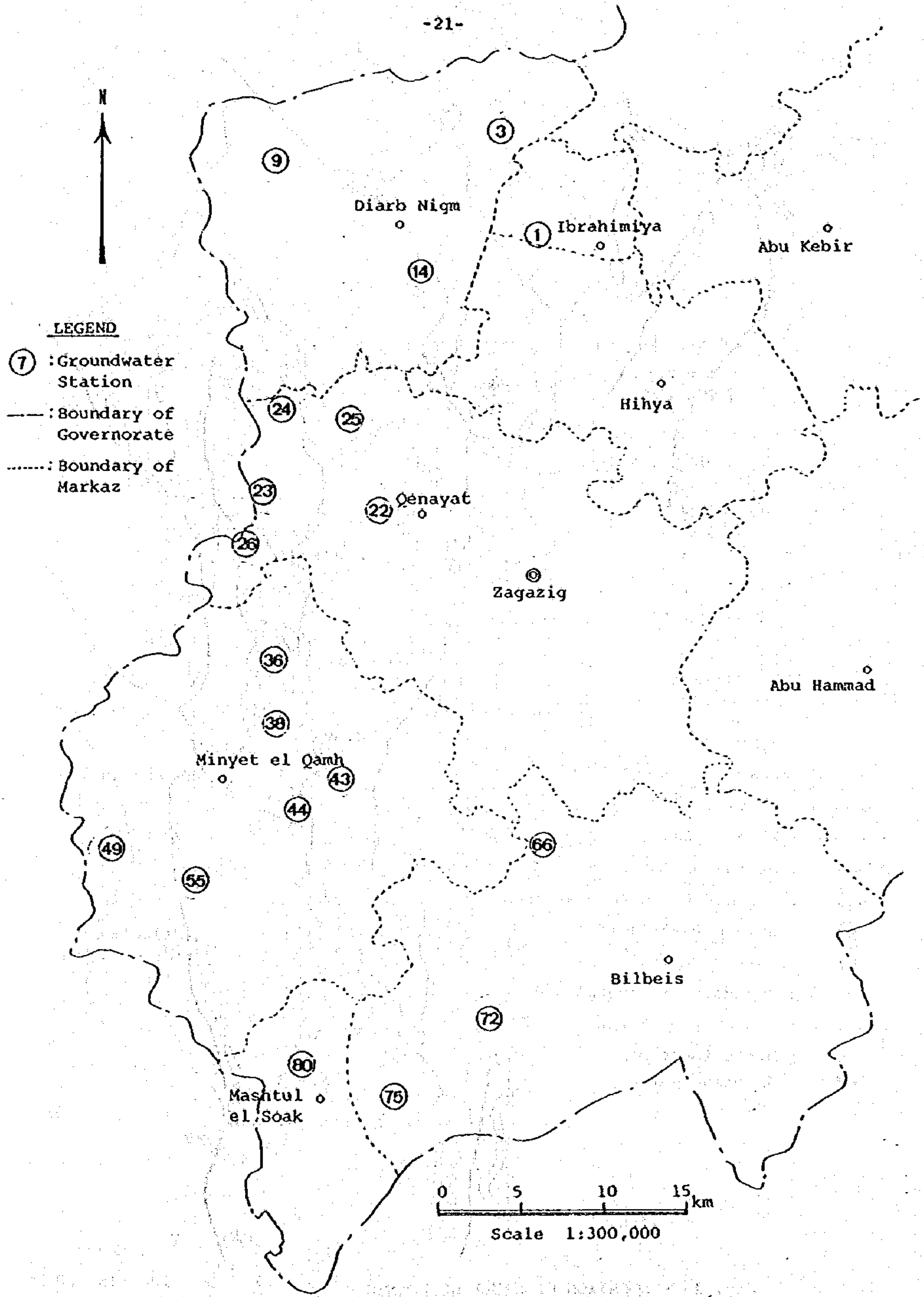


Fig.1-4 LOCATION OF GROUNDWATER QUALITY CHECK POINTS (b)

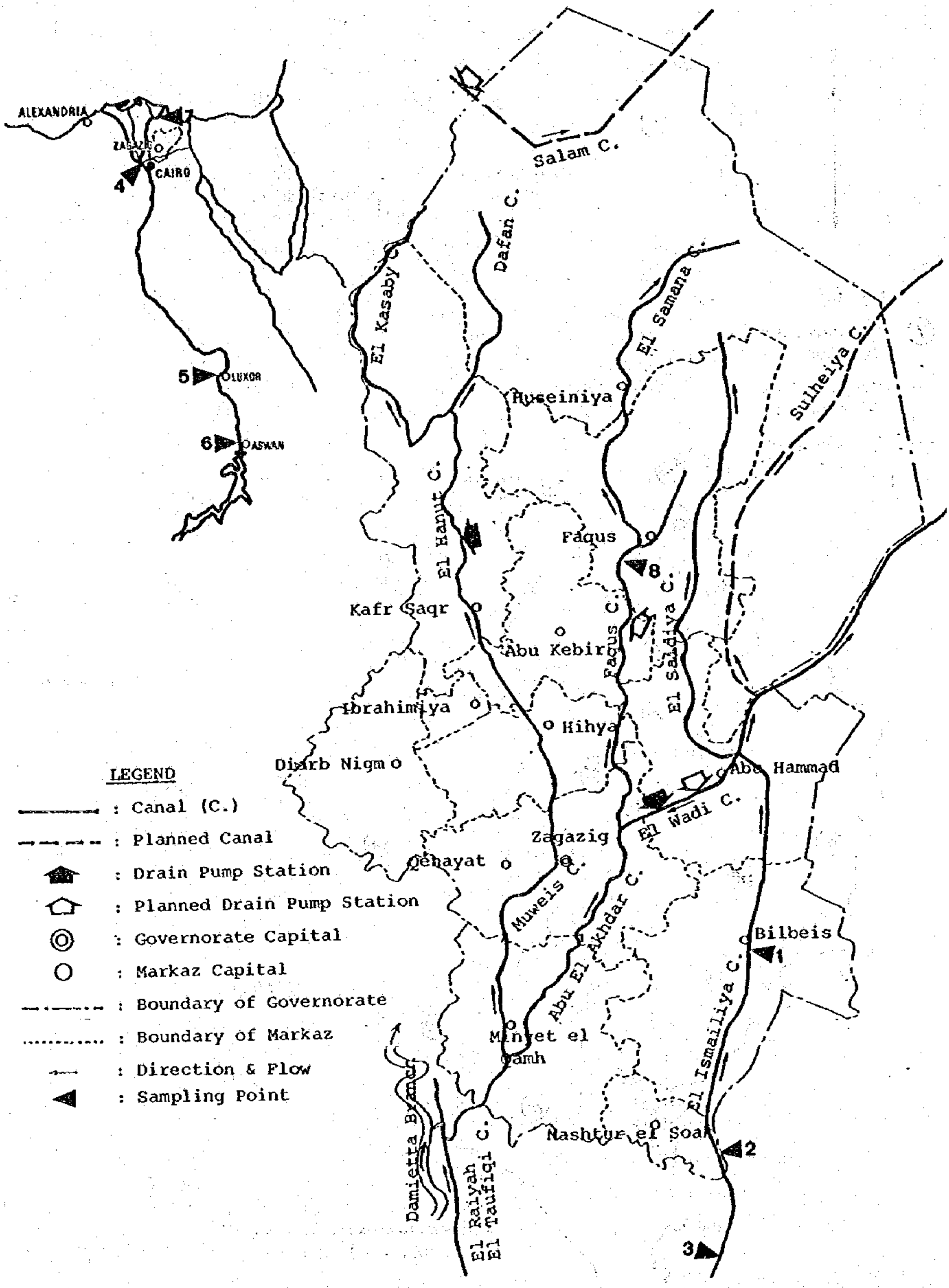
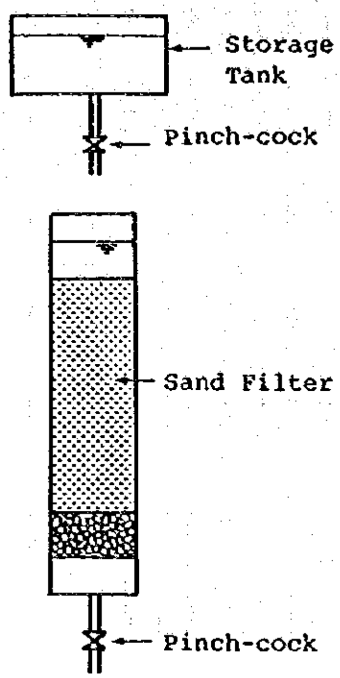


Fig. 1- 5. LOCATION OF SAMPLING POINTS FOR BIOLOGICAL EXAMINATION



Storage Tank Capacity	:	25 liters
Filter Tube height	:	67 cm
diameter	:	3.3 cm
area	:	8.56 cm2
Filter Sand	:	Abbasa Plant's Filter
" volume	:	415 cm3
Flow Control	:	by pinch-cock at outlets as shown
Raw Water	:	groundwater at Abbasa Plant, filling Tank 1 to 2 times/day
Test Period	:	30 Aug. - 14 Sep. 1983

Fig. 2-1 TEST APPARATUS FOR IRON, MANGANESE REMOVAL

Table 1-1 Water Quality of Groundwater (a)

No. on Fig.			A - 1	A - 4	C - 5	C - 3	H - 1	C - 4	H - 14	H - 3	H - 9	C - 6	H - 22	H - 23
Location														
Date sampled			21 Aug.	21 Aug.	21 Aug.	25 Aug.	12 Sept.	25 Aug.	12 Sept.	12 Sept.	12 Sept.	27 Aug.	3 Sept.	3 Sept
Water Temp. C.			24.0	24.1	24.1	23.8	23.5	25.4	24.8	24.9	28.2	24.4	25.5	24.4
pH (RpH)			7.52	7.55	7.44	7.36	7.37	7.74	7.48	7.60	7.63	7.94	7.26	7.33
Turbidity			1.5	1.5	2	2.5	2.0	1.2	2.5	1.2	1.0	1.5	8	3
Electric Conductivity		µS/cm	15,000	2180	2,200	6,500	2,050	810	1,300	3,600	1,700	1,120	2,180	1,000
Dissolved Oxygen		mg/l	-	-	-	-	-							
Total Alkalinity		mg/l	258.9	262.2	281.1	255.5	2,204	161.1	168.9	237.8	271.1	228.9	346.0	196
Total Hardness		mg/l	200	334	191	278	220	44	126	200	132	31.6	114.4	251
Ca Hardness		mg/l	128	228	-	179	-	21	-	-	-	28.0	-	-
Chloride	Cl	mg/l	430	367	380	390	280	110	130	459.1	220	155	230	160
Sulphate	SO4	mg/l	80	85	85	100	50	ND	48	100	neg	13	-	-
Phosphate	PO4	mg/l	-	-	-	0.25	-	0.5	-	-	-	0.85	-	-
Total Iron	Fe	mg/l	0.05	ND	0.15	trace	0.1	ND	neg	0.4	0.3	0.06	neg	0.15
Manganese	Mn	mg/l	0.6	trace	trace	0.5	0.3	ND	trace	trace	trace	ND	2.0	0.5
Silica	SiO3	mg/l	35	55	48	38	38	38	37	38	40	32	20	28
Ammonium	NH4-N	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	trace	trace	neg
Nitrite	NO2-N	mg/l	ND	ND	ND	trace	ND	ND	ND	ND	ND	ND	0.03	0.02
Nitrate	NO3-N	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	trace	ND	ND
XMnO4 consumed		mg/l	3.0	3.3	2.9	3.54	2.8	1.55	4.4	6.3	3.0	1.4	5.4	4.8
Cooper	Cu	mg/l	-	-	ND	0.25	-	ND	-	-	-	ND	-	-
Chromium	Cr^{6+}	mg/l	-	-	ND	-	-	-	-	-	-	-	-	-
Zinc	Zn	mg/l	-	-	-	ND	0.32	-	0.2	0.2	0.15	ND	0.6	0.2
Phenol		mg/l	-	-	-	-	-	-	-	-	-	-	-	-
E. Coli / ml			ND	ND	ND	ND	-	ND	-	-	-	ND	ND	ND
General Bacteria / ml			16	16	5	2	-	3	-	-	-	ND	3	4

Table 1-1 Water Quality of Groundwater (b)

No. on Fig.			H - 24	H - 25	H - 26	A - 14	A - 11	A - 11	A - 11 filtrated	A-11	C - 7	H - 43	H - 36
Location													
Date sampled			6 Sept.	6 Sept.	6 Sept.	25 Aug.	27 Aug.	29 Aug.	8 Sept.	8 Sept	27 Aug.	10 Sept.	10 Sept.
Water Temp. C.			27.5	26.3	26.7	23.7	23.9	24.5	23.9	-	23.5	25.2	23.4
pH (RpH)			7.30	7.52	7.34	7.43	7.47	-	7.09	-	7.71	7.63	7.68
Turbidity			1.5	2	2	1.5	1.5	12	15	2.5	3.0	2.5	2.5
Electric Conductivity		μS/cm	1550	1100	5000	1600	1200	-	1300	-	1700	900	1050
Dissolved Oxygen		mg/l	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity		mg/l	271.1	317.8	269.9	307.7	304.4	224.4	224.4	219.9	271.1	206.7	285.5
Total Hardness		mg/l	292	206	212	297	217.0	192	167	174	258.4	140.8	220
Ca Hardness		mg/l	-	-	-	185	-	-	-	-	236.0	-	-
Chloride	Cl	mg/l	200	190	450	268	150	130	120	-	220	180	150
Sulphate	SO4	mg/l	65	ND	8	70	50	-	80	75	92	22	13
Phosphate	PO4	mg/l	-	-	-	0.2	0.15	-	0.03	-	0.2	-	-
Total Iron	Fe	mg/l	ND	ND	ND	0.1	0.15	0.3	0.25	0.03	0.12	ND	ND
Manganese	Mn	mg/l	0.02	0.03	ND	0.5	0.6	0.03	0.6	0.2	0.6	ND	0.6
Silica	SiO3	mg/l	40	40	42	40	40	-	48	45	40	35	35
Ammonium	NH4-N	mg/l	ND	ND	ND	ND	1.3	trace	1.0	0.02	1.4	0.8	1.0
Nitrite	NO2-N	mg/l	0.1	0.15	ND	ND	ND	ND	0.05	0.2	0.04	ND	ND
Nitrate	NO3-N	mg/l	ND	ND	ND	ND	ND	ND	ND	trace	0.05	trace	ND
KMnO4 consumed		mg/l	3.4	2.8	4.3	2.65	1.9	2.4	2.8	-	1.8	4.4	3.7
Cooper	Cu	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	Cr^{6+}	mg/l	-	-	-	-	-	-	-	-	-	-	-
Zinc	Zn	mg/l	0.18	0.25	ND	-	0.3	-	0.2	0.1	0.3	ND	0.25
Phenol		mg/l	-	-	-	-	-	-	-	-	-	-	-
E. Coli / ml			-	-	-	ND	ND	-	color after chlor.		ND	0	0
General Bacteria / ml			-	-	-	30	ND	-	90	40	2	3	16

Table 1-1 Water Quality of Groundwater (c)

No. on Fig.			H - 55	H - 44	H - 49	A - 13	H - 66	H - 72	H - 75	C - 8	H - 80
Location											
Date sampled			10 Sept.	10 Sept.	10 Sept	27 Aug.	12 Sept	12 Sept	12 Sept8	27 Aug.	12 Sept
Water Temp. C.			26.2	25.5	27.9	25.0	23.9	24.0	24.4	29.3	28.3
pH (RpH)			7.40	7.69	7.23	7.55	7.27	7.34	7.26	7.25	7.15
Turbidity			2.5	0.5	7	3.0	0.5	0.5	0.5	3.5	0.5
Electric Conductivity		S/cm	900	1300	1400	900	1300	1300	1900	1710	1600
Dissolved Oxygen		mg/l	-	-	-	-	-	-	-	-	-
Total Alkalinity		mg/l	173.3	228.9	291.5	217.8	242.2	187.8	237.8	261.1	233.5
Total Hardness		mg/l	178	224	218	179	144.8	194	300	336.0	226
Ca Hardness		mg/l	-	-	-	110.4	-	-	-	179.0	-
Chloride	Cl	mg/l	100	110	120	100	170	190	290	240	220
Sulphate	SO4	mg/l	35	35	45	50	50	68	75	78	ND
Phosphate	PO4	mg/l	-	-	-	ND	-	-	-	0.12	-
Total Iron	Fe	mg/l	ND	0.1	0.1	ND	trace	trace	trace	0.05	trace
Manganese	Mn	mg/l	ND	trace	1.5	ND	0.3	ND	trace	trace	trace
Silica	SiO3	mg/l	30	35	35	32	38	42	42	40	45
Ammonium	NH4-N	mg/l	trace	1.2	1.1	0.07	ND	ND	ND	1.6	ND
Nitrite	NO2-N	mg/l	0.05	0.15	trace	ND	ND	ND	ND	0.07	ND
Nitrate	NO3-N	mg/l	trace	0.05	ND	ND	ND	ND	ND	0.05	ND
KMnO4 consumed		mg/l	1.5	4.8	6.7	0.3	6.7	3.5	5.4	1.3	3.8
Cooper	Cu	mg/l	ND	ND	ND	ND	-	-	-	ND	-
Chromium	Cr^{6+}	mg/l									
Zinc	Zn	mg/l	0.1	0.1	0.6	0.1	0.25	0.25	0.25	0.3	0.25
Phenol		mg/l	-	-	-	-	-	-	-	-	-
E. Coli / ml			0	0	0	ND	-	-	-	ND	-
General Bacteria / ml			18	35	5	3	-	-	-	ND	-

Table 1-2 Water Quality of Canals (a)

Location			Abbasa		Salei-Maya	Mihya	Gazar Canal	Samana Canal	Samana Canal	Muweis After Drain	Muweis
			29 Aug.	30 Aug.	21 Aug.	21 Aug.	21 Aug.	21 Aug.	23 Aug.	25 Aug.	25 Aug.
Date sampled											
			28.0	28.8	27.0	27.0	27.7	28.0	-	28.7	29.5
Water Temp. C.			7.70	7.70	7.82	7.80	7.56	7.66	-	7.82	7.66
pH (RpH)			18	8	45	10	26	27	38	12	21
Turbidity			-	630	650	-	1,056	10,000	-	4,000	610
Electric Conductivity		US/cm	7.21	-	3.6	4.3	3.3	-	-	5.48	5.48
Dissolved Oxygen		mg/l	133.3	137.8	111.1	135.5	168.9	170.0	17.0	135.5	135.5
Total Alkalinity		mg/l	110	106	103.1	102.0	145	152.0	146	104	104
Total Hardness		mg/l	-	-	-	-	-				
Chloride	Cl	mg/l	83	84	128	115	156	310	250	210	150
Sulphate	SO4	mg/l	-	-	ND	-	50	50	55	5	5
Phosphate	PO4	mg/l	-	-	ND	0.03	trace	ND	0.4	trace	trace
Total Iron	Fe	mg/l	ND	-	ND	ND	ND	ND	0.1	0.1	trace
Manganese	Mn	mg/l	ND	-	ND	ND	ND	ND	ND	trace	trace
Silica	SiO3	mg/l	-	-	-	-	-	20	17	10	12
Ammonium	NH4-N	mg/l	0.15	0.15	0.3	0.1	1.2	0.95	trace	trace	trace
Nitrite	NO2-N	mg/l	ND	ND	trace	trace	0.01	0.35	0.1	trace	trace
Nitrate	NO3-N	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND
KMnO4 consumed		mg/l	11.2	10.8	10.4	6.5	18.6	13.5	13.0	10.8	9.6
Cooper	Cu	mg/l	-	-	ND	-	-	-	ND	ND	ND
Chromium	Cr^{6+}	mg/l	-	-	ND	-	-	-	-	-	
Zinc	Zn	mg/l	-	-	-	-	-	-	ND	trace	trace
Phenol		mg/l	-	-	ND	-	-	-	-	-	-
E. Coli / ml			0	-	30	0	0	7	7	2	1
General Bacteria / ml			18	-	400	88	53	200	180	36	48

Table 1-2 Water Quality of Canals (b)

No. on Fig.			1	2	3	6	7	8	12	14	15	16	17	18
Date sampled			30 Aug.	4 Sept.	4 Sept.	30 Aug.	4 Sept	30 Sept.	1 Sept.	1 Sept.	1 Sept.	1 Sept.	1 Sept.	1 Sept.
Water Temp. C.			27.6	27.7	28.8	28.7	29.1	28.2	27.1	27.7	27.7	29.1	28.0	29.4
pH (RpH)			7.50	7.50	7.40	7.82	7.67	7.80	7.71	7.68	7.62	7.58	7.51	7.55
Turbidity			22	40	80	16	40	17	22	25	-	25	26	10
Electric Conductivity		µS/cm	610	900	940	630	640	640	600	600	600	700	1,500	1,600
Dissolved Oxygen		mg/l	-	2.83	3.94	-	2.93	-	5.15	6.08	-	4.84	4.12	3.19
Total Alkalinity		mg/l	134.4	167.7	262.2	135.5	173.3	136.7	137.3	140.0	-	146.7	221.1	116.6
Total Hardness		mg/l	106	143	374	104	140	107	103	114	-	127	186	217
Chloride	Cl	mg/l	90	146	166	89	118	91	101	110	-	110	246	260
Sulphate	SO4	mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Phosphate	PO4	mg/l	-	0.4	0.4	-	0.5	-	-	-	-	-	-	-
Total Iron	Fe	mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	Mn	mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Silica	SiO3	mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Ammonium	NH4-N	mg/l	0.25	ND	trace	0.15	trace	0.1	ND	ND	-	ND	ND	ND
Nitrite	NO2-N	mg/l	ND	ND	trace	0.02	0.1	0.02	ND	ND	-	ND	0.1	0.1
Nitrate	NO3-N	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND	ND
KMnO4 consumed		mg/l	16.4	16.7	17.4	15.4	17.4	18.4	9.54	9.54	-	11.70	13.6	11.7
Cooper	Cu	mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	Cr^{6+}	mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	Zn	mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Phenol		mg/l	-	-	-	-	-	-	-	-	-	-	-	-
E. Coli / ml			-	-	-	-	-	-	-	-	-	-	-	-
General Bacteria / ml			-	-	-	-	-	-	-	-	-	-	-	-

Table 1-2 Water Quality of Canals (c)
(Fixed Observatory Station at Muweis)

No. on Fig.			M - 1	M - 1	M - 1	M - 1	M - 1	M - 1	M - 1	M - 1	M - 1	M - 1	M - 1	M - 1	M - 1
Location			Muveis Zagazig	"	"	"	"	"	"	"	"	"	"	"	"
Date sampled			27 Aug.	30 Aug.	1 Sept.	3 Sept.	3 Sept.	4 Sept.	5 Sept.	6 Sept.	7 Sept.	8 Sept.	10 Sept	11 Sept.	12 Sept.
Water Temp. C.			27.1	26.7	26.6	26.7	-	26.8	26.8	26.8	27.3	27.2	27.0	27.0	26.7
pH (RpH)			7.56	7.64	7.71	7.50	-	7.63	7.75	7.67	7.70	7.62	7.51	7.50	7.50
Turbidity			15	22	16	20	23	25	20	18	7	6	15	15	16
Electric Conductivity		µS/cm	600	610	600	570	-	600	660	600	600	600	670	650	650
Dissolved Oxygen		mg/l	-	-	4.94	4.74	5.25	5.45	-	4.40	-	4.4	4.74	-	4.40
Total Alkalinity		mg/l	132.2	133.3	135.5	135.5	137.8	137.8	137.8	139.9	135.5	137.1	138.9	139.9	139.9
Total Hardness		mg/l	103	106	104	101	104	114	108	106	107	107	108	106	106
Chloride	Cl	mg/l	84	87	83	83	108	88	96	88	91	94	91	89	77
Sulphate	SO4	mg/l	3	-	-	-	-	-	-	ND	3	2	4	-	-
Phosphate	PO4	mg/l	ND	-	-	-	trace	0.1	-	-	-	-	-	-	-
Total Iron	Fe	mg/l	ND	-	-	-	-	-	-	0.04	ND	ND	ND	trace	ND
Manganese	Mn	mg/l	ND	-	-	-	-	-	-	ND	ND	ND	ND	ND	ND
Silica	SiO3	mg/l	12	-	-	-	-	-	-	4	-	-	3	5	6
Ammonium	NH4-N	mg/l	0.1	0.25	ND	trace	ND	ND	ND	ND	ND	ND	0.1	ND	ND
Nitrite	NO2-N	mg/l	trace	ND	trace	ND	ND	0.1	ND	ND	ND	ND	trace	ND	ND
Nitrate	NO3-N	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
KMnO4 consumed		mg/l	8.4	10.2	7.27	10.7	11.9	16.7	12.0	10.8	7.8	8.0	8.6	7.4	8.0
Cooper	Cu	mg/l	ND	-	-	-	-	-	-	ND	ND	ND	ND	-	-
Chromium	Cr^{6+}	mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	Zn	mg/l	ND	-	-	-	-	-	-	ND	ND	ND	ND	ND	trace
Phenol		mg/l													
E. Coli / ml			0	4	-	-	-	-	-	2	-	-	-	-	-
General Bacteria / ml			24	67	-	-	-	-	-	116	-	-	-	-	-

Table 1-2 Water Quality of Compact Unit and Treatment Plant (d)

No. on Fig.			Kafr Saqr			Zagazig Treat Plant				Abbasa Treatment Plant			
Location			R.Water	Treated	Eff. Sed.	R.Water	Eff.Sedi.	Filtrated	R.Water	R.Well	Before	Treated	
Date sampled												Filtration	
			25 Aug	25 Aug	25 Aug	27 Aug	27 Aug	27 Aug.2		29 Aug	29 Aug	29 Aug	29 Aug
Water Temp. C.													
pH (RpH)			32.2	-	-	27.1	-	-		28	-	-	-
Turbidity			7.53	-	-	7.56	-	-		7.7	-	-	-
Electric Conductivity		µS/cm	15	2.0	-	15	10	4		18	17	4.0	2.0
Dissolved Oxygen		mg/l	650	-	-	600	-	-		-	-	-	-
Total Alkalinity		mg/l	-	-	-	-	4.96	-		7.21	-	-	-
Total Hardness		mg/l	136.7	126.7	131.7	132.2	118.0	117.8		133.3	133.3	115.5	121.1
Ca Hardness		mg/l	104	104	104	103	101	103		110	112	110	111.0
Chloride	Cl	mg/l	-	-	-	-	-	-		-	-	-	-
Sulphate	SO4	mg/l	110	110	110	84	79	84		83	88	89	88
Phosphate	PO4	mg/l	5	5	8	3	38	38		-	-	-	-
Total Iron	Fe	mg/l	0.05	-	-	0.02	-	-		-	-	-	-
			0.05	-	-	0.02	-	-		ND	-	-	-
Manganese	Mn	mg/l											
Silica	SiO3	mg/l	0.1	0.0	0.1	ND	-	-		ND	-	-	-
			10	10	10	12	-	-		-	-	-	-
Ammonium	NH4-N	mg/l											
Nitrite	NO2-N	mg/l	trace	-	-	0.1	-	-		0.15	-	-	-
Nitrate	NO3-N	mg/l	trace	-	-	trace	-	-		ND	-	-	-
KMnO4 consumed		mg/l	ND	1.8	-	ND	-	-		ND	-	-	-
Cooper	Cu	mg/l	10.8	-	-	8.42	-	0.76		11.2	11.2	4.6	1.3
Chromium	Cr^{6+}	mg/l	0.01	-	-	ND	-	-		-	-	-	-
Zinc	Zn	mg/l	0.04	0.04	-	-	-	-		-	-	-	-
Phenol		mg/l	-	-	-	-	-	1.2		-	-	-	0.8
E. Coli / ml			0	0	-	0	-	0		ND	-	-	-
General Bacteria / ml			-	4	-	24	-	0		18	-	-	-

Table 1-3 Number of Individual Organism

Oct. 25, 1983

Samples No.	1	2	3	4	5	6	7	8
Species								
Diatom								
Synedra sp.	400	360	240	360	20			280
Nitzschia acicularis	20	120						
Nitzsvhia sp.		60	20	120	80	20		40
Melosira granulata	100	60	100	60				
Melosira sp.		20	80	60			40	80
Cyclotella sp.	40	240	120	200	40	60	20	
Navicula sp.		20						
Atteya sp.		20						
Cymbella sp.					20			
Green Algae								
Staurastrum sp.	20	40	20	40				
Senedesmus sp.		20						
Pediastrum sp.		20		20			40	
Blue Algae								
Microcytis sp.				20			20	
Merismopedia sp.				20				20
Anabaena sp.			20					
Oscillatora sp.			20					
Ring Worm								
Colurella sp			20					
Total Number	580	980	640	900	160	80	120	440

Table 3-1 Collected Water Quality Data

Page	Contents
I-1	Irrigation Canals (prospective source in future)
II-1	Weekly Average of Surface Water at Abbasa
II-2	Monthly Average of Surface Water at Abbasa
II-3	Groundwater under Abbasa Management
III-1 to III-16	Groundwater under Housing Department Management

I-1

WATER QUALITY OF CANAL

(One of alternatives for future resources)

Item Location	Nile Damietta Branch	Sroui Drain(Agriculture)
Date	26 Sept. '83	26 Sept. '83
pH	7.8	7.8
Electric Conductivity	600	1200
Total Dissolved Solid	480	920
Chloride, Cl	148	280
Total Hardness as $CaCO_3$	172	224
Total Iron, Fe	-	0.3
Manganese, Mn	-	-
Alkalinity as $CaCO_3$	164	228
Ammonia as N	+	-
Nitrite as N	+	trace
Nitrate as N	-	-
E.Coli/ml*	ND	6
General Bacteria/ml*	3	numerous

Analyzed by Abbasa Water Treatment Plant

* Bacteriological Test By Survey Team (Milipore Method)

II-1

RAW WATER QUALITY VARIATION BY WEEKLY AVERAGE OF ABBASA WATER TREATMENT PLANT (ISMAILIA CANAL)

Period Date in Month		Turbidity	Transperancy	Number of Algae
1982				
Oct.		29	30	6000
Nov.		28	31	6400
Dec.		26	33	5000
1983				
Jan.	1st week	28	31	2800
	2nd	28	31	2900
	3rd	26	33	3500
	4th	26	33	5200
Feb.	1st	28	31	5600
	2nd	28	31	6800
	3rd	30	29	6900
	4th	32	26	7800
Mar.	1st	30	29	6900
	2nd	30	29	5100
	3rd	28	31	4500
	4th	28	31	3200
Apr.		28	31	3700
May		28	31	2900
June		26	33	3600
July		26	33	4100
Aug.	1st	24	36	4500
	2nd	26	33	4900
	3rd	26	33	5900
	4th	28	31	6500
Sept.	1st	28	31	6200
	2nd	28	31	6900
	3rd	28	31	7500
	4th	26	33	8800

Data source : Abbasa Water Treatment Plant

II-2

RAW WATER QUALITY VARIATION BY MONTHLY AVERAGE OF ABBASA WATER TREATMENT PLANT (ISMAILIA CANAL)

Item / Month	Aug.'82	Sept.'82	Oct.'82	Nov.'82	Dec.'82	Jan.'83	Feb.'83
pH	8.0	7.9	8.0	8.0	7.9	8.0	.
Turbidity(JU)	27	26	29	28	26	27	.
Colour	nil	nil	nil	nil	nil	nil	nil
Total Alkalinity*	150	140	148	154	152	154	148
Total Hardness	106	110	132	128	134	132	126
Ca Hardness	68	70	74	78	78	78	74
Chloride, Cl	50	46	52	60	62	64	54
Total iron, Fe	0.3	0.2	0.2	0.2	0.3	0.4	0.3
Manganese, Mn	nil	nil	nil	nil	trace	trace	trace
Ammonia as N	+	+	+	+	+	+	+
Nitrite as N	nil	-	trace	-	-	trace	trace
Nitrate as N	-	-	-	-	-	-	-
E. Coli/100ml	18	18	18	18	18	18	18
No. of Algae/ml	4500	5000	6400	6400	5000	4700	7000

Item / Month	Mar.'83	Apr.'83	May'83	Jun.'83	Jul.'83	Aug.'83
pH	.	.	.	.	.	.
Turbidity(JU)	.	.	.	.	.	.
Colour	nil	nil	nil	nil	nil	nil
Total Alkalinity*	148	154	150	156	138	160
Total Hardness*	132	132	130	114	112	116
Ca Hardness	76	76	74	64	64	66
Chloride, Cl	62	60	64	62	42	40
Total iron, Fe	0.3	0.2	0.2	0.3	0.3	0.3
Manganese, Mn	nil	nil	nil	nil	nil	nil
Ammonia as N	+	+	+	+	+	+
Nitrite as N	trace	-	-	-	-	-
Nitrate as N	-	-	-	-	-	-
E.Coli/100 ml	18	18	18	18	18	18
No. of Algae/ml	4500	3700	3700	3600	4100	5600

* : as CaCo3 ppm

Data source : Abbasa Water Treatment Plant

II-3

GROUND WATER QUALITY

Location	Kafer Saker	Abbasa
Date	22 Sept. '83	12 Sept. '83
pH	7.7	8.0
Electric Conductivity	1700	950
Total Dissolved Solid	1368	490
Chloride, Cl	520	172
Total Hardness as $CaCO_3$	464	194
Ca Hardness	260	124
Mg Hardness	204	70
Total Iron	0.1	2.4
Manganese	0.1	0.2
Alkalinity as $CaCO_3$	316	228
Ammonia as N	ND	ND
Nitrite as N	ND	Trace
Nitrate as N	ND	ND
E. Coli (MPN)	ND	ND

Data source : Abbasa water treatment plant

II-4

Laboratory Report

Analysis of Didamoon Well Water

Data of Sampling : 28 October 1983

Analyzed by : Laboratory of Abbasa Water Treatment Plant

Physical Characteristics

- Color : Nothing
- Taste : Acceptable
- Turbidity : Nothing
- Smell : Nothing

Chemical Characteristics

- Ammonia : Nothing
- Nitrite : Nothing
- Nitrate : Nothing
- Electric conductivity : 1,300
- Solved chloride (Salt) : 1,040 at 120°C
- Chloride : 364
- Hydrooxide : 276
- Hardness : 400
- Calcium : 80.8
- Magnesium : 47.52
- Iron : 0.3
- Manganese : 0.2
- pH : 7.2

Evaluation Water is acceptable for drinking from physical/chenical view point.

III-1

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source Zagazig City : Mixture

Date	'82				'83		
	18 Sept.	17 Oct.	16 Nov.	16 Dec.	19 Jan.	9 Feb.	18 Mar.
pH	7.3	7.5	7.5	7.9	7.5	7.5	7.5
TDS*	450	500	510	350	410	620	440
Chloride, Cl	120	160	142	80	68	162	58
Total Hardness**	160	200	200	200	110	200	210
Ca	52	52	52	46	46	58	58
Mg	24.6	19.2	19.2	19.2	19.2	14.0	18.0
Total iron, Fe	0.1	0.3	0.3	0.2	0.1	0.3	0.09
Manganese, Mn	nil	nil	0.1	nil	0.1	0.1	0.1
Alkalinity**	230	240	240	185	200	320	310
Ammonia as N	nil	nil	nil	nil	nil	nil	nil
Nitrite as N	nil	nil	nil	nil	nil	nil	nil
Nitrate as N	nil	nil	nil	nil	nil	nil	nil

Date	'83					
	14 Apr.	10 May	11 Jun.	5 Jul.	8 Aug.	10 Sept.
pH	7.6	7.6	7.5	7.6	7.8	7.5
TDS	520	500	520	620	948	286
Chloride, Cl	118	108	130	128	284	46
Total Hardness	220	220	170	280	404	166
Ca	62	62	44	72	94.2	34.4
Mg	32	29.9	14.4	44.4	40.3	18.2
Total iron, Fe	0.3	0.3	0.2	0.3	0.3	o.2
Manganese,Mn	0.1	0.1	trace	0.1	0.1	trace
Alkalinity	320	300	290	400	442	188
Ammonia as N	nil	nil	nil	nil	nil	nil
Nitrite as N	nil	nil	nil	nil	nil	nil
Nitrate as N	nil	nil	nil	nil	nil	nil

* Total Dissolved Solid

** as $CaCO_3$

Data source : Mr Kamel, Housing Department

III-2

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source :	Zagazig	Nishwah		Zagazig	Tahlet Borden
Date	'82		'83	'82	
	23 May	7 Dec.	17 Jul.	23 Mar.	21 Nov.
pH	7.5	7.5	7.4	7.3	7.4
TDS*	410	530	430	610	600
Chloride	70	128	60	188	184
TH**	190	190	204	184	180
Ca	52	56	49.6	40	40
Mg	8.4	12	19.2	20.2	19.2
Fe	0.2	0.2	0.1	0.2	0.2
Mn	0.05	trace	trace	0.1	0.1
Alkalinity	280	280	294	176	280
NH_3-N	nil	nil	nil	nil	nil
NO_2-N	nil	nil	nil	nil	nil
NO_3-N	nil	nil	nil	nil	nil

Location & Source		Diarb Nigm	Diarb Nigm (City)
Date	'82	'83	
	13 May	19 Feb.	19 Jul.
pH	7.7	7.5	7.4
TDS	380	380	350
Chloride	92	100	68
TH	34	80	40
Ca	7.2	20	9.6
Mg	3.84	8	3.84
Fe	0.1	0.2	0.2
Mn	trace	0.01	0.01
Alkalinity	182	200	192
NH3 - N	nil	nil	nil
NO2 - N	nil	nil	nil
NO3 - N	nil	nil	nil

* TDS; Total Dissolved Solid

** TH; Total Hardness

III-3

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Diarb Nigm El-Assayed

Date	'82			'83	
	23 Mar.	23 Jun.	13 Jul.	17 Apr.	19 Apr.
pH	7.6	7.3	7.5	8.7	8.7
TDS	320	410	380	330	320
Chloride	58	62	50	50	64
TH	32	30	40	40	40
Ca	5.6	5.2	8	16	8.8
Mg	4.32	4.9	4.8	4.8	4.32
Fe	0.2	0.2	0.2	0.3	0.2
Mn	0.1	0.05	0.1	trace	trace
Alkalinity	200	210	220	196	200
NH_3 - N	nil	nil	nil	nil	nil
NO_2 - N	nil	nil	nil	nil	nil
NO_3 - N	nil	nil	nil	nil	nil

Location & Source : Diarb Nigm El-Megafif

Date	'82		'83	
	1 Feb.	12 Aug.	19 Jan.	21 Apr.
pH	7.6	7.4	7.4	7.9
TDS	500	500	650	630
Chloride	130	170	200	200
TH	130	130	140	124
Ca	24	24	28	32
Mg	18.8	18.8	16.8	16.6
Fe	0.2	0.2	0.2	0.02
Mn	0.05	0.05	0.01	0.2
Alkalinity	260	270	30	280
NH_3 - N	nil	nil	nil	nil
NO_2 - N	nil	nil	nil	nil
NO_3 - N	nil	nil	nil	nil

III-4

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Diarb Nigm El-Hawabir

Date	'82				'83	
	27 Jan.	13 Jul.	3 Jul.	21 Nov.	24 Apr.	24 Aug.
pH	7.5	7.3	7.5	7.5	7.8	7.4
TDS	800	680	640	630	820	580
Chloride	210	166	140	140	310	100
TH	310	320	350	340	270	220
Ca	100	56	56	56	56	92
Mg	14.4	43.2	50.4	48.2	31.2	50.6
Fe	0.3	0.3	0.3	0.3	0.3	0.3
Mn	0.05	0.1	0.2	0.1	0.1	0.2
Alkalinity	310	380	370	380	280	370
NH_3 - N	nil	nil	nil	nil	nil	nil
NO_2 - N	nil	nil	nil	nil	+	nil
NO_3 - N	nil	nil	nil	nil	nil	nil

Location & Source : Diarb Nigm Dibeeg

Date	'82			'83	
	25 Jan.	24 Mar.	15 Jun.	4 Jan.	14 Mar.
pH	7.4	7.5	7.8	7.5	7.5
TDS	420	380	400	450	460
Chloride	90	84	90	100	100
TH	50	30	30	270	80
Ca	5.6	4.8	2.4	72.5	20
Mg	8.6	4.3	5.8	21.6	7.2
Fe	0.2	0.2	0.2	0.2	0.2
Mn	0.05	0.05	0.1	trace	0.05
Alkalinity	240	210	230	270	250
NH_3 - N	nil	nil	nil	nil	nil
NO_2 - N	nil	nil	nil	nil	nil
NO_3 - N	nil	nil	nil	nil	nil

III-5

WATER QUALTIY DATA

HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Diarb Nigm Kafr el-Okl

Date	'82 27 Jan.	25 Feb.	13 Apr.	22 May
pH	7.5	7.6	7.3	7.6
TDS	800	480	680	480
Chloride	160	124	160	130
TH	360	132	320	130
Ca	100	22.4	56.	24.
Mg	14.4	18.2	43.2	16.8
Fe	0.3	0.3	0.3	0.3
Mn	0.05	0.1	0.1	0.1
Alkalinity	326	220	350	194
$NH_3 - N$	nil	nil	nil	nil
$NO_2 - N$	nil	nil	nil	nil
$NO_3 - N$	nil	nil	nil	nil

Date	'82 27 Jan.	25 Feb.	13 Apr.	22May
pH	7.5	7.5	7.7	7.8
TDS	660	606	875	640
Chloride	140	140	300	130
TH	350	328	272	336
Ca	56	51.2	56	52
Mg	50.4	48.	32.2	47.5
Fe	0.3	0.2	0.2	0.3
Mn	0.2	0.1	0.1	0.2
$NH_3 - N$	nil	nil	nil	nil
$NO_2 - N$	nil	nil	nil	nil
$NO_3 - N$	nil	nil	nil	nil

III-6

WATER QUALITY DATA

HOUSING DEPARTMENT OF SHARQIYA

Location & Source Faqus City : Surface Water

Date	'82 14 Jan.	6 Feb.	28 Mar.	25 Apr.	18 May	26 Jun
pH	7.5	7.4	7.5	7.3	7.0	7.5
TDS	1000	920	1100	1150	1150	1150
Chloride	260	240	340	350	366	370
TH	500	268	450	460	460	490
Ca	120	66.4	112	108	120	96
Mg	48	24.5	40.8	41.8	38.4	62.5
Fe	0.4	0.6	0.3	0.5	0.5	0.5
Mn	0.1	0.15	0.1	0.15	0.2	0.2
Alkalinity	510	408	450	460	460	490
NH_3 - N	nil	nil	nil	nil	+	nil
NO_2 - N	nil	nil	nil	nil	+	nil
NO_3 - N	nil	nil	nil	nil	+	nil

Date	'82 26 Aug.	15 Dec.	'83 9 Jan.	6 Mar.	10 Apr.	2 Sept.
pH	7.5	7.4	7.5	7.5	7.2	7.3
TDS	1230	1100	900	460	1130	980
Chloride	360	360	170	70	320	276
TH	390	440	200	156	470	488
Ca	92	96	64	43.2	64	145.6
Mg	38.4	48	9.6	11.5	74.4	29.7
Fe	0.3	0.5	0.3	0.3	0.6	0.6
Mn	0.1	0.2	0.1	0.1	0.5	0.4
Alkalinity	396	460	490	170	466	472
NH_3 - N	nil	nil	nil	nil	+	+
NO_2 - N	nil	nil	nil	nil	+	nil
NO_3 - N	nil	nil	nil	nil	trace	nil

III-7

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Hyhia City

Date	'82			'83		
	1 Apr.	11 May	15 Dec.	19 Feb.	27 Feb.	14 Mar.
pH	7.6	7.5	7.6	7.5	7.5	7.6
TDS	850	680	820	623	670	700
Chloride	310	224	260	180	200	196
TH	216	184	296	186	196	180
Ca	64	64	72	98	47.2	40
Mg	13.6	15.4	27.8	14.4	18.7	16.2
Fe	0.3	0.3	0.3	0.6	0.3	0.3
Mn	0.1	0.1	0.1	0.1	0.2	0.1
Alkalinity	326	314	330	320	306	330
NH_3 - N	nil	nil	nil	nil	nil	nil
NO_2 - N	nil	nil	nil	nil	nil	nil
NO_3 - N	nil	nil	nil	nil	nil	nil

Location Source : Hyhia Manzel Hian

Date	-
pH	7.4
TDS	1200
Chloride	480
TH	80
Mg	33.6
Fe	0.4
Mn	0.2
Alkalinity	234
NH_2 - N	nil
NO_2 - N	nil
NO_3 - N	nil

III-8

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Miniyet el-Qamh City

Date	'82 16 Feb.	13 Mar.	7 Apr.	27 May	5 Jun.	10 Jul.
pH	7.4	7.4	7.4	7.5	7.3	7.5
TDS	440	450	450	450	490	530
Chloride	70	74	90	70	90	86
TH	250	250	256	260	254	270
Ca	64	62.4	68	64	64	72
Mg	26.6	24	20.6	24	22.6	21.6
Fe	0.3	0.23	0.3	0.3	0.3	0.3
Mn	0.1	0.05	0.1	0.1	0.1	0.1
Alkalinity	290	290	290	290	310	320
NH3 - N	nil	nil	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil	nil	nil

Date	'83 22 Feb.	10 Mar.	19 Jun.	8 Sept.
pH	7.6	7.5	7.4	7.4
TDS	570	470	485	470
Chloride	110	76	60	60
TH	250	270	320	280
Ca	72	60	64	60
Mg	33.6	24.	26.4	19.2
Fe	0.3	0.2	0.2	0.1
Mn	0.1	0.1	trace	0.1
Alkalinity	320	320	320	320
NH3 - N	nil	nil	nil	+
NO2 - N	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil

III-9

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Minyet el-Qamh El-Gadaidah

Date	'82 31 Jan.	17 Mar.	29 Jun.	26 Dec.	'83 3 May
pH	7.6	7.5	7.5	7.5	7.9
TDS	850	800	710	700	740
Chloride	204	210	240	224	220
TH	320	324	310	330	334
Ca	100	85.6	84.8	90.4	92
Mg	16.8	26.4	23.9	24.9	24.9
Fe	0.4	0.4	0.3	0.1	0.1
Mn	0.1	0.1	0.1	nil	trace
Alkalinity	296	280	312	260	274
NH3 - N	nil	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil	+
NO3 - N	nil	nil	nil	nil	trace

Location & Source : Minyet el-Qamh El-Sansafeen

Date	'82 25 Feb.	29 Jun.	26 Dec.	'83 28 Mar.	21 Aug.
pH	7.5	7.5	7.5	7.5	7.4
TDS	340	450	450	380	400
Chloride	64	68	120	66	60
TH	190	190	204	190	182
Ca	40	52	76	60	56
Mg	21.6	14.4	27.4	9.6	7.7
Fe	0.2	0.3	0.1	0.1	0.1
Mn	0.05	0.1	nil	trace	trace
Alkalinity	210	280	224	230	254
NH3 - N	nil	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil	+
NO3 - N	nil	nil	nil	nil	trace

III-10

WATER QUALITY DATA

HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Minyet el-Qumh El-Tallin

Date	'82 27 Jan.	16 May	29 Aug.	28 Nov.
pH	7.5	7.5	7.3	7.4
TDS	440	440	910	430
Chloride	92	72	400	80
TH	226	228	220	190
Ca	53.4	59.2	56.	66.
Mg	21.	19.2	16.8	40
Fe	0.2	0.2	0.3	0.3
Mn	0.1	0.1	trace	0.1
Alkalinity	292	284	400	272
NH3 - N	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil

Date	'83 23 Jan.	16 Mar.	17 Apr.
pH	7.5	7.5	7.6
TDS	510	450	440
Chloride	80	70	70
TH	220	270	230
Ca	56	56	60
Mg	19.2	31.2	19.2
Fe	0.3	0.2	0.1
Mn	0.1	0.1	nil
Alkalinity	360	280	280
NH3 - N	nil	nil	nil
NO2 - N	nil	nil	nil
NO3 - N	nil	nil	nil

III-11

WATER QUALTIY DATA
HOUSING DEPARTMENT OF SHARQIYA .

Location & Source : Minyet el-Qamh Kafr el-ghnaimy

Date	'82 26 Apr.	12 May	25 May	21 Jun.	28 Dec.
pH	7.6	7.3	7.3	7.3	7.4
TDS	490	490	520	480	550
Chloride	118	110	136	90	120
TH	274	256	266	266	290
Ca	75.2	67.2	53.6	64.	78.3
Mg	20.6	21.1	31.7	24.	21.6
Fe	0.3	0.3	0.3	0.3	0.2
Mn	0.1	0.1	0.1	0.1	0.1
Alkalinity	150	284	250	300	310
NH3 - N	nil	nil	nil	nil	+
NO2 - N	nil	+	nil	nil	+
NO3 - N	nil	+	nil	nil	+

Date	'83 6 Apr.	22 Apr.
pH	7.5	7.9
TDS	470	460
Chloride	104	110
TH	280	256
Ca	68.0	19.6
Mg	26.4	18.1
Fe	0.2	0.4
Mn	0.1	0.4
Alkalinity	248	240
NH3 - N	nil	+
NO2 - N	nil	trace
NO3 - N	nil	nil

III-12

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Minyet el-Qamh El-Sadyeen

Date	'83 27 Feb.	29 Mar.	21 Apr.
pH	7.6	7.6	7.6
TDS	370	430	540
Chloride	64	70	72
TH	200	220	288
Ca	40	40	72
Mg	24	28.8	26.0
Fe	0.2	0.2	0.2
Mn	0.05	0.05	0.05
Alkalinity	240	236	320
NH3 - N	nil	nil	nil
NO2 - N	nil	nil	nil
NO3 - N	nil	nil	nil

Date	'83 6 Jan.	7 Mar.	18 Apr.	8 May
pH	7.5	7.5	7.9	7.7
T DS	320	390	400	400
Chloride	70	60	60	60
TH	190	192	194	190
Ca	40	30.2	40	60
Mg	21.6	22.6	22.5	9.6
Fe	0.1	0.2	0.2	0.2
Mn	trace	0.05	0.05	0.05
Alkalinity	160	238	246	244
NH3 - N	nil	nil	+	+
NO2 - N	nil	nil	nil	trace
NO3 - N	nil	nil	nil	trace

III-13

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Minyet el-Qamh Banadf

Date	'82			'83	
	1 Mar.	24 Apr.	30 Aug.	24 Jan.	26Apr.
pH	7.5	7.4	7.5	7.5	7.6
TDS	600	740	660	610	575
Chloride	100	174	140	120	120
TH	290	288	350	320	288
Ca	65.	25.9	80	72	76
Mg	36	-	36.	33.6	23.5
Fe	0.3	0.3	0.3	0.3	0.2
Mn	0.1	0.1	0.1	0.1	0.4
Alkalinity	410	420	370	380	354
NH3 - N	nil	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil	nil

III-14

WATER QUALITY DATA

HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Belbeis Meet Habib / Belbeis El-Gausak

Date	'82 27 Jan.	17 May	'83 22 Mar.	'82 28 Nov.	'83 22 Jan.
pH	7.4	7.5	7.4	7.4	7.5
TDS	500	598	450	395	400
Chloride	156	142	100	100	120
TH	174	164	150	180	180
Ca	58.4	42.8	34.4	48	50
Mg	18.7	13.7	10.6	14.4	7.2
Fe	0.3	0.3	0.2	0.1	0.2
Mn	0.05	0.05	0.1	0.05	0.05
Alkalinity	272	274	230	204	240
NH3 - N	nil	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil	nil

Location & Source : Belbeis Keremlah / Belbeis El-Balashon

Date	"82 30 Aug.	'83 15 Mar.	'82 29 Aug.	'82 28 Dec.
pH	7.5	7.5	7.3	7.5
TDS	710	900	600	600
Chloride	250	310	190	182
TH	260	200	200	210
Ca	80	48	56	62.4
Mg	19.2	19.2	14.4	12.96
Fe	0.3	0.2	0.3	0.2
Mn	0.05	0.05	0.1	0.05
Alkalinity	230	290	240	240
NH3 - N	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil

III-15

WATER QUALITY DATA
HOUSING DEPARTMENT OF SHARQIYA

Location & Source	Bilbeis	Sandanhour			
Date	'82			'83	
	31 Jan.	15 Apr.	26 Aug.	26 Jan.	30 Jul.
pH	7.4	7.4	7.4	7.5	7.5
TDS	620	630	550	590	514
Chloride	152	156	160	160	100
TH	150	160	280	200	304
Ca	36	44.8	64.	98.	98
Mg	14.4	11.5	28.8	19.2	29.4
Fe	0.2	0.2	0.2	0.2	0.3
Mn	0.05	0.05	trace	0.05	0.1
Alkalinity	280	300	240	280	192
NH3 - N	nil	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil	nil

Location & Source	: Mashtul el-Suk	Kafr Iberash
	'82	
Date	28 Jun.	
pH	7.4	
TDS	570	
Chloride	176	
TH	250	
Ca	64	
Mg	20.1	
Fe	0.3	
Mn	0.1	
Alkalinity	250	
NH3 - N	nil	
NO2 - N	nil	
NO3 - N	nil	

III-16

WATER QUALITY DATA

HOUSING DEPARTMENT OF SHARQIYA

Location & Source : Ibrahymia Ibrahymia

Date	'82 24 Apr.	12 May	7 Jun	3 Jul.
pH	7.3	7.3	7.3	7.4
TDS	1600	1600	1600	1680
Chloride	690	720	710	840
TH	370	388	388	300
Ca	89.6	91.2	96.0	64.0
Mg	35.0	38.2	35.5	33.6
Fe	0.6	0.6	0.6	0.5
Mn	0.2	0.2	0.2	0.3
Alkalinity	280	264	256	300
NH3 - N	nil	nil	nil	nil
NO2 - N	nil	nil	nil	nil
NO3 - N	nil	nil	nil	nil

Date	'83 23 Feb.	10 Apr.	27 Apr.
pH	7.5	7.7	7.6
TDS	1130	1750	1575
Chloride	500	840	810
TH	280	310	296
Ca	64.0	80	76.0
Mg	28.8	26.4	25.4
Fe	0.3	0.4	0.4
Mn	0.1	0.2	0.3
Alkalinity	280	280	270
NH3 - N	nil	+	nil
NO2 - N	nil	nil	nil
NO3 - N	nil	nil	nil

Table A-1 DRINKING WATER QUALITY STANDARDS (a)

Item	Unit	GOGCWS (Tentative)	WHO Target	WHO 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
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

Table A-1 DRINKING WATER QUALITY STANDARDS (b)

Item	Unit	GOGCWS (Tentative)	W H O Target	W H O Permissible Maximum	Japan
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

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

WORKING REPORT NO.3

STUDY OF

LABOR, MATERIAL AND CONSTRUCTION METHOD

FOR

CONSTRUCTION WORKS

JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS

I. GENERAL

This study report aims to collect and analyze the basic informations concerning construction in the country, as they are needed in evaluating the feasibility of Shargiya Water Supply System Project which is being studied under an agreement between NOPWASD and JICA made in March 1983.

In the introductory part of the report, an overview will be presented about the situation of the construction industry, the policy and guidelines of the Government, availability of construction materials and machinery, trend of construction-related prices increase and other relevant problems.

Technical aspects of the construction industry will be discussed subsequently and recommendations on the matter will be proposed. Managerial issues shall also be raised and discussed there, as the structural improvement of construction industry is what this country needs virtually. Also some practical approaches will be recommended.

After reviewing the background conditions as described above, this report will list the elementary construction costs like unit cost of labor and materials and the composed unit costs of various construction works which are essential in estimating the cost of project.

II. OUTLINE OF CONSTRUCTION

2.1 Construction and Contractor

In the government projects, open tendering is widely employed for construction works and/or material procurement. Two sectors of construction contractors are co-existing in Egypt, one the publicaly owned and another privately owned. Although the former has been engaged, owing to better staffing of engineers and experts, in large scale and high technology works and has been in more advantageous positions than the latter for many years in the past, the latter has become resourceful and experienced recently.

To promote the contractors' ability, a regulation which gives opportunities, as many as possible, to more contractors is being enforced at present. Tendering is to be announced publicly in the national gazette and general newspapers. When necessary, heavy or special construction machines will be rented by the government to contractors. When a special construction method, like jacking pipes underground instead of laying in open-cut trenches for Cairo Water Supply System, is to be employed, experienced contractors are urged to help less-experiencedcontractors in training on the job and by lending necessary machines and equipments.

2.2 Working Hour

In the guideline issued by the Ministry of Labor, it is instructed that the working hours of employee should be 7 hours a day basically. Following it, all public offices and private companies fix their employees working hours from 8 a.m. to 3 p.m. usually, based on 6 working days a week. However, 5 working days system is gradually becoming popular, especially for private companies.

The guideline is observed also by the construction industry, though many construction works are promoted by the workers' overtime and/or night shift, when necessary.

For the operation of heavy construction machineries, the working hour may be extended by 1 hour of daily maintenance, in addition to the said 7 hours.

2.3 Rental System of Construction Machinery

For an average contractor, it is very difficult to own every kind of construction machinery as it cannot be operated economically under limited work volume. Meanwhile, the statistics show that the whole volume of construction work has been growing remarkable, owing to the recent growth and expansion of economy. When compared with the last two decades' achievement, the growth trend is noticable. To cope with the increasing volume economically, rental system of construction machinery has been developed in recent years.

There are two types of rental agents presently: one is those agents which do only rental business and another is the construction contractors which rent their machineries to other firms. Machines purchased for particular projects and laid idle afterwards are placed for rent by the owner usually.

To the latter type of rent agents belong such companies as National Arab Construction Company (Shirket Al Mokaweloon Al Arab) and Egyptian Construction Company (Shirket Al Mokawelet Al Masria) that were engaged in the well-known construction work of Aswan High Dam ans Six-October Bridge in Cairo. Recently the local government of Ismailiya Governorate also has set up a Lease Department in it, to utilize efficiently the machines woned by the Governorate.

Generally speaking, business activity of the latter is still lower than that of the former. A daily rent is higher for the monthly basis than for the yearly basis by the nature of business.

2.4 Construction Material

Almost all of basic materials for construction work can be obtained in the market freely. Fundamental materials such as cement and steel bar have been produced domestically, not only for the domestic needs but also for the export. Only some specific "shaped steel" is imported for construction consequently. Wood is imported mostly as the country is incapable of production.

For stabilizing supply and promoting construction, the Government controls the market price of cement, steel bar, glass and wood by subsidizing them for the public rpojects use. They are low cost housing, mosque and education facility construction and so forth. The difference between the controlled and free market price is about 15 - 25 % at present. In some cases it is as high as 40% but the trend is that the difference has been kept stable or rather decreasing under the current government policy.

Cast iron pipes and fittings are produced by local manufacturers except for big size ones, in conformity with Egyptian, ISO, BS and other dtandards, upon the specification of users. Sluice valves and various types of gates can also be produced locally, as the Irrigation and Canal Authority, as a big buyer/user, has helped improvement of the local manufacturers' capability. Asbesto cement pipes, polyvinyl chloride pipes and steel pipes with their fittings are widely used in water supply projects, due to the reasonable price and local production capacity. Ductile iron pipes are not produced in Egypt yet, though domestic production is being prepared.

Locally made pumps and engines are used in groundwater pump stations. Machineries such as dewatering pumps and concrete mixers can also be manufactured, even though the supply capacity is still short to meet the domestic demands.

2.5 Guidance of the Government

To standardize the design work procedure, the Integration Department of the Government prepares and distributes the design data to local branches under its authority, to be used for public construction projects. The data include a unit price schedule which is revised every year. The local branches utilize the data, modifying properly to make them updated and fitted for the local conditions.

The Government has carried out periodical training courses to train the engineers concerned at the government-owned training facilities, under the tutorship of learned and experienced specialists. In addition, it has sent engineers overseas to master the latest techniques and knowledge. Through the foreign aid programmes which have been increasing in the number of projects, technology transfer has been realized simultaneously with execution of the projects.

2.6 Trend of Price Increase

The Central Statistic Bureau of the Government estimates the annual increase rate of price indexes and standard wages as 12% which will be described in detail in the separate report.

As all prices stated in the report are the present ones, adequate modification will become necessary when costs are estimated in the future.

III CONSTRUCTION METHOD

3.1 Construction Method

Almost all techniques have been experienced in the civil engineering field in the country. As for the construction works of water supply systems, for instance, such latest techniques as wellpoint method for dewatering, prestressed concrete for water tanks and pipe jacking work for underground installation have been worked by local contractors already. At the same time, utilization of the construction machinery has become more popular recently, in order to raise the quality and productivity of construction works.

In applying specific techniques for construction works, however, a study is always needed from points of not only technical suitability but also practicability, that is, whether the contractors can provide a sufficient number of experienced engineers and skilled laborers, among others.

Also, the number and kind of construction machinery seems to be in shortage here. For instance, it is observed that a 0.3 m^3 capacity backhoe is used instead of 0.8 m^3 one which is far more suitable for the size of excavation volume. Theoretically, construction machines are to be selected for that they can economically and efficiently manage the site conditions and work volume. In practice however, available machines have to be used, sometimes disregarding the economy and efficiency of works, to a certain extent.

From the above mentioned background, the following points must be considered in selecting the construction method:

1) A construction method should be decided, taking account of local conditions including aspects of practicability.
2) Supply and/or rent of adequate construction machines by the owner shall be considered, if necessary.

and,

3) Special and/or not-widely-used method could be selected, only when the site conditions and construction period require and the contractors capability is well confirmed.

3.2 Construction Ability

A few, nationally known, top ranking contractors retain many experienced engineers and they have made substantial achievements in diversified fields of engineering. In the civil engineering field, there exist a gap of capability between the mentioned few and other average contractors. The gap seems to have originated from the difference of financial ability and engineering experiences accumulated in the past. The average contractors still have a good possibility to improve their overall status in the future, however.

If they are given opportunities with financial and technical considerations and back-up, the average contractors' position will be raised remarkably. For it, the following points shall be practiced preferably:

1) Prior to commencement of works, an advance payment is to be made to the contractors as a step of financial back-up.
2) In cases of public construction projects, the basic materials like comment and steel bars, of the controlled price level, are to be purchased and supplied to the contractors. It will certainly ease the contractors's financial load and help improve the quality of works.
3) For the works employing special construction methods, the average contractors shall be given more chances of being awarded, so that they can train staff members on the job.

IV. UNIT COST OF LABOR, MATERIAL AND CONSTRUCTION WORKS

Main costs of labor and materials like sand and gravel were collected in Sharqiya Governorate. As for some materials costs which were available in Cairo but not in the Governorate, adequate modification was applied to the Cairo prices, taking into consideration the possible difference between in Cairo and the Governorate.

Data collection was made through inquiring to the experienced engineers of the Governorate, local contractors and manufacturer/suppliers. For cross-checking and reference, similar data were collected in Cairo as well. The costs of imported pipes and fittings and rental charge of heavy construction machines were obtained mostly in Cairo, where those data could be collected rather easily.

Because of flexible market mechanism, some difference was found in the quotations of the same material at same time and spot. Under such situations, reasonable costs had to be selected with the experienced engineers assistance and advice. The listed costs are valid for the present and shall be revised in the future, taking possible changes into consideration.

4.1 Unit Cost of Labor

Earthworker	LE	4 - 5/day
Chief of Earthworker		8
Carpenter		7 - 8
Plasterer		7 - 8
Mason (for brick and stone)		8 - 10
Concrete Worker		7 - 8
Welder		12
Steel Bar Worker		10
Scaffolding worker		8
Pump Man		5
Truck Driver		
Operator (for bulldozer, excavator, truck crane, etc.)		

Electric Worker	7
Pipe Worker	8
Glass Worker	6
Tile Worker	10
Gardener	5
Painter	6
Office Boy	3
Typist	6

4.2 Unit Cost of Material

Concrete Sand (cashed)	LE 8/m3
Concrete Gravel (washed and sieved)	15/m3
Sand (without washed and sieved)	6/m3
Gravel (do)	10/m3
Crushed Stone (gravel)	20/m3
Cobble Stone	60/m3
Portland Cement (sack: 50kg)	75/ton
Shite Cement	75/ton
Steel Bar	400/ton
Deformed Steel Bar (More than 13mm size)	400/ton
Wire	800/ton
Paint	1.2/kg
Gasoline	0.15/l
Kerosene	0.05/l
Grease Oil	1.5/kg
Machine Oil	1.5/kg
Wooden Plate	220 - 300/m3
Wooden Column	220 - 300/m3
Palm Tree (for foundation, Length: about 4m)	4/piece
Nail	1.5 - 3/kg
Form (wooden)	
Form (steel)	
Shape Steel (section steel)	1,000/ton
Steel Plate	800/ton

4.3 Rental Charge of Machinery

Truck (5 ton)	LE 50/day
Dump Truck (6 ton)	100/day
Bulldozer (30 - 50 ton)	200/day
Backhoe (0.5 m3)	8/hour*
Power Shovel (0.5 m3)	8/hour*
Pile Driver	200/4 m3-pile**
Truck Crane ( )	200/day
Diesel Hammer (Ram: 2.5 - 3.5)	200/day
Pump (with engine)	50/day
Horse Cart (with two drivers)	15/day
Concrete Mixer (0.5 m3)	50/day
Concrete Vibrator (engine or electric motor)	20/day
Concrete Tower (with Crane, 10 ton/hour)	50/hour
Concrete Pump	
Engine Welder	40/day
Winch (with engine and wire, Lift : 5 ton)	50/day
Tamping Machine (Hand type)	150/day
Road Roller (10 ton)	70/day
Road Roller (30 ton)	100/day
Vibration Roller ( )	40/day
Transportation from Cairo to Zagazig and Cairo for Construction Machinery	400/one round trip

(Note) * : Working Hours 8 hours/day

** : 4 m3-pile means 0.5 m2 X 8 m length pile for instance

4.4 Unit Cost of Construction Work

Aggregate Layer (with tamping)	LE 40/m3
Plain Concrete	50/m3*
Reinforced Concrete (without steer bar)	120/m3**
Scafforlding (3m height)	100/500 m2
Timbering (3m height)	100/500 m2

Concrete Pile	(without criving, 40cm X 40cm X 10m)	500/piece
Excavation	(by manual, until 2m depth)	4/m3
Excavation	(In case of more 2m depth, LE 1.50 will be added every 1m depth.) Ex. 4m Excavation : LE 4.00 + 2 X LE 1.50 = LE 7.00/m3	
Excavation	(by Machine	4/m3
Backfill	(by manual)	2/m3
Backfill	(by machine)	2/m3
Valve Chamber		300/1m3 empty volume

(Note) * : cement 250kg + sand 0.4m3 + gravel 0.8m3

** : cement 400kg + sand 0.4m3 + gravel 0.8m3

APPENDIX

A.1 Construction Cost of Well Digging and Elevated Tank

A.1.1 Construction Cost of Well Digging

A.1.2 Construction Cost of Elevated Tank

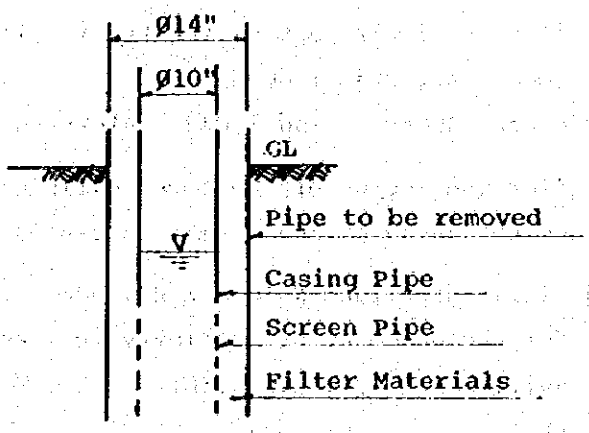
A.1 Construction Cost of Well Digging and Elevated Tank

The cost quoted below is reference data, prepared and distributed to the local branches recently by the Integration Office of Housing Department. The cost of well digging and elevated tank are calculated, based on the previously (4.1 to 4.4) listed unit costs and the result can be cross-checked with these data.

A.1.1 Construction Cost of Well Digging (by manual works)

Ø14" Steel Pipe (sampling soil every one meter, digging, pipe installation and removal, material)	LE 42/m
Ø10" Steel Pipe Casing X Thickness 6.35mm (Pipe material and incidental necessary works)	LE 60/m
Ø10" Screen Pipe (including Screen net and filter materials)	LE 85/m
Ø10" Header Pipe (including movable flanges, joint materials, excavation and backfill)	LE 75/m
Ø10" Cast iron Bend (with movable flange, joint materials and jointing works)	LE 175/m
Ø10" Cast Iron Valve(High Pressure Type, including joint works)	LE 300/set

SCHEMATIC WELL SECTION



A.1.2 Construction Cost of Elevated Tank

Excavation (with backfill)	LE 3.50/m3
Plain concrete (cement 250kg + sand 0.4m3 + gravel 0.8m3)	LE 28.- /m3
Reinforced concrete (with steel bar kg/m3 cement 350kg + sand 0.4m3 + gravel 0.8m3)	LE 112.- /m3
Reinforced concrete (with steel bar kg/m3, for slab, wall and bottom of Elevated Tank with all other necessary works. cement 400kg + sand 0.4m3 + gravel 0.8m3)	LE 196.- /m3
Brick masonry (concrete mortar cement 300kg + sand 1.0m3 for the outside of exposed tank walls)	LE 14.- /m2
Cement mortar (for the inside and outside wall of the tank including bottom, thickness 3cm cement 300kg + sand 1.0m3)	LE 2.50/m2
Cement paste plastering (for the inside and bottom of the tank and machinery room for water-proof cement 400kg + sand 1.0m3 + SIKA kg)	LE 3.50/m2
Reinforced concrete (for tower cylinder of the tank cement 350kg + sand 0.4m3 + gravel 0.8m3, with steel bar kg/m3 and other all necessary works)	LE 112.- /m3
Cement mortar (for tower cylinder, thickness 3cm cement 300kg + sand 1.0m3)	LE 4.50/m2
Cement mortar (for the lower part of the tower cylinder Lower part area : 60m2/tower cement 300kg + sand 1.0m3, thickness 3cm)	LE 2.50/m2
Cement mortar (for the inside of the tower cylinder cement 300kg + sand 1.0m3, thickness 2cm)	LE 2.- /m2
Concrete tiling (tile size 10cm X 10cm X H 1.0cm for the basement of machinery room and surrounding cylinder 2.0m)	LE 14.- /m2

Concrete tiling (tile size 10cm X 10cm X H 2.0cm for the operation floor in the cylinder) LE 4.50/m2

Concrete block curb(block size H 30cm X W 15cm X L 50cm. cement 350kg + sand 0.4m3 + gravel 0.8m3) LE 4.-/m

Steel door of tower (including key, hinge, painting and all incidental necessary works) LE 2.-/kg

Steel manhole cover on the tank (including key, hinge, painting and all incidental necessary works) LE 1.50/kg

Wooden door (including key, hinge, painting and all incidental necessary works) LE 35.- /m2

Steel window (with glass, painting and all incidental necessary works.
window size H X W cm) LE 35.-/window

Steel inspection window (for the inspection of water level, with glass, painting and all incidental necessary works.
window size H cm X W cm) LE 2.- /kg

Steel window for cylinder (with glass, painting and all incidental necessary works.
window size H cm X W cm) LE 45.- /window

Steel zigzag stair (including safe hand rail, painting and incidental necessary works.) LE 2.- /kg

Steel helical stair (stair installed from operation floor to top of the tank._ LE 2.50/kg

Safe hand rail (made of steel) LE 2.50/kg

Water level indicator (including fooat, wire and all other necessary works.) LE 280.-/set

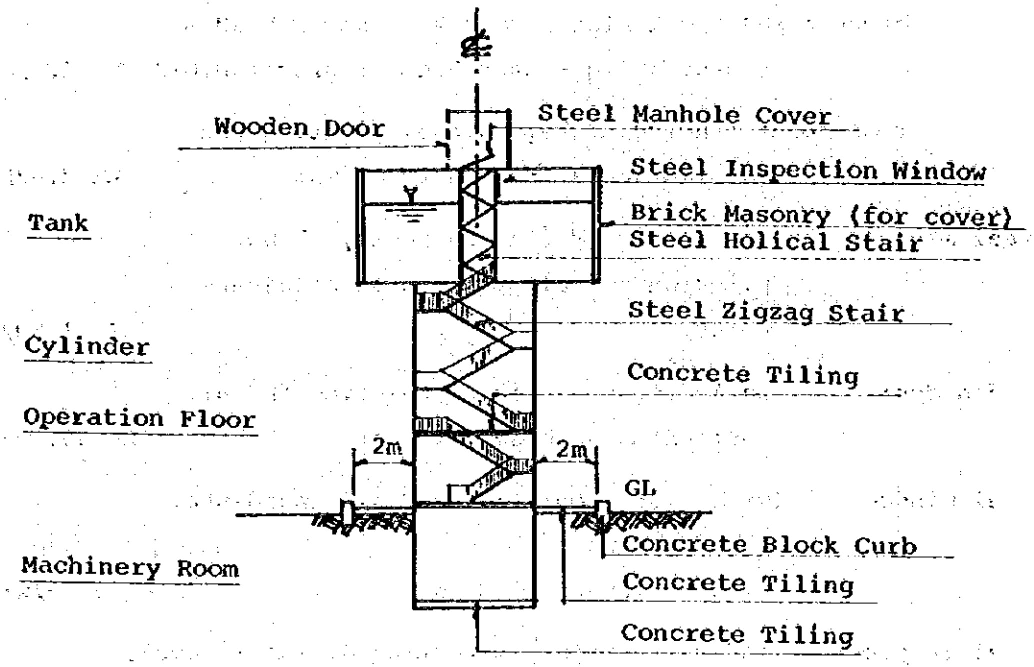
Steel pipe (SGP Ø6") LE 35.-/m

Non-return valve (cast iron Ø6") LE 125.-/set

High pressure valve (cast iron Ø6") LE 130.-/set

Clay drain pipe (Ø8" clay pipe including concrete pit pit size 1.0m X 1.0m X 1.m) LE 18.-/m

ELEVATED TANK



A.2 Estimated Construction Costs of Pipe Installation Works

Dewatering (Engine 5PS) (per day)

Petrol	9.0 l	@ 0.05	LE 0.45
Miscellaneous Material	20%		LE 0.09
Pump Worker	0.8	@ 5.-	LE 4.-
Depreciation			
Pump Ø 100 x 5PS	1 day	@ 10.-	LE 10.-
		Total	LE 14.54

Dewatering of Trench (per 10m)

Dia	Pipe Installation Speed (A) (m/day)	No. of Days (B = 10/A) (day)	No. of Days when pump is used (B/2)	Dewatering (per 10m) (@LE14.54/day)
100	34.2	0.29	0.15	2.18
150	31.5	0.32	0.16	2.33
200	29.2	0.34	0.17	2.47
250	27.3	0.37	0.19	2.76
300	25.5	0.39	0.20	2.91
350	24.0	0.42	0.21	3.05
400	16.0	0.63	0.32	4.65
450	14.6	0.68	0.34	4.94
500	13.4	0.75	0.38	5.53
600	11.2	0.89	0.45	6.54
700	9.5	1.05	0.53	7.71
800	8.0	1.25	0.63	9.16
900	6.0	1.67	0.84	12.21
1,000	5.4	1.85	0.93	13.52
1,100	4.4	2.27	1.14	16.58
1,200	2.8	3.57	1.79	26.03
1,350	3.2	3.13	1.57	22.83
1,500	2.7	3.70	1.85	26.90
1,600	2.2	4.55	2.28	33.15

(Note) * Data source of Pipe Installation Speed : "Data Book for Civil Engineering Field Practices"

* It is broadly estimated that number of days when dewatering pump is used will be half of total construction days.

Transportation of Pipe Materials (5t truck) (per ton)

carrying capacity of truck	:	5,000 kg	
distance between storage and site	:	25 km	
carrying number a day	:	1.5	
Total weight	:	1.5 x 5 = 7.5 ton	

truck (5t)	1 day	@ LE 50	LE 50
worker	6	@ LE 5	LE 30
chief	1	@ LE 8	LE 8
		(Total	LE 88)

per ton : 88/7.5 LE 11.73

Total LE 11.73

Transportation of Pipes (per 10m)

Dia.	Weight of Pipe (Kg/piece)	Length of Pipe (m)	No. of Pipe in 10m	Total Weight (kg)	Carrying Cost (LE/10m)
100	78.9	4	2.5	197.3	2.31
150	141.6	5	2.0	283.2	3.32
200	187.3	5	2.0	374.6	4.39
250	233.1	5	2.0	466.2	5.47
300	282.9	6	1.7	480.9	5.64
350	446.8	6	1.7	759.6	8.91
400	538.0	6	1.7	914.6	10.73
450	637.0	6	1.7	1,082.9	12.70
500	743.0	6	1.7	1,263.1	14.82
600	976.0	6	1.7	1,659.2	19.46
700	1,304.0	6	1.7	2,216.8	26.00
800	1,600.0	6	1.7	2,720.0	31.91
900	1,936.0	6	1.7	3,291.2	38.61
1,000	2,392.0	6	1.7	4,066.4	47.70
1,100	2,797.0	6	1.7	4,754.9	55.77
1,200	3,222.0	6	1.7	5,477.4	64.25
1,350	4,040.0	6	1.7	6,868.0	80.56
1,500	4,822.0	6	1.7	8,197.4	96.16
1,600	4,706.0	5	2.0	9,412.0	110.40

(Note) "Weight of Pipe" = Weight of D3 Pipe + Cement Lining

Cost/Ductile Iron Pipe Installation (per 10m)

Dia	Setting				Jointing				Sub-Total (A)	Miscel-laneous (A x 11%)	Total (LE/10m)
	Pipe Worker (@ LE8)	Price	Worker (@ LE5)	Price	Pipe Worker (@ LE8)	Price	Worker (@ LE5)	Price			
100	0.19	1.52	0.65	3.25	0.05	0.40	0.05	0.25	5.43	0.60	6.02
150	0.25	2. -	0.91	4.55	0.06	0.48	0.06	0.30	7.33	0.81	8.14
200	0.37	2.96	0.95	4.75	0.07	0.56	0.07	0.35	8.62	0.95	9.57
250	0.41	3.28	1.05	5.25	0.08	0.64	0.08	0.40	9.57	1.05	10.62
300	0.65	5.20	1.57	7.85	0.09	0.72	0.09	0.45	14.22	1.56	15.78
350	0.84	6.72	1.98	9.90	0.09	0.72	0.09	0.45	17.79	1.96	19.75
400	1.01	8.08	2.37	11.85	0.10	0.80	0.10	0.50	21.23	2.34	23.57
450	1.18	9.44	2.76	13.80	0.11	0.88	0.11	0.55	24.67	2.71	27.38
500	1.75	14. -	3.17	15.85	0.12	0.96	0.12	0.60	31.41	3.46	34.87
600	2.21	17.68	4. -	20. -	0.14	1.12	0.14	0.70	39.50	4.35	43.85
700	2.68	21.44	4.82	24.10	0.16	1.28	0.16	0.80	47.62	5.24	52.86
800	3.11	24.88	5.61	28.05	0.21	1.68	0.21	1.05	55.66	6.12	61.78
900	3.55	28.40	6.42	32.10	0.24	1.92	0.24	1.20	63.62	7. -	70.62
1,000	4.22	33.76	7.62	38.10	0.28	2.24	0.28	1.40	75.50	8.31	83.81
1,100	5.13	41.04	9.26	46.30	0.33	2.64	0.33	1.65	91.63	10.08	101.71
1,200	6.11	48.88	11.02	55.10	0.39	3.12	0.39	1.95	109.05	12. -	121.05
1,350	7.83	62.64	14.13	70.65	0.48	3.84	0.48	2.40	139.53	15.35	154.88
1,500	9.49	75.92	17.05	85.25	0.59	4.72	0.59	2.95	168.84	18.57	187.41
1,600	12.62	100.96	22.68	113.40	0.78	6.24	0.78	3.90	224.50	24.70	249.20

(Note) "Setting" includes transportation within sites
"Jointing" includes setting and jointing of special joints
"Miscellaneous" includes miscellaneous material (1% of labor cost) and pipe cutting (10% of labor cost).

Excavation (Depth 1 - 2m) (per m^3)

Worker	0.77	@ 5.-	LE 3.85
Chief	0.02	@ 8.-	LE 0.16
		Total	LE 4.01

Excavation (Depth 2 - 3m) (per m^3)

Worker	0.90	@ 5.-	LE 4.50
Chief	0.02	@ 8.-	LE 0.16
		Total	LE 4.66

Backfill (including compaction) (per m^3)

Worker	0.26	@ 5.-	LE 1.30
Chief	0.01	@ 8.-	LE 0.08
		Total	LE 1.38

Disposal Volume of Earth (5t truck) (per day)

unit weight of earth	:	1,800 kg
carrying capacity of truck	:	5,000/1,800 = (5,000/1,800)x0.8=2.2m^3
distance	:	4.0 km
loading and carrying hour	:	7/3.1 hr
carrying number a day	:	3.1 = 2.3
disposal volume	:	2.3 x 2.2 = 5.1 m^3/day

Disposal (Earth, 5t truck) (per day)

truck (5t)	1 day	@ 50.-	LE	50.-
worker	5	@ 5.-	LE	25.-
chief	1	@ 8.-	LE	8.-
		Total	LE	83.-

Disposal (Earth, 5t truck) (per m^3)

per m^3	: 83/5.1 =	LE 16.27
	Total	LE 16.27

Pipelaying Work (Cast/Ductile Iron Pipe)

(Unit : LE/m)

No. Item	Unit	100	150	200	250	300	350	400	450	500	600	700	800
1) Excavation													
Unit Price	LE/m^3	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.66	4.66	4.66	4.66
Volume	m^3	0.92	1.02	1.14	1.28	1.58	1.73	1.88	2.36	2.83	3.35	3.80	4.25
Price	LE	3.69	4.09	4.57	5.13	6.34	5.73	7.54	9.46	13.19	15.61	17.71	19.81
2) Backfill													
Unit Price	LE/m^3	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Volume	m^3	0.92	1.00	1.11	1.23	1.51	1.63	1.75	2.19	2.63	3.07	3.42	3.76
Price	LE	1.27	1.38	1.53	1.70	2.08	2.25	2.42	3.02	3.63	4.24	4.72	5.19
3) Disposal													
Unit Price	LE/m^3	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27
Volume	m^3	-	0.02	0.03	0.05	0.07	0.10	0.13	0.17	0.20	0.28	0.38	0.49
Price	LE	-	0.33	0.49	0.81	1.14	1.63	2.12	2.77	3.25	4.56	6.18	7.97
4) Pipe Installation	LE	0.60	0.81	0.96	1.06	1.58	1.98	2.36	2.74	3.49	4.39	5.29	6.18
5) Transportation	"	0.23	0.33	0.44	0.55	0.56	0.89	1.07	1.27	1.48	1.95	2.60	3.19
Sub-Total	"	5.79	0.94	7.99	9.25	11.70	12.48	15.51	19.26	25.04	30.75	36.50	42.34
6) Hydrostatic Test *	LE	0.30	0.41	0.48	0.53	0.79	0.99	1.18	1.37	1.75	2.20	2.65	1.55
7) Dewatering	"	0.22	0.23	0.25	0.28	0.29	0.31	0.47	0.49	0.55	0.65	0.77	0.92
8) Miscellaneous Works **	"	0.29	0.35	0.40	0.46	0.59	0.62	0.78	0.96	1.25	1.54	1.83	2.12
Sub - Total	LE	0.81	0.99	1.13	1.27	1.67	1.92	2.43	2.82	3.55	4.39	5.25	4.59
Total	LE	6.60	7.93	9.12	10.52	13.37	14.40	17.94	22.08	28.59	35.14	41.75	46.93

No.	Item	Unit	900	1,000	1,100	1,200	1,350	1,500	1,600	Remarks
1)	Execavation									
	Unit Price	LE/m^3	4.66	4.66	4.66	4.66	4.66	4.66	4.66	* Hydrostatic Test cost:
	Volume	m^3	4.91	5.57	6.29	7.00	8.19	9.47	10.85	(Pipe Installation)
	Price	LE	22.88	25.96	29.31	32.62	38.17	44.13	50.56	x 0.50 ..... Ø100 - Ø700
										(- do -)
2)	Backfill									x 0.25 .... Ø800 and more
	Unit Price	LE/m^3	1.38	1.38	1.38	1.38	1.38	1.38	1.38	
	Volume	m^3	4.27	4.78	5.33	5.87	6.76	7.70	8.54	** Miscellaneous Work:
	Price	LE	5.89	6.60	7.36	8.10	9.33	10.63	11.79	(sub-total) x 0.05
3)	Disposal									
	Unit Price	LE/m^3	16.27	16.27	16.27	16.27	16.27	16.27	16.27	
	Volume	m^3	0.64	0.79	0.96	1.13	1.43	1.77	2.31	
	Price	LE	10.41	12.85	15.62	18.39	23.27	28.80	37.58	
4)	Pipe Installation	LE	7.06	8.38	10.17	12.11	15.49	18.74	24.92	
5)	Transportation	"	3.86	4.77	5.58	6.43	8.06	9.62	11.04	
	Sub-Total	"	50.10	58.56	68.04	77.65	94.32	111.92	135.89	
6)	Hydrostatic Test *	LE	1.77	2.10	2.54	3.03	3.87	4.69	6.23	
7)	Dewatering	"	1.22	1.35	1.66	2.60	2.28	2.69	3.32	
8)	Miscellaneous Works **	"	2.51	2.93	3.40	3.88	4.72	5.60	6.79	
	Sub - Total	LE	5.50	6.38	7.60	9.51	10.87	12.98	16.34	
	Total	LE	55.60	64.94	75.64	87.16	105.19	124.90	152.23	

AVERAGE PRICE OF FITTINGS

Material	Joint Type	Dia.	Weight (kg) (A)	Price (LE) (B)	B/A (LE/kg)	Average Price (LE/kg)	Average Price (LE/kg)
90° Bend	T	250	56.1	134.94	2.41		
"	T	600	312.0	744.78	2.39		
"	K	700	554.0	1,229.60	2.22	2.32	
"	K	1,500	2,836.3	6,354.73	2.24		
45° Bend	T	250	44.7	108.23	2.42		
"	T	600	218.9	528.90	2.42		
"	K	700	413.0	915.05	2.22	2.34	
"	K	1,500	1,888.3	4,305.30	2.28		2.31
Flanged Spigot	T10	250	40.1	87.68	2.19		
"	T10	600	170.3	390.05	2.29		
"	K10	700	233.3	521.40	2.23		
"	K10	1,500	1,018.9	2,326.06	2.28	2.25	
Tee	T	250	77.0	185.22	2.41		
"	T	600	346.4	852.48	2.46		
"	K	700	662.8	1,442.63	2.18		
"	K	1,500	3,641.0	7,952.44	2.18	2.31	

Demolition of Pavement (Asphalt)

Worker 1.3 persons/m3 x 1.3 x @5 = LE 8.45/m3

Thickness of Pavement : 20 cm

Demolition Cost per m2 : 8.45 x 1/5 ≒ LE 1.70/m2

Disposal : 16.27 x 1/5 ≒ LE 3.25

Total LE 4.95/m2

Asphalt Pavement (t=200)

t = 200 (Asphalt)	LE 32.0
t = 180 (Crusher Run)	LE 5.0
t = 200 (Crusher Run)	LE 6.0
Total	LE 43.0/m3

PIPE MATERIAL PRICE PER METER

Dia	Length (m)	Pipe Price (LE) Per Piece	Pipe Price (LE) Per m (A)	Weight (kg) Per Piece	Weight (kg) Per m	Fitting Price (LE) (B)	Price per m (A+B) (LE/m)
100	4	51.22	12.81	78.0	2.34	5.41	18.22
150	5	97.87	19.57	145.3	4.36	10.07	29.64
200	5	137.49	27.50	196.5	5.90	13.63	41.13
250	5	184.84	36.97	256.1	7.68	17.74	54.71
300	6	279.97	46.66	405.8	12.17	28.11	74.77
350	6	362.89	60.48	501.5	15.05	34.77	95.25
400	6	439.11	73.19	591.7	17.75	41.00	114.19
450	6	526.48	87.75	696.9	20.91	48.30	136.05
500	6	618.56	103.09	803.1	24.09	55.65	158.74
600	6	823.81	137.30	1,038.5	31.16	71.98	209.28
700	6	1,081.36	180.23	1,374.2	41.23	95.24	275.47
800	6	1,351.17	225.20	1,675.0	50.25	116.08	341.28
900	6	1,646.32	274.39	2,001.9	60.06	138.74	413.13
1,000	6	1,999.94	333.32	2,454.6	73.64	170.11	503.43
1,100	6	2,365.00	394.17	2,854.2	85.63	197.81	591.98
1,200	6	2,758.02	459.67	3,274.9	98.85	228.34	688.01
1,400	6	3,686.82	614.47	4,355.5	130.67	301.85	916.32
1,500	6	4,194.65	699.11	4,869.4	146.08	337.44	1,036.55

(Note) 1. The delivery of pipe materials is at Sharqiya Governorate.

2. The standard of pipe material is based on ISO.

3. The necessary weight of fittings is estimated as follows:
(Weight of Fittings) = (Weight of Straight Pipes) x 3 %

4. Fitting prices are estimated as follows:
   (Fitting Price) = (Fitting Weight) x (Average Fitting Price LE 2.31)

5. All necessary jointing material prices are included in the prices concerned.

PIPE INSTALLATION COST PER METER

(Unit : LE/m)

Dia.	Pipe Material	Pipelayin Work	Thrust Block	Reconstruction of Pavement Area (m2)	Reconstruction of Pavement Cost	Pipe Installation
100	18.22	6.60	0.99	0.46	22.06	47.87
150	29.64	7.93	1.19	0.50	23.98	62.74
200	41.13	9.12	1.37	0.53	25.41	77.03
250	54.71	10.52	1.58	0.57	27.33	94.14
300	74.77	13.37	2.01	0.65	31.17	121.32
350	95.25	14.40	2.16	0.69	33.09	144.90
400	114.19	17.94	2.69	0.72	34.52	169.34
450	136.05	22.08	3.31	0.80	38.36	199.80
500	158.74	28.59	4.29	0.88	27.81	219.43
600	209.28	35.14	5.27	0.97	46.51	296.20
700	275.47	41.75	6.26	1.04	49.87	373.35
800	341.28	46.93	7.04	1.11	53.22	448.47
900	413.13	55.60	8.34	1.21	58.02	535.09
1,000	503.43	64.94	9.74	1.30	62.34	640.45
1,100	591.98	75.64	11.35	1.40	67.13	746.10
1,200	688.01	87.16	13.07	1.49	71.45	859.69
1,400	916.32	105.19	15.78	1.65	79.12	1,116.41
1,500	1,036.55	124.90	18.74	1.80	86.31	1,266.50

(Note) 1. The construction cost of Thrust Block is estimated as follows:

(Thrust Block Cost) = (Construction Cost of Pipelaying) x 15 %

2. Area of pavement to be reconstructed in assumed as half of excavated area.

3. The unit price of reconstruction of pavement (LE47.95/m2) includes the demolition cost of pavement and necessary disposal.

4. The cost of Pipe Installation includes miscellaneous works except valve and its chamber cost.

VALVE CHAMBER

Dia	Valve (LE)	Chamber (LE)	Total (LE)	Remarks
100	116.56	90.000	206.56	sluice valve with flanges, cast Iron surface Box
150	198.94	90.00	288.94	do , do
200	300.25	90.00	390.25	do , do
250	472.48	100.00	572.48	do , do
300	603.82	100.00	703.82	do , do
350	821.96	100.00	921.96	do , do
400	1,159.10	100.00	1,259.10	do , do
450	1,518.01	100.00	1,618.01	do , do
500	2,103.75	100.00	2,203.75	do , do
600	3,773.07	2,000.00	5,773.07	do , do
700	4,887.36	2,000.00	6,887.36	Butterfuly valve with flanges, R.C. Chamber
800	5,955.58	2,000.00	7,955.58	do , do
900	7,365.57	2,200.00	9,565.57	do , do
1,000	9,503.42	2,200.00	11,703.42	do , do
1,100	11,116.67	2,200.00	13,316.67	do , do
1,200	12,398.63	2,500.00	14,898.63	do , do
1,400	15,344.71	2,500.00	17,844.71	do , do
1,500	19,295.66	2,500.00	21,795.66	do , do

(Note) 1. Standrad Sluice V. : JIS

Butterfly V. : JWWA

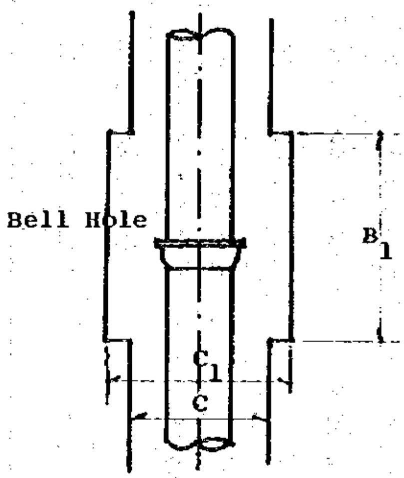
2. Delivery Place : Sharqiya Governorate

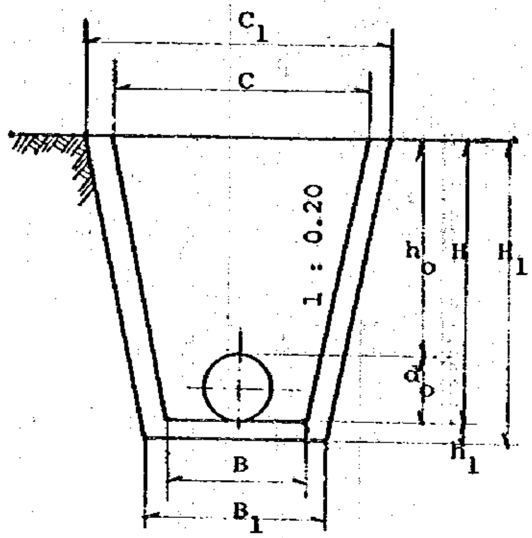
A.3 Estimated Earth Works on Pipe Installation

1. Condition

Type of Joint	Ø 100 - Ø 250	: push-on Joint Type
	Ø 300 and more	: Mechanical Joint Type
Unite Length of pipe	Ø 100	: 4 m
	Ø 150 - Ø 250	: 5 m
	Ø 300 - Ø 1,500	: 6 m
	Ø 1,600	: 5 m

2. Excavation (per 100m)





$Q_E = A \times L + (A_1 - A) \times B_1 \times n$

Q_E : Excavation (m^3/100m)

A : Sectional Area of Trench

L : Pipeline Length = 100m

$(A_1 - A)$: Additional Excavation at Bell Hole

n : Number of Bell Hole = [L/unit length of straight pipe] x 1.10 (Allowance)

= 110/unit length of straight pipe

3. Backfill

$Q_B = (A - a_o) \times L + (A_1 - A) \times B_1 \times n$

Q_B : Backfill (m^3/100m)

A : Sectional Area of Trench

a_o : " " of Pipe

L : Pipeline length = 100m

4. Disposal

Q_D : Disposal (m^3/100)

$Q_D = a_o \times L$

DIMENSION OF EARTH WORK

Dia	ho	do	H	B	C	A	h_1	H_1	B_1	C_1	A_1	a_o	$A-a_o$	A_1-A
(mm)	(m)	(m)	(m)	(m)	(m)	(m2)	(m)	(m)	(m)	(m2)	(m2)	(m2)	(m2)	(m2)
100	1.20	0.10	1.30	0.40	0.92	0.87	0.05	1.35	0.60	1.14	1.17	-	0.87	0.30
150	"	0.15	1.35	0.45	0.99	0.97	"	1.40	0.65	1.21	1.30	0.02	0.95	0.33
200	"	0.20	1.40	0.50	1.06	1.09	"	1.45	0.70	1.28	1.44	0.03	1.06	0.35
250	"	0.25	1.45	0.55	1.13	1.22	"	1.50	0.75	1.35	1.58	0.05	1.17	0.36
300	"	0.30	1.50	0.70	1.30	1.50	0.10	1.60	0.90	1.54	1.95	0.07	1.43	0.45
400	"	0.40	1.60	0.80	1.44	1.79	"	1.70	1.00	1.68	2.28	0.13	1.66	0.49
500	1.50	0.50	2.00	0.95	1.75	2.70	"	2.10	1.15	1.99	3.30	0.20	2.50	0.60
600	"	0.60	2.10	1.10	1.94	3.19	"	2.20	1.30	2.18	3.83	0.28	2.91	0.64
800	"	0.80	2.30	1.30	2.22	4.05	"	2.40	1.50	2.46	4.75	0.50	3.55	0.70
1,000	"	1.00	2.50	1.60	2.60	5.25	0.15	2.65	1.80	2.86	6.17	0.79	4.46	0.92
1,200	"	1.20	2.70	1.90	2.98	6.59	"	2.85	2.10	3.24	7.61	1.13	5.46	1.02
1,350	"	1.35	2.85	2.15	3.29	7.75	"	3.00	2.35	3.55	8.85	1.43	6.32	1.10
1,500	"	1.50	3.00	2.40	3.60	9.00	"	3.15	2.60	3.86	10.17	1.77	7.23	1.17
1,600	"	1.60	3.10	2.60	3.84	9.98	"	3.25	2.80	4.10	11.21	2.01	7.97	1.23

EXCAVATION

Dia (mm)	A (m^2)	AL (m^3)	Al - A (m^2)	Bl (m)	n	(Al-A)xBl x n (m^3)	QE (m^3)
100	0.87	87	0.30	0.60	28	5.0	92.0
150	0.97	97	0.33	0.65	22	4.7	101.7
200	1.09	109	0.35	0.70	"	5.4	114.4
250	1.22	122	0.36	0.75	"	5.9	128.1
300	1.50	150	0.45	0.90	19	7.7	157.7
400	1.79	179	0.49	1.00	"	9.3	188.3
500	2.70	270	0.60	1.15	"	13.1	283.1
600	3.19	319	0.64	1.30	"	15.8	334.8
800	4.05	405	0.70	1.50	"	20.0	425.0
1,000	5.25	525	0.92	1.80	"	31.5	556.5
1,200	6.59	659	1.02	2.10	"	40.7	699.7
1,350	7.75	775	1.10	2.10	"	43.9	818.9
1,500	9.00	900	1.17	2.10	"	46.7	946.7
1,600	9.98	998	1.23	2.10	22	56.8	1,054.8

BACKFILL & DISPOSAL

Dia (mm)	$A-a_o$ (m^2)	$(A-a_o)L$ (m^3)	$(A_1-A)xB_1$ x n (m^3)	Q_B (m^3)	Q_D (m^3)
100	0.87	87	5.0	92.0	-
150	0.95	95	4.7	99.7	2.0
200	1.06	106	5.4	111.4	3.0
250	1.17	117	5.9	122.9	5.0
300	1.43	143	7.7	150.7	7.0
400	1.66	166	9.3	175.3	13.0
500	2.50	250	13.1	263.1	20.0
600	2.91	291	15.8	306.8	28.0
800	3.55	355	20.0	375.5	50.0
1,000	4.46	446	31.5	477.5	79.0
1,200	5.46	546	40.7	486.7	113.0
1,350	6.32	632	43.9	675.9	143.0
1,500	7.23	723	46.7	769.7	177.0
1,600	7.97	797	56.8	853.8	201.0

FEASIBILITY STUDY ON
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WORKING REPORT NO.4

EXISTING WATER SUPPLY

JAPAN INTERNATIONAL COOPERATION AGENCY

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